



## **7th. Information Systems and Economic Intelligence, SIIE 2017: Proceedings**

Sahbi Sidhom, Anass El Haddadi, Mourad Oubrich

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May 11 – 13, 2017 in Al-Hoceima (Morocco)

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ON “INFORMATION SYSTEMS  
AND ECONOMIC INTELLIGENCE”

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Sahbi Sidhom, Anass El Haddadi and Mourad Oubrich (Eds.)

# Information Systems and Economic Intelligence

7th. Information Systems and Economic Intelligence, SIIE 2017

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Proceedings

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## Preface

The conference "SIIE" aims to develop the dialogue between experts and researchers from public and private sectors, to acquire basic and experimental on Information Systems (IS) and Economic Intelligence (EI) (or Competitive Intelligence in English acceptance and terminology). This promotes, in a risk environment, technologies related to economic intelligence. The dynamic of EI depends on the control of knowledge and requires competences to design the best strategies and ensure that decision-makers take the right decisions. The international conference SIIE will be held in its seventh (7th.) edition in Marrakech in April 2017, after the six successful editions. This edition is organized by CIEMS and IEEE Technology & Engineering Management Society (TEMS), and sponsored by the Universities of Maghreb and Europe countries. The theme of SIIE is « Trends in Technology Management and Economic Intelligence ». Since 2008, the six proceedings and editions have allowed academic researchers and economic actors to achieve completed projects. The goal of SIIE is to continue in this way by creating opportunities, ideas and innovative ways to enhance projects, and build connections between universities and industries on both sides of the Mediterranean Sea. SIIE'2017 includes keynotes, tutorials, authors' sessions and industrial panels, animated by experts, to identify new approaches and knowledge in economic intelligence, applied research and feedback. This will allow the emergence of new clusters in competitive intelligence. Within a convivial and comfortable framework, as Morocco knows so well how to offer such a framework, the SIIE conference has always been thought to promote the weaving of trust networks between actors in academia, industry and politics, thus contributing to the training of the SIIE scientific community. The expert recommendations and advices will help the SIIE community to find solutions to their many questions and problems.

September 2017

Sahbi Sidhom, Anass El Haddadi and Mourad Oubrich

## Préface

La conférence SIIE a pour vocation de favoriser le dialogue entre les experts et les chercheurs venant tant du secteur public que privé, sur les acquis fondamentaux et expérimentaux concernant les Systèmes d'Information et l'Intelligence Economique (SIIE). Il s'agit de promouvoir dans un environnement de risques les technologies liées à l'intelligence économique (IE). La dynamique de l'IE dépend de la maîtrise des connaissances et des compétences requises pour concevoir les meilleures stratégies et garantir aux décideurs de prendre les bonnes décisions.

SIIE est organisée dans sa septième édition à Al-Hoceima le 11, 12 et 13 mai 2017, après les six premières éditions. Cette édition est organisée par CIEMS et soutenue par les universités des pays du Maghreb, de l'Europe et le sponsorship de IEEE Technology & Engineering Management Society (TEMS).

Les premières éditions et ses actes depuis 2008 ont permis aux chercheurs académiques et aux acteurs du monde économique d'aboutir à des projets finalisés. L'objectif de SIIE est de poursuivre dans cette voie en créant des opportunités, des idées innovantes et des moyens pour renforcer les projets, et de dresser des ponts entre les universités et les industries des deux rives de la Méditerranée.

SIIE'2017 proposera des conférences, tutoriels, sessions d'auteurs et panels industriels qui seront animés par des experts, pour identifier les nouvelles approches et connaissances en intelligence économique, ainsi que les recherches appliquées et les retours d'expérience.

Dans un cadre convivial et agréable, comme le Maroc sait si bien le faire, la conférence SIIE favorise le tissage de réseaux de confiance entre les universitaires, les industriels et les politiques, contribuant ainsi à renforcer les alliances de la communauté scientifique SIIE. Les recommandations et les avis des experts aideront cette communauté à trouver des solutions à ses multiples interrogations et problèmes.

Septembre 2017

Sahbi Sidhom, Anass El Haddadi et Mourad Oubrich



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## Towards the model L.D.D “Learner” “Designer” “Decider”: quality e-learning document

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### Abstract

Our contribution propose a new model of e-learning document design process according to info- communication approach. Following our previous work (El Harrassi, 2008), we have implemented a data collection protocol to identify e-learning document quality criteria according to the views of the " Learner ", the " Designer "and the" Decider ": 1 - the " Learner " approach allows us to understand his perception to make recommendations to designers document. 2- " Designer " approach is the subject of a return designer experience on how learners have seen and used the document. 3- 'Crossing' approach is to merge the criteria established in the steps " Learner " and " Designer ". 4- the " Decider " approach identifies the needs in decision making. We end this way by our e-learning document model formalization in Sport

**Keywords** : modeling, e-learning document, infocommunicationnel, mediation, protocol, quality approach.

### I. INTRODUCTION

In this paper, we propose a new model of e-learning document design process by reviewing otherwise the old model and problematic anterior search works (El Harrassi, 2008) inspired from (Paquette, 2006). So we want to participate in the progress of scientific thought on "a technical system " to common sense, to turn it into" a socio-technical system of Communication and information Science (CIS) viewpoint. "

Following this research, we developed the L.D.D Protocol that includes all the approaches "Learner", "Designer" and "Decider". This study (El Harrassi & Laudati, 2013) was conducted to identify the criteria that contribute to satisfying the users needs and expectations. We will limit ourselves to the training sport field. For this, we targeted two learners groups of two training institutions; one in Morocco and one in France.

For this reason our study focuses on Sport as application domain; Morocco and France as a place of experimentation?

We chose the Sport as application domain following a enormous need for training in the matter, explicitly expressed by deciders and pedagogues of the Royal Institute and the National Center for Sports (IRFC-CNS My Rachid) located in Rabat, Morocco.

According to ministerial directives of Youth and Sports, which have proven to be a way to interview with these actors. We organized several meetings to a state of the existing

e-learning document design within the institute. We noticed that no documents were designed. This main fact allowed us to formulate our problematic and to extend our analysis to other Moroccan or French universities, there where he infrastructure Sport is more developed.

First, a preliminary interview with the teaching and administrative actors IRFC-CNS My Rachid in Rabat, hasn't found any e-learning document has been designed. Teachers have explicitly expressed their enormous need for training in e-learning. We also recall the hypothesis, that it is relevant to study their needs and expectations, to develop criteria that can contribute to the development of the e-learning document quality in the field of Sport. What motivated us to extend our analysis to other disciplines Moroccan universities. From this observation, a field data collection protocol was implemented.

This protocol called -L.D.D- aims to identify quality criteria of e-learning document under the points of view of the "Learner", the "Designer" and "Decider". This protocol has four times.

We start in a first phase, the approach "Learner" which consists of a field study through a questionnaire to the Moroccan learners of the National Sports My Rachid Centre (CNS My Rachid) at the IRFC Institute with the french learners of the Faculty of Science and Sport (FSMS) - section of Sciences and Techniques of Physical and Sports Activities (STAPS) at the University of Valenciennes and Hainaut Cambrésis (UVHC).

The questionnaire being composed of open and closed questions. The counting of the first allows us to determine the percentage of learners who have access to e-learning, having faced difficulties during the learning phase and requesting follow a tutor. From this qualitative analysis content based on answers to open questions, we can identify the needs and expectations of the learner perspective. It is indeed essential to understand their perceptions to make recommendations to the e-learning document designers in Sport.

In a second time, the "Designer" approach is a field study through a semi-structured interview with the designers of the Universities Med V in Morocco and FSMS UVHC in France. The goal is to make the designers experience feedback on how learners have seen and used the e-learning document in Sport.

Thirdly, the crossing of the two results is to identify the criteria of quality e-learning document as two logical "Learner" and "Designer". The results of this cross allow us to

identify the levers and constraints of access to distance course and thus offer possible solutions for improvement.

Finally, in a fourth qualitative phase, the "Decider" approach is a study by collecting data using a semi-structured interview with officials of the virtual University in Nord-Pas de Calais region and Information Systems UVHC direction. Our goal is to examine and identify the need for help in decision-making.

To avoid data redundancy with our latest research work (Carpon El Harrassi, 2016), we present briefly all the steps of the protocol (Fig.1) we proposed to achieve the criteria that have allowed us to develop an e-learning document quality in Sport, which can be transposed to other contexts.

## II. CHALLENGE OF E-LEARNING

E-learning is a domain that brings together a number of domains in the social and human sciences as well as those of the engineering fields, notably in computing engineering and ergonomics. This is itself can be problematic when it comes to organizing a common project where each expert comes with his/her certitudes and "language" system. One of the first challenges is to establish a common language to be mutually understood. Such a language is not neutral. It invariably conveys a mindset that may not always be easy to grasp between, for example, engineers and their social science colleagues. For some the entry point to e-learning is the technical issues of an information system while for others it is the educational efficiency and utility that needs to pass the litmus test. Given this, our study attempts to bridge (El Harrassi, 2012);

It is necessary, before anything else, to define the used concepts. The definition of the quality indicating all the properties and the characteristics of a product or the service which confer it the capacity to satisfy expressed or implicit needs, turns out here a necessity, in spite of its heaviness, in the measure or the words still have no same meaning in an environment of hard sciences or human sciences (El Harrassi & al, 2012).

### What a quality approach?

Upstream, the objective is to know with exactness the needs of the users, to look for all the causes of errors susceptible to intervene, to define and to schedule the various stages of realization of the work and finally to look for the necessary material and human means to get them itself in the best conditions of quality and the cost. Downstream, the evaluation allows a quantitative and/or qualitative appreciation of the product, in the purpose with the aim of determining if the product is capable of satisfying the specified requirements, to correct to indicated defect and detect the new possible needs (Mayeur, 2004).

## III. PROTOCOL L.D.D IMPLEMENTING

The L.D.D protocol was implemented during an experiment conducted in Morocco and France between 2010

and 2013. We leaning on the interviews results with the pedagogues and Deciders CNS My Rachid-IRFC .

The L.D.D protocol was designed specifically to experiment the design and identify e-learning document quality criteria from the "Learners", "Designer" and "Deciders". The steps succeeded depending upon the facts, findings and results of each.

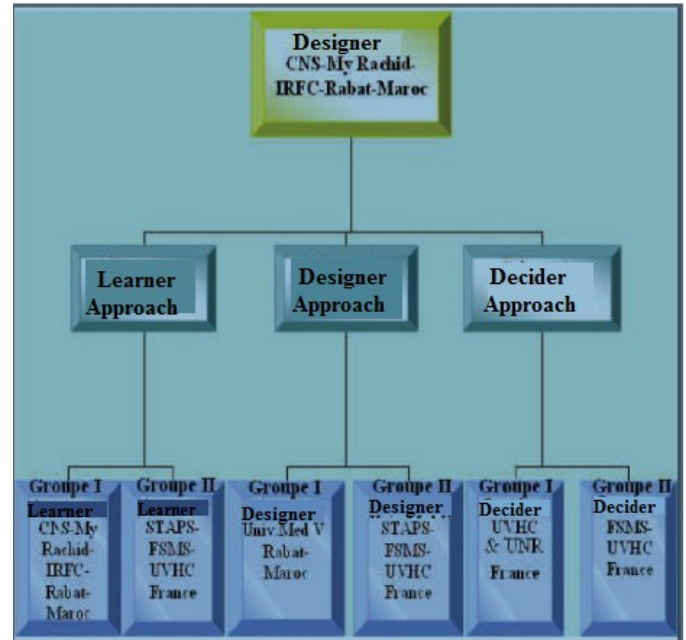


Fig.1. L.D.D protocol (Learner: Designer: Decider)

### A. Protocol L.D.D approaches

#### 1) « Learner » approach

We targeted two learners groups: one side of the CNS My Rachid Centre-IRFC Institute- learners in Rabat-Morocco, on the other side the FSMS-STAPS UVHC learners in Valenciennes -France. These learners are the end users of e-learning document in Sport.

Out of a total of 110 learners at CNS My Rachid only 22 learners (20%) completed the questionnaire. These learners are distributed over all the promotions from L1(Licence 1) to L3 (Licence 3) in initial training, BAES and continuing training.

Saw this low response rate, we noted that these results are not satisfied for our study, This is what prompted us to broaden the analysis to other disciplines in Moroccan universities indeed to other learners from a French university. this is the reason our choice of the FSMS STAPS UVHC University.

For STAPS learners, out of a total of 320 learners distributed on all the promotions L1, L2, L3, M1(Master 1) & M2 (Master 2), all the 206 (64%) responded to the questionnaire whose 16% answered having followed a distance course and were selected. It is indeed indispensable to understand their perception to propose recommendations to

designers e-learning document. The verbatim of the analysis of the two learners groups allowed us the identification of criteria that contribute to the satisfaction of their needs.

## 2) "Designer" approach

Us remember that, following discussions conducted with the pedagogical actors in CNS-My-Rachid Centre in Rabat-Morocco, we noted that no any e-learning document has been designed. What prompted us to extend our analysis to other disciplines of Moroccan or French universities. We also remind that the objective of this approach is to give an experience feedback which is essential for pedagogues to future planning and how learners have seen and used the e-learning document in Sport. Also, the goal is to identify the conceptual approaches of e-learning document designers, and the criteria taken into account in the elaboration of this document.

After the approach "Designer" comes next the "Crossbreeding" third approach. This last step, consists of the results junction of the "Designer" with the "Learner" approaches.

## 3) "Crossbreeding" approach

From this approach already appeared orientations as to model of the e-learning document design. The crossbreeding of the "Learner" and "Designer" approaches has allowed us to identify two types of "quality" criteria extracts with different of analysis techniques and methods. The crossbreeding results showed that cleared criteria of the "Designer" approach are validated and completed by the "Learner" approach cleared criteria, with some analogies and differences. We highlight here some as well as solutions that have been proposed:

- Unlike the "designer" approach, we have seen a point of view inversion where social stake premium over technical or technological solution. The Designer must consider the learner mode and standard of living, including their budget constraints.

- As to spatiotemporal constraints raised in the "Learner" approach, we have identified the interoperability and reusability criteria proposed by the "Designer". These are standardization stakes that allow make the techniques all interoperable between them to facilitate the use of pedagogicals sequences and resources on all e-learning platforms (SCORM 2004) and (IMS LD, 2006a). The stakes are considerable for the designer who can reuse courses already designed and available in the catalogs.

- We also note that almost all of the learners and designers point to the mediatization. They claim that is useless to have a distance course if we do not care mediatization which is indispensable to influence the dropout rates.

- We have cleared the differences and similarities between both types of criteria.

## 4) "Decider" approach

The primary objective of this approach is to validate -or not- the crossbreeding results of the "Learner" and "Designer" approaches. The "Decider" approach allows us to interview and identify the need for help in decision making.

After a comparative analysis of the tabulation results of both groups of the "Decider" approach; from the deciders voice are extracted key points which are grouped together in order to determine limited expectations or expectations classes.

The analysis is carried out a qualitative analysis of the content type semantic. We extracted some interviews sequences concerning the salient results, particular the e-learning document availability in Sport, their reusability, learners and teachers satisfaction, the role and the position of each actor in the design process, storyboarding, mediatization, services, platforms availability and learners budgetary constraints that limit their access to e-learning document.

We then cruciate the results of this approach with those obtained in the "Crossbreeding" process and we have got the results illustrated in the table.4.

## B. Data collection method

We have opted for the EBAHIE method (Listening to the needs and expectations and their prioritization) that combines the qualitative and quantitative tools which are absolutely complementary.

This method results from work conducted in the Communication Sciences laboratory at the Valenciennes and Hainaut Cambresis University, in a reflection on the qualification and quality measurability context . It includes a campaign taking field data starting at interviews or questionnaires. At this experience, the L.D.D protocol proves to robust method to combine several sources of information by putting in synergy several approaches and tools to achieve results in pertinent and exhaustive on the problematic posed;

## C. Data taken

### 1) "Learner" approach

The Table.1 shows the total strength distribution of learners. Only the learners effective who answered the questionnaire is considered:

	Number	Percentage
<b>Boys</b>	<b>170</b>	<b>75%</b>
<b>Girls</b>	<b>58</b>	<b>25%</b>
<b>Total</b>	<b>228</b>	<b>100%</b>

Table.1. Learners number and percentage who answered the questionnaire



The table.2 shows the number and percentage of boys and girls who responded to the questionnaire.

	Institution	Learners Number	Full questionnaire Number	Percentage
<b>Group I</b>	CNS My Rachid-Rabat	<b>110</b>	<b>22</b>	<b>20%</b>
<b>Group II</b>	STAPS-FSMS-UVHC-Valenciennes-France	<b>320</b>	<b>206</b>	<b>64%</b>
<b>Total</b>	<b>Two Institutions</b>	<b>430</b>	<b>228</b>	<b>53%</b>

Table.2. Number and percentage of boys and girls who responded to the questionnaire

## 2) "Designer" approach

The "Designer" approach is a qualitative field study through a semi-structured interview, with two designers groups. This phase is performed in two steps.

The first group is composed of 20 professors and researchers from the Moroccan University Mohammed V Rabat (National School of Applied Informatics and Systems (ENSIAS), Mohammedia School of Engineers (EMI), School of Sciences of the information (ESI), National School of Applied Statistics (ENSA) and the Institute of Arabization (IA)). The interviews were over seven months, from May 2010 to November 2010.

The second group is composed of 20 research professors and researchers of the French University -UVHC-FSMS-STAPS-Valenciennes. The interviews were over three months, from December 2012 to February 2012.

We have taken into consideration all designers available both to Group I and Group II, which are of the order of 20 (Griffin, Hauser. 1991).

## 3) "Decider" approach

The "Decider" approach consists of a qualitative study through an interview free, with two groups of Deciders. This phase is performed in two steps:

- "Group I": the first Moroccan group is represented by the director of IRFC Institute in Rabat.

- "Group II" the second French group is compound the responsible for Virtual University in Nord-Pas-de-Calais region, the Information Systems director at UVHC, and the pedagogic director at FSMS Faculty.

## D. Data collection techniques

### 1) "Learner" approach: conduct of the questionnaire

The main data collection technique for this approach has been the survey by the questionnaire.

The questionnaire is composed of open and closed questions. This type of questionnaire should ideally include

simple and easy questions to reduce the possibility of subjective interpretation and allow for more explicit criteria.

The layout of the questionnaire is also very important for learner to ensure a maximum efficiency. The Closed questions are designed to determine the learners percentage who have access to distance course, having meet difficulties in the training phase and that solicit monitoring with a tutor. Open questions incite learners to freely express their viewpoints. This questionnaire aims to understand their perception to propose recommendations to e-learning document designers.

### 2) "Designer" & "Decider": interview progress

An appointment was fixed with each designers group. During the interview, we started with a brief description of the interview guide insisting on the goal. This guide was composed of open questions with raises to incite the interviewee to express himself freely. We took notes and simultaneously we recorded the verbatim on a tape recorder to be protected from oblivion. Primary data are afterwards retranscribed on text. The retranscription was performed immediately after each interview before the details memory will not be erased

## E. Data Counting Techniques

### 1) "Learner" approach

A qualitative method is used to perform the corresponding counting questionnaires. The analysis tools than, we have chosen the statistical analysis data tools, especially Excel or SPSS for the closed questions and qualitative tools. For the opened questions, we used especially Weft QDA. Our analysis technique is the one concerning the user and which bears respectively on a statistical analysis of the words to define the percentage, and the other one concerning the content analysis. We achieved a comparative study from the both learners groups results.

Combining both of these results allowed us to elaborate a single "Learner" approach quality, with a view to e-learning document design.

### 2) "Designer" approach

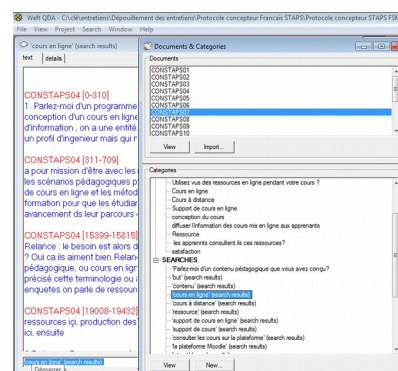


Fig.2. Setting categories

Having recorded verbatim interviewed, we transcribed them on files (\*.doc) and imported as format (\*.pdf) in WeftQDA software (only TXT or PDF formats are read by WeftQDA). We looked for passages expressing explicitly or implicitly a need.

WeftQDA allows to create some categories and sub-categories as shown in Fig.2. Each category comprises an idea and one that transcribed as faithfully as possible what was really said. We had therefore, at the end of the transcripts of all verbatim, several hundred categories to classify. These categories were grouped by means of affinities diagram (Fig.3).



Fig.3. Zoom setting categories

We have had the designers feedback experience on how learners have seen and used the e-learning document in Sport. Some experiences were mentioned as part of various projects (El Harrassi, Laudati, 2013).

The results junction of the "Designer" approach allowed us to regroup and identify key points. All interviewees expressions were grouped by conceptual and semantic affinity. We will convert them in users expectations and expectations of classes.

#### A) Translation into users expectations

The voice analysis of each interviewee has led to operate a semantic classification to 18 groups by conceptual affinities. Those rankings correspond to the designers needs key points. These key points are translated to designers expectations. In this conversion, the requirements have been expressed in functions positive terms to satisfy rather than in terms of concrete solution, while avoiding the abstractions (Laudati 2000, p.211).

For formulate expectations, we chose more the quotes that reflect a nuanced thought, to have more flexibility in searching for designer satisfaction.

#### B) Defining expectations classes (Criteria)

The most meaningful expectations are grouped once again according to their proximity, into four major expectations classes (Table.3). We represent on this table the crossbreeding results of both "Designer" approaches, the identified key points, expectations and their grouping into expectations classes. This will allow us to identify the criteria taken into account during the e-learning document elaboration thus than the designers conceptual approaches of this document.

#### 3) "Decider" approach

From the Deciders Voice are extracted key points, grouped to determine limited expectations or expectations classes. The analysis is carried out a qualitative analysis of the semantic content type. We extracted some conversations sequences of about the salient results, including the e-learning document availability in sports, their reusability, learners and teachers satisfaction, the role and the position of each player in the design process, storyboarding , mediatization, e-learning platforms services and availability as well as the learners budgetary constraints that limit their access over distance. We then crossed these results with those obtained in the "Crossbreeding" approach .These results are illustrated in the table.4.

	Points clés	Attentes	Classes d'attentes	Processus
1	Scénarisation des cours	Scénariser en des petites séquences pédagogiques de 20mn	Scénarisation	Processus de Production
2	Déclassement des cours diffère d'un domaine à un autre	déclassement en unités d'apprentissage		
3	Portfolio : L'apprenant est orienté afin d'améliorer son profil	Personnalisation des profils des apprenants		
4	La spécification des profils	Reconnaissance des diplômes en ligne pour éviter la rétroaction des apprenants au Maroc		
5	influence de la concurrence mondiale sur le document e-Learning	Embarras de Choix multiple	Médiatisation	Processus de normalisation
6	disponibilité de vrais documents e-Learning	Des documents interactifs téléchargeables facilement		
7	Sous-traitance de la médiatisation	L'influence des médias sur le taux d'abandon,		
8	L'influence des médias sur le taux d'abandon	audio, vidéos, images, sc		
	Retour d'expérience	Retour d'expérience		
9	les produits actuels sont des produits automatisés de manière statique	Des outils flexibles, conviviaux et simples à utiliser	Interopérabilité et réutilisabilité	Processus de normalisation
10	Difficultés des infrastructures technologiques	L'amélioration de l'infrastructure technologique comme le haut débit de la connexion à Internet		
11	Normes et standards : Interopérabilité et réutilisabilité	Accès au cours quelque soit l'endroit et le moment où on se trouve		
	Retour d'expérience	Reutilisation des ressources		
12	Création de nouveaux métiers et nouveaux emplois	le tuteur et le suivi en e-learning	Médiation	Processus de Médiation
13	Les apprenants doivent utiliser les outils fournis dans les environnements numériques de formation, pour faciliter le suivi à travers les « traces » automatisées sur les plateformes.	Outils de communication		
	Retour d'expérience	Retour d'expérience		
14	L'enseignant changera de fonction	L'enseignant devra être l'auteur qui fournit le support		
15	L'enseignant versus le document numérique	Présence physique de l'enseignant est prioritaire, formation à distance doit être complémentaire à la formation en présentiel	Médiation	Processus de Médiation
16	Difficultés rencontrées et solutions proposées	diminuer la charge du volume horaire, améliorer l'infrastructure technologique et la vie socioculturelle de l'apprenant		
17	satisfaction des parties prenantes	une approche de l'apprentissage par problème pour responsabiliser ses étudiants.		
18	Contrainte et motivation	des outils flexibles pour développer des tutoriaux et des cours interactifs avec mouvement des formalismes spécifiques à l'enseignement d'un thème donné.		

Table 3. Key points translation to expectations and expectations classes

#### IV. THE PROTOCOL "L.D.D" RESULTS

In the light of of the protocol "L.D.D "Learner" "Designer" "Decider", we noted that one of the first difficulties lies in the vocabulary to obtain a serene and simple comprehension of a new concept. Regarding e-learning, the words abundance, abbreviations, acronyms competitors-and for most practically synonyms-used in recent years by sector actors to designate this new way training, can not fail to sow

confusion and doubt in the minds: e-learning document, online courses, resource, course support ... e-learning, e-training, opened and distance learning (ODL), information and communications technology for education (ICTE), teaching computer assisted (EAO), new educational technologies (NET), new information and communications technology (NICT), information and communications technology (ICT) : so many expressions variants used today to describe a different method of training or learning of classical training .

E-learning, online courses, resources, training material: four different terms to refer, under various names, supports transmission and acquisition of knowledge and skills.

Toward which orient themselves?

Note that in French "course" may be used according to a double meaning: from the professor angle who gives the course and from the learner angle who receives the document. The French language lacks of precision here. Indeed, it means by the same term two separate concepts. A real e-learning document or quality e-learning document, it is use all the content educational aspects and tutoring: courses, Tutorial classes, Practical works, online supervision in real time, videoconference, chat and synchronous or asynchronous forums. We do not find the nowhere in the UVHC and even in France, where only 4% of e-learning document have been developed in some fields but not in Sport field. All that is available is the Learning web page download documents. There is no tutoring. These are only support course that are posted on format (\*.ppt) (\*.doc) or (\*.pdf) which are not real e-learning documents. We note that no distance course is then created, even if the technology infrastructure is very well developed in France! The designers pedagogical have estimated happy to deposit course supports on the Moodle e-learning platform; what does not represent a correspondence course or an online course. The results collected during the qualitative phase confirm and complement those obtained in the quantitative phase. The protocol developed allows us to identify the quality criteria.

It is obvious that, whatever the equipment, connection speeds and the learning interfaces ergonomics, to certain criteria "quality" e-learning document remain the key values for success. It is not just about transmission of educational supports for the current information technology and communication upsetting all the usual frameworks from the training. No matter the technology forward, producing an e-learning document is first and foremost a matter of satisfying the learners needs and expectations who are the product end users. Produce a course on e-learning being is first and foremost a question of storyboarding content and intellectual rigor face the mediation requirements.

Critères	Actions	Processus
Médiation	Identifier les besoins des apprenants et des enseignants	Processus de médiation
	Définir le cadre de la formation, de l'organisation, du public cible, les objectifs pédagogiques de la formation et les ressources	
	Elaborer le cahier des charges	
Scénarisation	Découper le contenu en petites séquences pédagogiques,	Processus de production
	Spécifier des objectifs qui doivent être atteintes à la fin d'exécution de chacune de ces séquences	
	Définir les droits d'accès pour chaque séquence pédagogique	
Médiatisation	Spécifier à chaque séquence pédagogique un type et une description des médias	Processus de médiation
	Intégrer à chaque séquence pédagogique un type et une description des médias	
Intégration	Implémenter ou générer le contenu par un éditeur standard	Processus de normalisation
	Déployer le contenu sur une plateforme e-learning conformément aux normes	
Médiation	Evaluer le document dans un environnement 'Interface Homme Machine' (IHM).	Processus de médiation

**Table.4.** Results of the Crossbreeding approaches of protocol L.D.D

## V. MODEL L.D.D ELABORATION

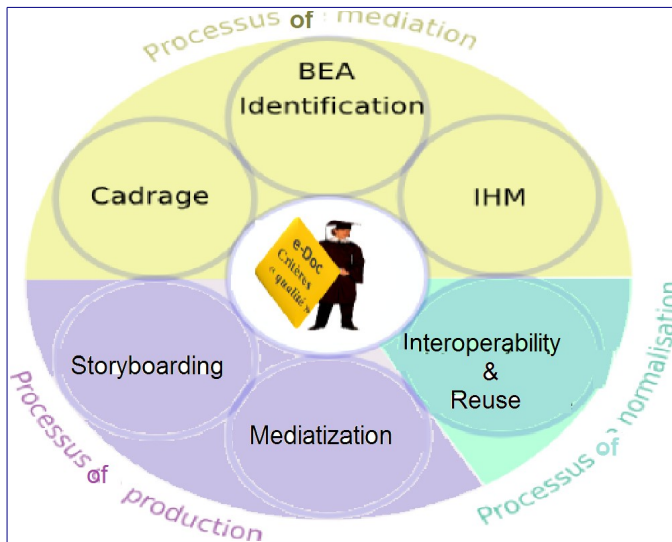
In order to model the e-learning document quality and as opposed to deductive approaches of other authors, our approach is based on empirical data which make the originality of this scientific research. Concretely , Unlike the linear model inspired by (Paquette, 2002) based on an approach motivated by technical aspects, as we noted in the state of the art, our model is mainly characterized by a closed loop process and an empirical approach and multi-actorial (Learner, Designer and Decider) based on reality. Also, it is from the Learners, Designer and Decider needs and expectations analysis, that we have identified the "quality" criteria that contribute to the model elaboration, in which the learner occupies the central place. Indeed, it is no longer a single process but three processes including mediation, production and standardization (Fig.4).

We highlight the relationship between the mediation process and the production process or the e-learning document standardization process. Therefore, our empirical experiences, the L.D.D results protocol and several theoretical references, we used to lead to the development of our L.D.D model design e-learning document quality.

These results showed that mediation, by its very nature is fundamental, stressing the continuities in the forms of mediation upstream and downstream of the e-learning document design process. Mediation is omnipresent:

- 1) Mediation,
- 2) Storyboarding,
- 3) Mediatization,
- 4) Integration,
- 5) Mediation.





**Fig.4. L.D.D model: e-learning document design quality**  
(Carpon El Harrassi, 2014)

## VI. GENERAL CONCLUSION

The protocol results highlighting often the question is asked of production upside down. Instead of wondering about the learners needs and expectations, the designer strives to provide most recent and most sophisticated technologies that may not be suitable for the end users who are these learners. It follows that our starting hypothesis is validated and that the adoption of a quality approach imposed a viewpoint of inversion where the user need satisfaction premium in any form of technological determinism.

Our experiences and our protocol L.D.D results analyzes converge to prove that the improved e-learning document bears -essentially- on the document restructuring, the content and tutoring, not redefining and reconstructing of learner activities. It is not a question to promote of such e-learning synchronous or asynchronous mode to maintain a human dimension. It is not a matter either to incorporate this or that type of the media or generate 3D animations, but it is a content restructuring and story-boarding. The combination of the CIS and e-learning has given us new perspectives for arouse a new pedagogy, keeping the learner in the center of the e-learning document quality design process. It's very interesting to take into account the interactions and relations well as the mediation usefulness induced by the content, content structuring, tutoring and by the necessity of grouping physical.

The role is reversed in e-learning, the learner is the main actor. The learner may be lost in the slew of competitors on the market. The question arises for content designers: on what platform to invest? The risk is that designers and learners prefer "common denominators" that are found from one model to another. Since the available Web applications without any downloads and compatible with all platforms. He made his choice based on the e-learning document quality if its profile allows (Mayeur, 2004). As a result, learners synchronously promote e-learning to maintain a human dimension, and asynchronously to maintain its pace of learning. Asynchronous

mode allows the learner to view the content when he wants and when he can. It is not necessary to be in a particular geographic location to learn.

The role of the teacher makes perfect sense. He must by its function be the guide. A trusted guide for learners to reaper, Identify some resources and increase the curiosity. The teacher challenge is to give learners some keys for using the web and its resources.

As to the "Decider" to design an e-learning space in an institution must be seen as a project fully fledged. One is being placed in a project approach, it is easier to understand the support necessity from the "Deciders", information / training all project stakeholders, risks and costs calculate and also the objectives at the term short medium and long. This strategy allows to succeed a leading change because all of the institution actors are concerned and informed. They are more confident and more involved.

By opposition to others approaches motivated by of the technical, technological or media aspects, especially that of (Larose, Peraya, 1999) and (Pernin 2006) that have long defended a distinction between mediation of the pedagogical relation and the mediatization content. And unlike to what often hear, "Teach at distance is necessarily resort at of the mediatized systems" or " If the distance involves technology". These last, allow back to articulate the distance and presence. Indeed, it is not more only from posting pedagogical mediatized resources on a network like a mailbox. It's a real work who undertakes therefore rigor, rights and duties.

Our posture thus departs the approaches that reduce the design process only on the mediation and the mediatization. Our empirical approach is based on the reality. We insist that everything is a matter of the content "mediation and storyboarding ". The scenario must be well designed in the light of all issues relating to learner profile, the training objectives and the content nature that we want to teach. Every judicious use of a media whatsoever, is tributary a deeper reflection on what we desires to transmit to the learner. Whether training sequences written on paper or posted online, audiovisual sequences, those operating micro-computing or any other media, the efficiency of a good sequence resides in the fact that it will have been neatly scenarized accordance with the learner expectations.

This is where the great challenge of producing an e-learning document. That's the reason for which it is important to have a solid expertise in the field. The most of designers still working the traditional way, as for the classroom training that means, they mix the content and the form. The e-learning design document requires rigorous processes as indicated below.

Our Study aims to contribute to the university reforms in progress at the profit of a political favoring better responsiveness of education to the learners and society expectations and needs. We therefore hope that this paper content will facilitate the task to anyone and all those who engage in this great challenge of designing an e-learning document. Must than Deciders and designers incorporate a priori, the learners and the teachers in the e-learning document conceptual modeling.

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# Research and Implementation of RDP proxy proxy-based audit system

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## ABSTRACT

Using the Windows RDP protocol developed by Microsoft Inc to connect and operate the remote machines which base on the same system become a trend, However, the RDP has caused many security problems. it is necessary to design and implement a audit system to ensure the system's security and guarantee the machine run correctly. It points out improper methods and accomplish the RDP proxy proxy-based audit system to solve the problems.

## Keywords

RDP protocol, the agency agreement, the audit system, the operation Playback

## 1. INTRODUCTION

Business Scale expansion cause the working place and implementation in the different workplace. The operator through RDP to operate the remote server. RDP provides a graphical interface to help the maintain staffs interact with the remote server system. Compared to before, The maintenance works can finish the works easier, at the same time, their efficiency of the operation can increase<sup>[1]</sup>. using the remote desktop client to connect whatever the sever you want also decrease the workload, of course, the server must support the remote control. The remote desktop procedure just convey the information about the user's mouse, keyboard and other device to the remote server system, and it never involved in the data processing, so the level of hardware requirements commonly. It is a kind of the Gospel for the user.

Currently, RDP is the most popular graphical remote access protocol in the market. The protocol initially used at the Windows Ins interior, comparing with other protocols, and not publish the detail about itself, the accomplish process always been a trade secret. However, the Ins has disclosed the detail about the protocol now. As a kind of terminal services network protocol, RDP adopt the typical C/S architecture consists of two partitions. The client running on the local machine, and the server side on the remote server machines<sup>[2]</sup>. With the RDP protocol has been used widely, it not only apply to the server machines which based on the Windows system, but also fit the Linux system. There are so many Linux clients providing remote desktop control, such as Winconnect, Linrdp, and Rdesktop.

The Agent Technology, also known as network agent, is a kind of special network service, allowing one network terminal(typically represent the client) through the service to connect other network terminal(typical represent the service) indirectly<sup>[3]</sup>. The agent technology usually apply to the fortress parts in the entire system. The fortress between the client and the server, and consist of the

agent client and server. First, the client establish a relationship with the server, then accord to the content of the protocol the agent server adopt, requesting a connection with the target server or obtaining the source which the target server specifies(for example: documents)<sup>[4]</sup>.

The agent record the client's requests and the server's feedback, and offer data for the maintain system to audit. At present, maintain the operations mostly audit the system logs through audit techniques, then find the illegal operations or analysis the logs to conclude the reason that result in the application system crashed. But this way can not provide a direct manner to audit the system, and it is difficult to guarantee the logs' security because the logs are dispersal<sup>[5]</sup>.

Under the background of this topic in the above requirements and the research, basing on the RDP protocol and agent techniques, by means of the audit session, to design and implement a remote desktop audit system.

## 2. THE KEY TECHNOLOGY RESEARCH

### 2.1 RDP Protocol Analysis

Following are the several points about RDP protocol:

Based on the TCP protocol

On the strength of TCP protocol, the RDP protocol can avoid the packet loss problem.

2.Data Encryption

According to the RDP protocol rules, the data are encrypted before transfer from other point and thus avoid criminals to intercept the plain text.

3.Multi-Channel

When using the remote desktop to connect the target, both of the clipboard in the desktop can be used mutually, Even copy the files from virtual desktop to the physical machine. Generally the protocol start many channels to implement different functions during the operation time. From the format of RDP can see, its each channel has a unique id to identify itself. The id consist of a field of 16 bits and through it can identify the channel.

4.Based on the graphic command

Based on the remote display graphics protocol, the RDP through frame buffer to realize the graphic data transfer<sup>[6]</sup>. Because of the graphic data is very large, so the data which are transferred need

to compress or filter. The RDP fits the follow steps and finally successfully guarantee the efficiency of data transmission<sup>[7]</sup>.

### 5.General principles

The designer who designed the protocol tried their best to reduce the transmission of traffic.

At the begin, the application layer prepared the data entirely, and then delivered the data to the next layer to encapsulation. Finally, according to the protocol rules, adding data at the both ends of link layer of the corresponding information.

Same as the other network protocols, at initialization time of the RDP, the next layer start to initialize. At the end of the initialization, the formal layer come to connect through the pipes which have been built.

### 6.Based on the hierarchy protocol

The RDP protocol consists of five layers, such as network connection layer, ISO data layer, virtual channel layer, encryption and decryption layer and function data layer<sup>[8]</sup>. The function of each layer show in the following table:

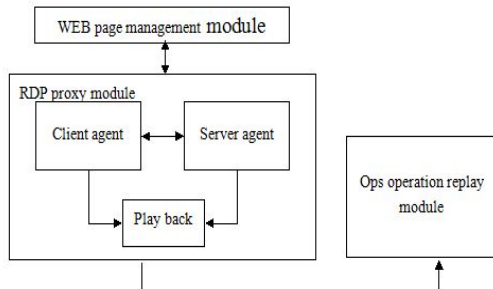
**Tab.1 RDP protocol hierarchy**

name	function
Network connect	Define a complete and logical package of RDP data, in order to avoiding the network package data losing because of the packet are so long.
ISO data layer	To ensure the connection of RDP data communication normal.
Virtual channel layer	Above the ISO data layer, a virtual channel layer defined by RDP protocol, in order to divide the virtual channel by the different data, to speed up the client's procession and save time avoid to occupy the network interface.
Encrypt decrypt layer	To encrypt or decrypt data about all the functions.
Function data layer	Processing data from all the functions, such as data processing function, image information functions, local resources transformation , voice data and print data. Dividing into different layers accord to the data type.

## 3. SYSTEM DESIGN

### 3.1 The design of overall system structure

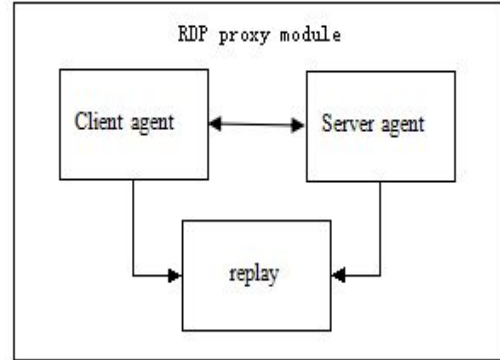
The function of the system structure as shown in the figure below. The whole system is composed of three parts, including WEB page management module, RDP agent module and maintain operation replay module. Besides, the WEB module and proxy process are deployed in the Linux Centos system<sup>[9]</sup>. While the playback function module is which usually are based on Windows system are deployed in the auditor's local machine.



**Fig.1 Overall system structure design**

### 3.2 RDP Proxy

The RDP proxy is composed of three parts, including the RDP proxy client, RDP proxy server and data storage module.



**Fig.2 RDP agent module diagram**

#### 1.RDP Proxy Client

The RDP proxy client's main functions lie in the following aspects. One is receiving the proxy send the user's data packets, two is connecting the target server and sending the data packets to the destination, and three is store the content and so that the audit work late.

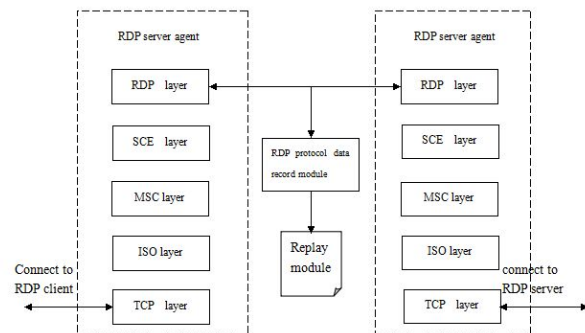
#### 2.RDP Proxy Server

The main function about RPD proxy server is receiving the data from users, and transfer the packets to the RDP proxy client, waiting the agent client return message.

#### 3.Data Store

This part's main function is store the message which are analyzed by the RDP proxy client and server<sup>[10]</sup>. The type of storing is a kind of file which can playback through video player.

The RDP proxy is layered<sup>[11]</sup>, and each level has its special functions, as shown in the figure below, and each layer at the location in the agent.



**Fig.3 RDP agent general structure**

## 4. Implementation

### 4.1 The RDP Agent Module

The RDP proxy consists of three parts, the main program Rdpdproxy<sup>[12]</sup>, the RDP proxy library Librdpddproxy.so<sup>[13]</sup> and the basic library which named Libcommon.so. Besides, the Rdpdproxy

is the main program in the agent, making up the main body of RDP agent framework. In the agent, there is one monitor thread and many connect threads. The function of the connect threads is to resolve the problems between the client and server, at the same time to deal with the data transfer<sup>[14]</sup>. After the connection, keeping the connected status. The RDP proxy stack consists of two parts, the server protocol stack and the client. The server protocol stack aims at the basic library between the Rdp proxy and Librdproxy.so, while the client protocol stack to solve the communication problems between the client and server<sup>[15]</sup>. The library Libcommon.so is the basic library for the main program, because it provides the threading encapsulation, signal encapsulation and socket communication, and supply service for the other parts.

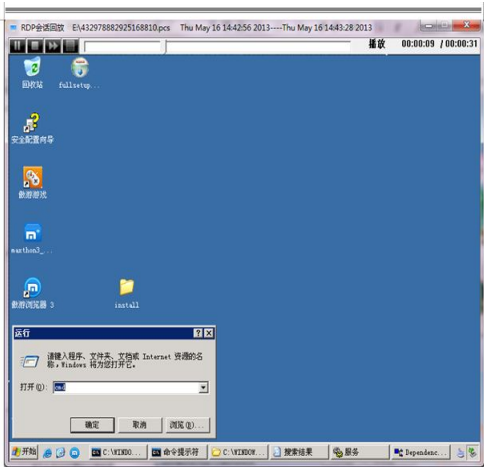


Fig.4 RDP agent rdproxy overall flow chart

Picture above is the RPD proxy program running rendering.

### 4. 1. 1 The Realization of Rdp proxy

The main thread in the Rdp proxy is used to monitor whether exist connections from client, if client want to connect to the server, after identifying the client and agree the client's request, the server allow the request and create thread to process the connection. The connection thread acquire the socket from the client<sup>[16]</sup>, which is usually called ser\_sck, then call the stack processing library that is librdpproxy.so to initialize the connection function for the client. After the initialization, call the function rdproxy\_connect() to deal with the connection of server. The return from the function is named socket, also called client\_sck. At the end, the connection program has finished the .duty to initialize the connection between client and server. The remain works is transferring data between client and server.

Judging whether the client transfers data to the server, if dose, call the librdproxy.so functions to process, if not, jump the next step. Judging wheterh the server transfers data to the client, if dose, also call the functions, if not, sleep the thread and repeat to judge. It means the thread is running all the time to monitor whether there is a transfer data between the client and server. The whole process as shown in the figure below:

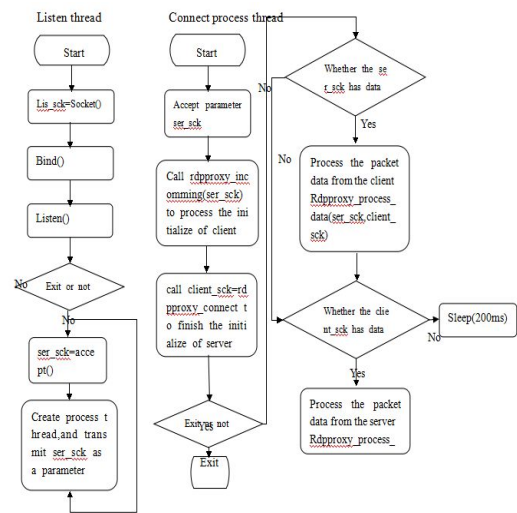


Fig.5 RDP agent rdproxy overall flow chart

## 4.2 The Playback Module

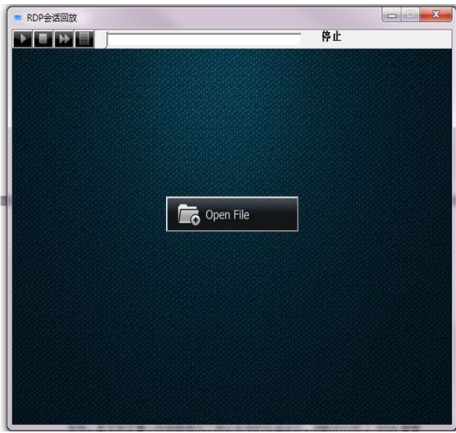
Based on the Windows system, the video can playbacks the file that store the operations by the maintain stuffs, So that provide an intuitive way to the auditors to audit operations. Following the table shows the file header.

Tab.2 Playback File Header Format

0	31
version	
start_time(s)	
...continue	
start_time(s)	
...continue	
end_time(s)	
...continue	
end_time(s)	
...continue	

The table shows the file header, and under the version number is the start and end time which are alternating.

The playback program composed of three threads, are the main thread, drawing thread and time control thread. The main thread creates windows and all kinds of buttons, also creating the draw thread; the drawing thread is responsible for read the playback commands and draw in the windows, finally, creating the time control thread; the time control thread set the trigger cycle and the perform which need being triggered timer processing routines.



**Fig.6 Playback Program Rendering**

Captions should be Times New Roman 9-point bold. They should be numbered (e.g., “Table 1” or “Figure 2”), please note that the word for Table and Figure are spelled out. Figure’s captions should be centered beneath the image or picture, and Table captions should be centered above the table body.

## 5. Conclusions

The purpose for this paper is researching the RDP protocol which is used frequently in the remote log in and access process, and adopt a systematic study for this parts, hierarchy structure of RDP protocol, connection initialization, connection status keeping and graphic data transmission and so on. Based on a deep learn about the work principle about RDP protocol, designing and implementing a RDP audit system which based on the agent techniques. The system includes WEB management module, the RDP proxy and video playback part. The research focus on the RDP protocol theory and the audit system ’ s design and accomplish.

- 1)Researching the RDP protocol deeply.
- 2)Designing the WEB and implementing the functions.
- 3)Designing the RDP proxy program and accomplishing the functions

Although this article has learn the RDP protocol deeply, but still can’t display all of the comment about the protocol, and there are some parts have not been researched. For the RDP proxy, there are many shortcomings, and the audit system’s safety level is not the highest compare with other mature products.

## 6. ACKNOWLEDGMENTS

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## REMOTE LABORATORIES IN ENGINEERING EDUCATION AND COLLABORATIVE WORK

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**Abstract** —This work proposes a model of a collaborative process in the context of e-learning whose actors are teacher, student and collaborative tools. On the other hand, this project as part of the improvement and development of the distance learning system (E-Learning) especially remote laboratories which are new technology allows learners or researchers to create and conduct scientific experiments and deepen their experimental knowledge in a remote lab via the web. For it is necessary for this system of E-Learning to use and respect the educational and pedagogical standards followed in teaching, the performance of this system concerning the speed and precision of interaction with the laboratory. On the other hand, this system must make the work and the tasks easier for the laboratory manager in matters of preparing and managing the access to experiments and manipulation.

To achieve this, we have created a system which allows us after- managing appointments for the practical work —the access to experiments and manipulation Then realization any electronic experience via a web application which are going to be our web simulator for electronic and by using a control circuit (pduino and a set of relays ) we will achieve the real electric circuit in laboratory as the virtual diagram and we get the desired measurements, that were benefiting the existence of a certain device (Generator, multimeter, oscilloscope ...) accessible and configurable via the web.

**Keywords:** E-Learning, Remote laboratories, php, Node js, library socket.io and FS, HTML5, Canvas, Pduino, Collaborative Learning, Relays.

### I. INTRODUCTION

Many projects of Remote laboratory have been done to improve the system of E-Learning but among the reasons that push us to make a new conception we find

**-Educational and pedagogical standards followed in teachings:**

(Realization an electrical diagram and schema is a skill so is must be realized by the student ) . In the electronic field, to understand the running of some component electronic and the realization of a practical work requires the creation of electrical circuits, that is to say, it is the students who are to choose the components and link them

for to get the schema of the circuit and takes the desired measurements. But the current system does not give this opportunity to the student; we find just the predefined schema with only the switch or buttons that the student can be open or close. So we created an application that gives hand to the student to choose the component and be connected to realize their own schema.

**-Laboratory management:**

In the old system, for each practical work, the laboratory preparer must program a client-side application and a server-side program, and, likewise, to realize the real assembly of the specific circuit of that practical work in the laboratory so that the student can control remotely the TP real.

Since the electronic field contains many TP to achieve and realize, the preparer must for each TP repeat all the works. So this method is not efficient and requires much effort and time. Since our systems — allows to realize any electrical diagram **by one program**, will solve this problem. More than that, in the existence each TP needs a pduino card to orders the real assembly. So our system with a single card pduino can do several TP even at the same time depending on the need, thanks to another application that will make the management of the laboratory easier by taking the appointment of the practical work for any student or researcher.



## II .ARCHITECTURE AND TECHNOLOGY SYSTEM.

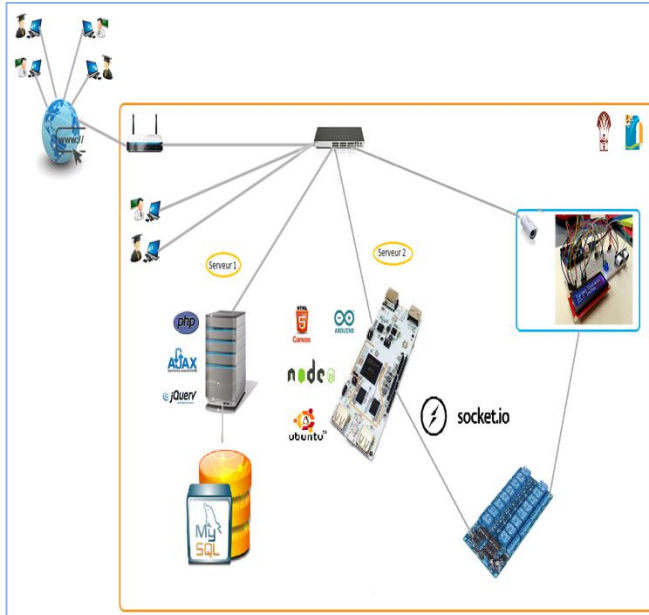


Figure 1:Architecture and technology system

In the diagram of Figure 1, there are two perimeters. The first is the web (Internet) and the second is the perimeter of the university (specifically the local school network LAN).

In the perimeter of LAN, we have two web servers, one containing the learning platform that represents the central faculty information system, where all information is found. The second server is a **pcduino** that contains the application that will allow students to handle the practical work.

The process would work as follows: a teacher or teachers connect either using the Web or the local network; each teacher defines one or more TP, puts the theoretical part and the scenario after having made the TP reservation for all students.

On the other side, students connect using either the Web or the local network (Most of the time, students will use the web, because the use of web was among our goals from the beginning). If the student has a TP, he consults and reads the scenario, then he checks the reservation. If the reservation time arrives, he manipulates the TP; during this stage each reservation is destined towards the server 2 (pcduino card). If the reservation time elapses, the TP ends and the material resources are released for a future reservation.

### 2-1 Platform of management

For the management of the laboratory we have created a web application by the interaction of several programming languages (php, ajax, sql...) This platform is divided into 2 parts:

- Admin Part where the administrator organizes the laboratory by the management of students, using a set of criteria (branch, group, module...), and the creation of the niches and the appointments for the manipulation and particle work.

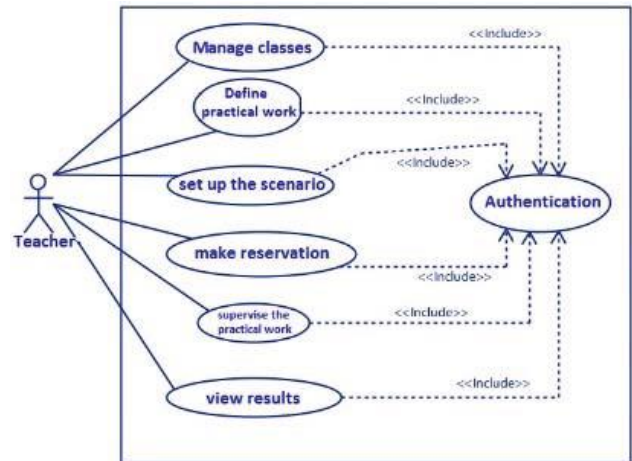


Figure 2: Use case of Admin

**Actor** : "Admin or Teacher":

- **Authentication:** the application checks that the teacher is what it purports to be then it gives the access authorization.
- **Manage classes:** allows teachers to manage classes, specialty and students.
- **Define TP:** enables teachers to set a TP, put his name, objective and theoretical part.
- **Put the scenario:** allows the teacher to work a practice scenario, which defines the steps to be implemented to make this work convenient.
- **Make reservation:** allows the teacher to create a reservation for each student to a specific practical work.

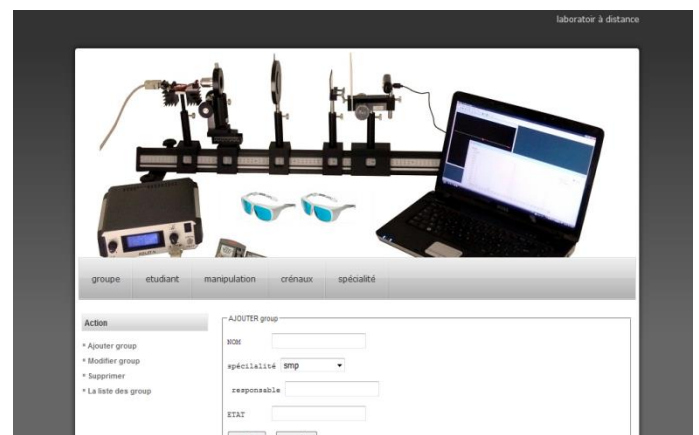


Figure 3: Application of management admin part

-The 2<sup>nd</sup> part concerns the client part in which the student, after authentication in the management platform, will see if he has an appointment for a manipulation; he will even know the date and time with which to start the TP. If the time comes, the link of the manipulation will appear and who will send the student towards the 2nd application that are the our electronic simulator in the web .

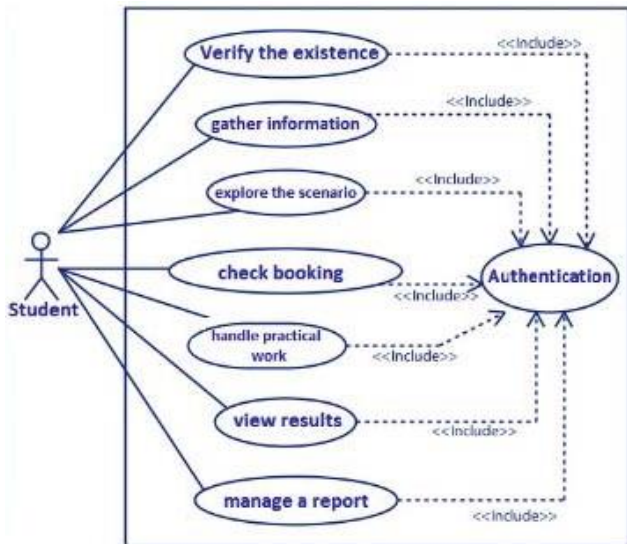


Figure 4 : Use case of student

**Actor: "Student"**

- Authentication: the application verifies that the student is what it purports to be and then gives the access authorization.
- Check there is a TP: enables student to check if he has a practical work.
- Gather information about the TP: enables the students to see and learn the theoretical work.
- Read the TP scenario: allows the student to read the script, to know all the steps and details to bring up this assignment.
- Check the date of handling: allows the student to check the reservation practical work in order to know the exact time of manipulation.
- Handle the TP: enables the student to handle the practical work Using another application in server 2 (web simulator ) but this will happen only when the reservation time for this student is checked.

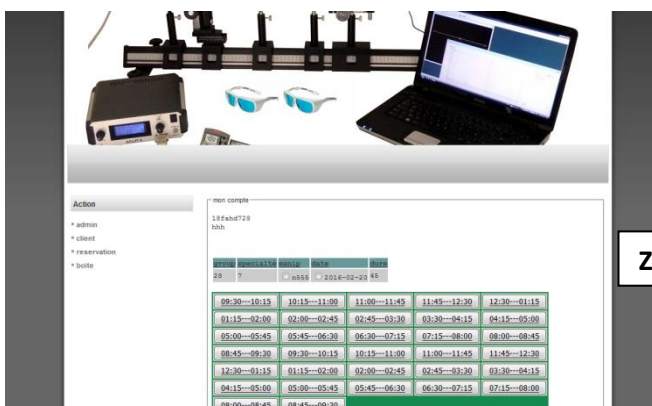


Figure 5: Management application of student

## 2-2 The electronic simulator via the web

the student will achieve the electrical schema of the circuit and can control and order the real Assembly of laboratory via the web. The great technologies used in this application are **html 5** especially its suitcase **canvas**, **Node.js**, **websocket (socket.io)** and the **pcduino card**.

What is new in our system is the following: To have reactivity between the client and the application we used the canvas suitcase of **html5** that comes to replace the flash. Then this technology will allow to virtualizes the real practical work and realize the circuits by using the pictures and animation that will be the ways by which the student will manipulate and control the real TP.

To develop an application in **html5 (<canvas>)** for have an animation and flexibility to choose the device and link them requires using a lot of JavaScript. That is why we used the **Node.js** technology that will allow to set up a web server on our electronic card **pcduino** (it's Also the card by which we will control the real circuit). The advantage of using **Node.js** is that it allows running the java script in the server side instead of the client side and is based on the engine of google chrome V8 that makes faster the execution of JavaScript. This technology already used but what is new ,is in the **socket.io** library that allows the exchange of information between the client and the server: this library in the latest projects is used, but it does not operate the interest in this Library; they are only used for sending the request from the client towards the server, knowing that we can do just with **Ajax** because it actually allows the client and server to exchange information without reloading the page. But in **Ajax** it is always the customer who request and the server repeats. The server cannot decide by itself to send information to the client. So with **Socket.io** this has become possible, and we were going to exploit it since our server is itself our **pcduino** card by which we are going to protect the real circuit and device. If the voltage of the threshold level is exceeded, then the server must inform the client to pay attention to the protected component and device.

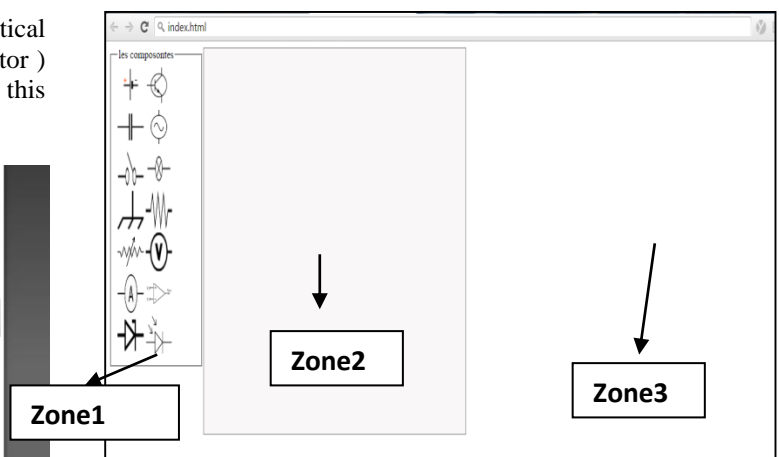


Figure 6 : simulator

**Zone 1:** This zone contains all the electronic-components that the student has to choose and works at.

**Zone2 :**It is in this area where the student must carry his electric scheme.

**Zone 3 :** This area will display the control interface when the student will choose the measuring tool or power because we will exploit the existence of some measure of material and source of energy configurable and controlled via the web from a web interface such as tools of InfiniiVisionagilent

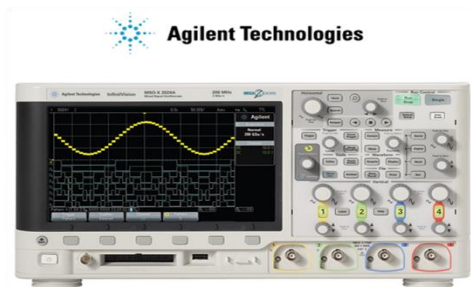


Figure 7: Oscilloscope agilent

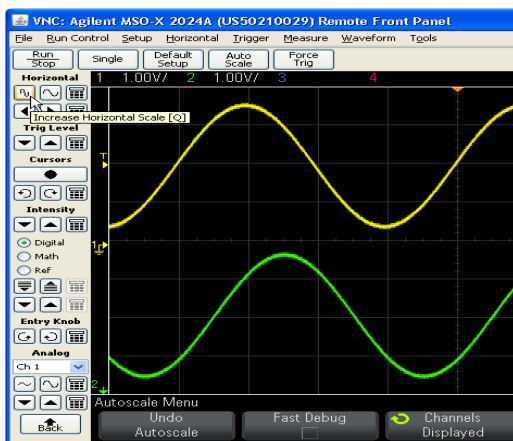


Figure 8: Interface web of oscilloscope

We gather the control interface of the specific device (oscilloscope, generator) and simulation interface. In one interface we are using the tag of html5 :<iframe>. For example, when the student chooses the generator and

oscilloscope, he will get the following interface:

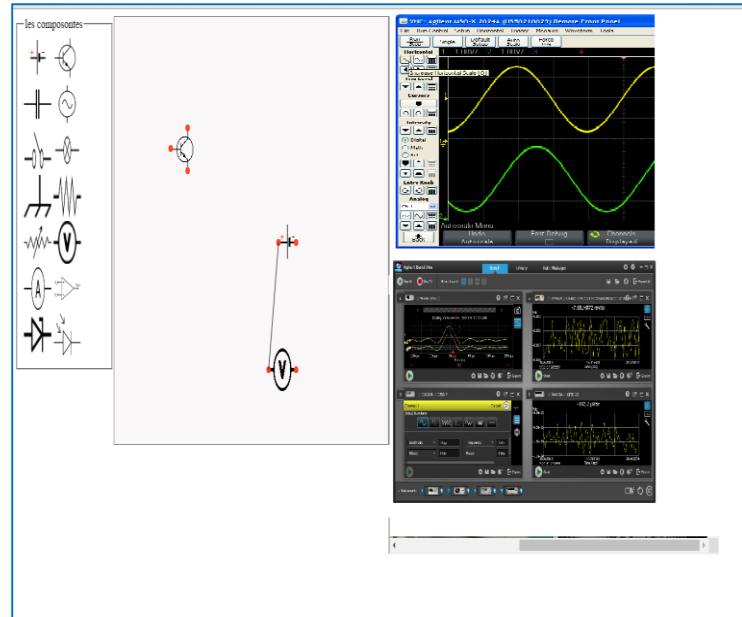


Figure 9 : Simulator and electric tool of measure

## 2-3 Hardware Part

The laboratory must be equipped with a pcdiuno card and a board on which all the electronic components mounted depending on the given needs. These components are connected between them by relays; we will even exploit the existence some measure of material and source of energy configurable and controlled via the web from a web interface

In the **pcdiuno card** we will use the Node.js technology that will allow us to create an http server and the application of simulation. This card uses a Linux operating system, and from the Linux file system we can control and order the pins of pcdiuno-to manipulate the assembly:

- GPIO digital pin: 18 I / O 3.3V
- Analog inputs: 2 x 6 bits 0-2V and 4 x 12-bit 0-3.3V.
- Analog outputs: 6 x PWM (2P "fast" in 520Hz - 8-bit and 4-pin "slow" in 5Hz - 20 levels).

So, in order not to overload the memory of the card, by to installer the set tools (python, pcdiuno, editor...) to program the card, we just used the library <FS> of Node.js which will allow access for the control file of the pcdiuno pins. The all in a single program (http server program and the pcdiuno control and command parts).

The files fixing the input or output mode are set in the Linux directory:

`/sys/devices/virtual/misc/gpio/mode/`

- Files containing / defining the state of the pins are placed in the directory:

`/sys/devices/virtual/misc/gpio/pin/.`

When the student chooses the electronic element and links them, for every link a request will be sent by the library **Socket.io** of Node.js towards http server which processes and hands over pcdiuno for the sake of controlling the relay. Our system is designed to solve the problem of having to program every time an application for a lab TP and create an assembly for this TP. So our solution is in the web application that is like an electronic simulator, but the difference is that it is used in the web, and in the pcdiuno program and in an assembly which includes the electronic component which are connected together by relay.

#### 2-4 Part of the protection:

Since our system gives freedom to the student to choose any component and make their circuit, the problem is that the student can make mistake in the TP or this may impose a voltage that can damage the electronic component. So, while respecting the pedagogical approach, our system allows the student to make mistakes then it signals them because from such errors the student will learn but maintaining the protection of equipment.

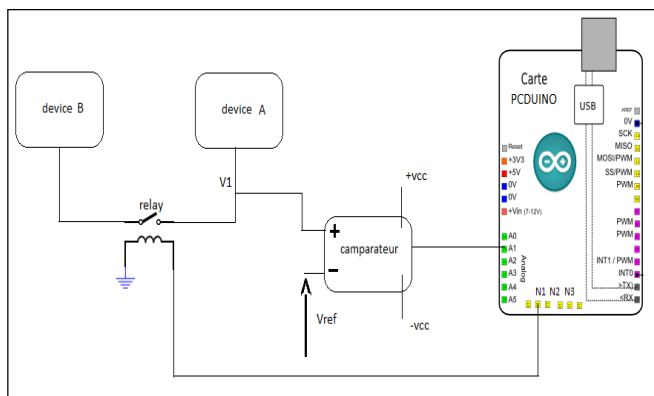


Figure 10: Protection tools

The real assembly should contain an electronic comparator with a tension reference placed at the entrance of each sensitive component can be damaged; the output of the comparator will be linked to the pin of pcdiuno; if the comparator rocker so the state of the pin pcdiuno will change and the pcdiuno server will inform the client (student) by an http request (a alert) of the Socket.io Library who are giving this new advantage .

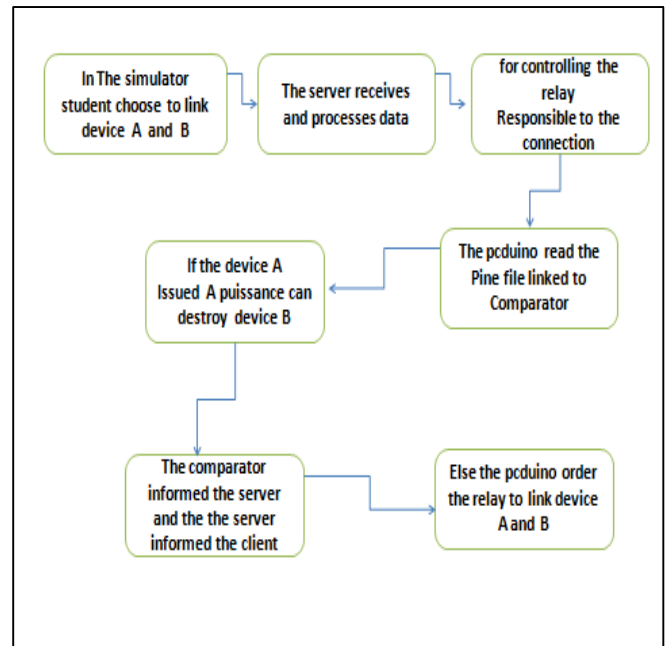


Figure 11 Organizational chart

### III - Model of a collaborative work in the context of e-learning.

In spite of the effort made by National Education Ministry for to promote e-learning and despite the huge resources allocated to these actions, there is still a high dropout rate and the number of beneficiaries of online training remains very low compared to the total number of educational staff. In addition, the design of online learning, as it is practiced in our e-learning structures, is essentially based on a transmissive approach to teaching. The process of knowledge transfer is conceived on a model of the individualistic learning, formalized and automated. Learning is individual; it is centered on a single user interacting with a system, while many psychologists, pedagogues and didactics stipulate that the activity of learning is social, emotional and cultural before it is logical and functional.

In this context, it should be noted that cognition, (or knowledge), culture and technology are inseparable. These three areas are reflected in recent developments in collaborative learning environments. In these environments, technology is only one element of a learning complex configuration. This configuration integrates indeed learning objects, interactions between peers, learners, tutors, institutional, emotional and motivational factors. Technology must be at the service of the pedagogical approach, and the use of collaborative learning activities offered by ICT such as wiki, glossary, blog, and



synchronous and asynchronous communication tools could contribute positively to the introduction of a new learning based on collaborative configuration and cooperative work. Indeed, this online collaboration allows the networks learners to organize a reciprocal trade relationship. This will achieve understanding and the strength of a set that we can never get by the simple addition of individual interests. Each actor tends to justify his actions and acts according to these skills. And adopt the pipes and different attitudes. These differences reflect the plurality of interests, world-references and representations. In a socio-constructivist approach, community knowledge is not only more extensive than that of a single individual, but also each member of the community can contribute to the cognitive development of the group. Lev Vygotsky explains that "it is through the interaction around an activity that skills and knowledge can be explained and that members of a group can identify strategies to achieve common learning goals."

Collaborative tools can be set up as follows:

1. **"Self-service"**: any authorized person can create a collaborative space for a dedicated task (Project, work, case, file).
2. **"Ready to use"**: all the collaborative functions are available to users once a collaborative space is created.
3. **"Universal access" by a web browser**: collaborators can work together without strain compatibility between the different systems they use.

There is a myriad of features behind the notion of collaborative tools; it is necessary to group them in categories of use:

- Information exchange and sharing
- Project management and Collaborative design / product development

### 3-1 Information exchange and sharing:

Courier, E-Mail allows real-time communication and file sharing. It retains its original function of sending and receiving messages; documentation must be managed by a tool provided for this purpose. A document management software or Electronic Document Management (EDM) offers the ability to organize, structure, and classify data by making them available to a user group in consultation and /or modification. Its main features are:

#### **-Online edition (check in / check out):**

This feature allows multiple people to work on the same document without interfering with each other in their update operation on the document (asynchronously). Clearly, a user

"recovers" the document he wants to update by locking it automatically on the data server (check out): it prohibits any modification of the document by another person until it is "reinstated" (check in) after modification.

#### **-Versioning:**

All versions of the same document can be preserved to ensure the traceability of changes made on the original document.

### **3-2 Project management and collaborative design / product development:**

A project management collaborative environment is characterized by the features described below:

#### **Project Plan:**

The project plan meets three objectives:

- Monitoring and measuring the evolution of a project by assigning specific tasks (or activities) to members of the team.
- Empowering team members and giving them visibility on tasks that precede them, what is asked of them, the desired and available tasks resulting the reform.
- Bringing a shared vision of the project with in the team by clearly displaying all the required steps, the players and the associated delays.

#### **- Discussion forum**

This asynchronous communication channel, widely available to the general public, is an exchange site for processing one or more topics in the form of a discussion. Each subscriber to the forum can be informed of the responses of a community member.

#### **- Shared Calendar**

With this tool, it is possible to plan the events related to the project and view the availability of all team members.

#### **-Online Meeting / Sharing applications distance**

Drop the video conference, meeting tools online (or web-conferencing) combine audiovisual technologies, information technology and telecommunications to allow remote parties to dialogue, to see, and to present documents for the sake of organizing and projecting reviews. Some utilities of web-conferencing also allow taking in charge remote applications: to power a file in a session, for example.

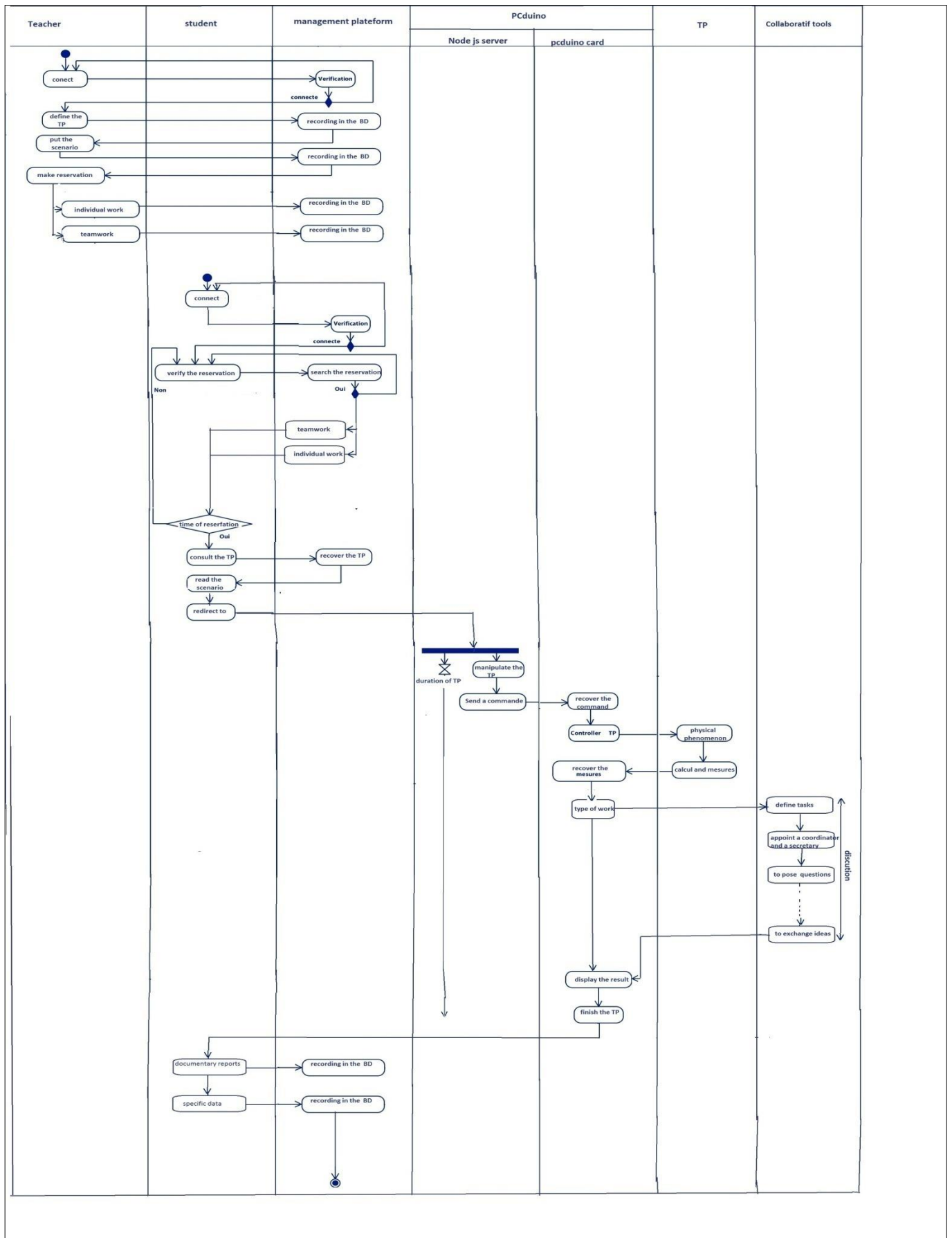


Figure 12 Activity diagram of modeling a scenario of TP

Our Remote labs address many problems encountered within the laboratories of the modern university because they:

-Extend the learning experience of students by making more efficient their use of time.

-Increase students' exposure to a greater number of experiments and equipment.

-Reduce costs by remote laboratories; startup costs are minimal compared to traditional laboratories, and they cater for a larger group of students.

-Give external students the ability to conduct laboratory experiments.

-Provide students with the ability to conduct experiments at hours that suit them.

-Test conceptual knowledge and collaborative work.

-Allow students to interact with the real equipment and to learn by trial and error.

-Allow students to conduct an analysis of experimental data.

Our distance lab	<p>explanation of the concept.</p> <p>-collaborative work</p> <p>--realistic data and measurements</p> <p>- No restrictions of place and time.</p> <p>-Low price.</p> <p>-facilitates management of the laboratory.</p> <p>-Protection the hardware.</p> <p>-flexible system</p> <p>-Learning by trial and error.</p>	-virtual presence in the laboratory.

Tab 1: comparison between laboratory-type

Type of Lab	Advantages	Disadvantages
Real	<p>-realistic data and measurements.</p> <p>-Interaction with real hardware.</p> <p>-Teamwork.</p> <p>-Interaction with the preparer.</p>	<p>-restrictions of the place and time</p> <p>-requires scheduling</p> <p>-Expensive.</p> <p>-required surveillance</p>
Virtual	<p>-Good for explanation of the concept.</p> <p>-No restrictions of place and time.</p> <p>-Low price.</p>	<p>-idealized data and measurements</p> <p>-Lack of collaboration.</p> <p>-No interaction with the real hardware</p>
	<p>-interaction with the real hardware.</p> <p>-Good for</p>	

So In this section, we discuss the questionnaire which was answered by the teachers and students of university cadi ayad, with the intention of giving a general view on the degree of the use of Information and Communication Technologies ICT in high education.

So because our system allows to realize any travel work the travel work practical works asked the student we choose to work on voltage divider and RC. So the student must see the scenario of the this travel in the management platform for to have this circuit.

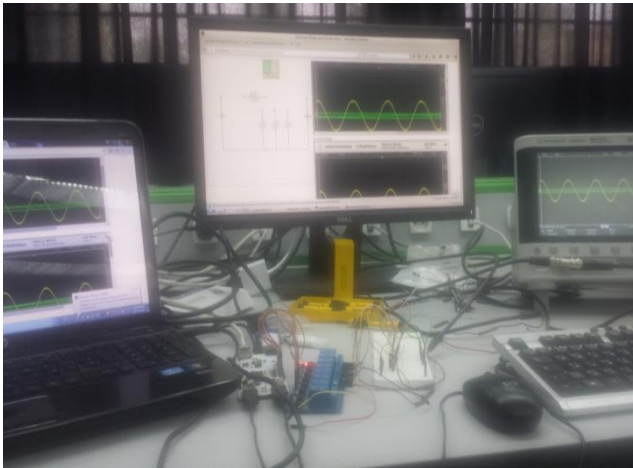


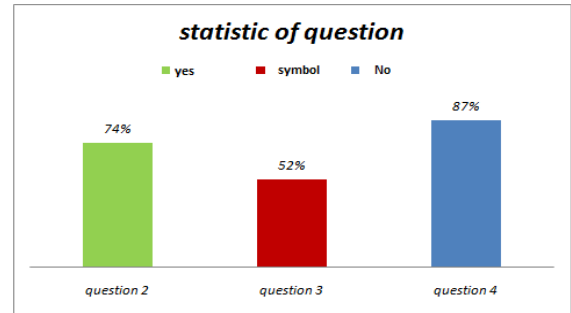
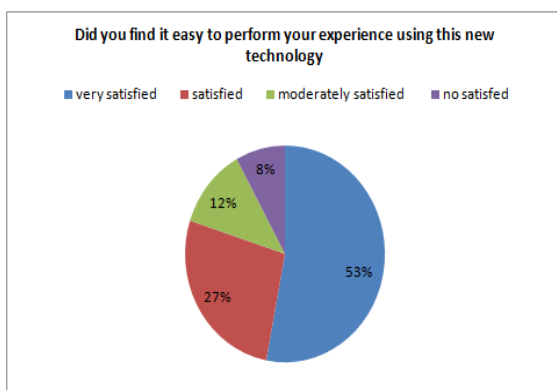
Figure 13 : real travel work RC

when the student choose the component, it will make the link requested in the scenario.

the yellow signal it is of the generator is sinusoidal (the student can easily update) it defaults mounted to the chain 1 of oscilloscope.

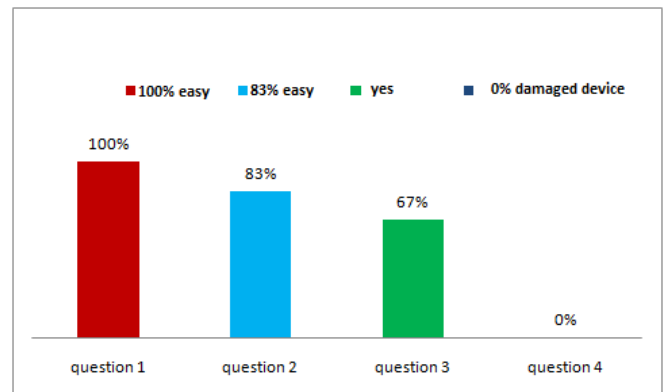
#### Student questionnaire :

1. Did you find it easy to perform your experience using this new technology.
2. helps you to understand the principle of TP.
3. to understand the operation of an electronic component, what you prefer to use symbol or real device.
4. did you experience any problems.



#### Teachers questionnaire :

1. It is easy to prepare the manipulation?
2. It is easy to book appointments for the student ?
3. the student comes to understand the principle of working practice ?
4. you have a damaged component ?



#### Conclusion

The paper demonstrated a new way of building remote experiments to solve a set of problems in the laboratory management and in educational, pedagogical standards followed in teaching. This solution is an advanced real-time and flexible software/hardware. It describes both the software architecture based on the two applications: management platform and the application of simulation use of Node.js written in JavaScript and hardware architecture, especially the pduino card and a set of electric devices. So our Remote laboratories offer students access via the Internet 24 hours / 7 days. They also open the possibility of sharing expensive laboratories with other institutions, local or abroad. Instead of **having** each institution developing and executing the same types of laboratories, Remote laboratories can be shared globally where only access to Internet is available.



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# Documentaries and informatics aspects of BOUGAINVILLE - a database developed by the French Military Center of Epidemiology and Public Health to manage its sanitary documentation

M. Tanti, R. Vivès

**Abstract-** To manage the corpus of documents collected as part of Medical Intelligence process, the Health Monitoring Service of the Military Center of Epidemiology and Public Health has developed a database called BOUGAINVILLE that has certain documentaries and informatics features allowing its users querying the corpus by keywords. This database is a web application coded in PHP 7.0.9. It works with Apache 2 HTTP server and a relational database MariaDB 10.1 (derived from MySQL). The documents are classified by risks with metadata. It has shown its usefulness, particularly in the context of the latest Ebola epidemic to recover more quickly and efficiently scientific documents collected during documentaries requests and to follow scientific developments. It has enabled saving time. However, this application can still be improved, particularly in terms of deployment to all users of the Service.

**Index Terms**—Databases, classification, metadata, keywords, French Military Medical Service, Apache2

## I. INTRODUCTION

Medical Intelligence was defined in 2004 as the process of collection, analysis, synthesis and dissemination of polymorphic health information, to military decision makers, to identify health risks that might impact the French forces on the territory and in operation (Boutin, 2004).

This mission was entrusted to the Health Monitoring Service of the Military Center of Epidemiology and Public Health from Marseille (CESPA). The process developed to meet this task is time consuming and requires the collection of massive data from scientific and medical databases on the Internet (Raghupathi, 2014). It also requires the treatment of these data and their classification to develop valuable information products for military decision makers that meet their expectations (Tanti, 2010).

To be re-used, all of this documentation collected from the sanitary "Big Data" therefore needs to be managed (Pouylau, 2014). The proposed article aims to present the database developed by the Health Monitoring Service of the CESPA to treat the collected corpus of information in the context of medical intelligence and called BOUGAINVILLE for Base

d'Ouvrages Généraux et d'Articles du service de veille sanitaire sur les maladies infectieuses et le risque Chimique,

## II. BOUGAINVILLE : DOCUMENTARY FEATURES

### A. Collected corpus

The corpus is mainly composed of electronic journal articles, books, theses, reports used to feed documentary products for decision use or for answer operational information requests

The corpus of articles was mainly collected from the medical and scientific databases MedLine, ToxLine, ScienceDirect, Web of Science and EM-Premium. (Brand de Heer, 2001)

The corpus of electronic books and reports comes mainly from the World Health Organization, Public Health France, and the Institute of Research and Development.

The theses have been retrieved from Google Scholar, HyperArchives en Ligne (HAL), from sites of Common Services of documentation of universities and from SUDOC (Bérard, 2008 & Chazelas, 2009).

This corpus includes, at the time of writing this article, about 15.000 documents, mainly in .pdf format, of around 12 GB. The corpus has therefore no sensitive character or medical personnel data. It comes principally from the open sources of scientific internet.

### B. Documentary classification

In agreement with the users, the documents were classified in the info-communicational device in different hierarchical folders by risks for the forces, questioning the practices of "rank, think, control" (Ihadjadene, 2013). The following classification plan was adopted: "Biological risk", "Chemical and industrial risk", "Risk by country", "Veterinary Risk", "Military health state". Inside each folder "Risk", the documents are classified in subfolders corresponding to the risk agents, for example, in the folder "Biological risk", documents relating to smallpox are classified in sub-folder "Smallpox". In total, there are 1.900 subfolders.

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To give them meaning, it was decided to apply to each document a rigorous naming procedure. Thus, all the primary documents are named as follows: main key word of the document- Secondary keyword- Third Keyword- First author- Year of publication (Morlanne-Fendan, 2013).

Thus, to each document, metadata corresponding to the contents are allocated, allowing finding them according to the metadata in a relational database. The selection of these metadata is done through the use of a thesaurus: the Medical Subject Headings (MeSH) of the National Library of Medicine (Lipscomb, 2000) that class medical and scientific concepts in general and specific terms, according to their meaning more or less wide in the thesaurus, allowing a relatively thin manual indexing and a possible search on these metadata to 4-5 concepts, the author and the publication year.

### III. BOUGAINVILLE : COMPUTER FEATURES

#### A. Principle of the application

The developed program allows conducting research in the corpus of documents by keywords, on different metadata fields. However, it does not do a full text search in the entire body of the document.

So, in the application, the documents are being assigned different keywords, during their manual indexing by the program administrator. For example, a document dealing with HIV may be "tagged" HIV, STD, prevention, biological risk and be found by this way when entering keywords in the different fields of metadata and their combinations by operators AND and OR.

#### B. Specifications

##### B.1. Main features

The program is a web application coded in PHP 7.0.9. It works with Apache 2 HTTP server and a relational database MariaDB 10.1 (derived from MySQL). The pages are displayed in HTML5 (Welling, 2009 & Valade, 2010).

The application also uses a jQuery 1.12.4 plugin (Javascript library) to enable automatic auto-complete search boxes. This plugin is not essential to the operation of the application. But, he adds "user-experience" by helping to seize fields via forms. So when the first letters of a word are entered, a search is performed on the fly in the basis of existing keywords to complete the word (or phrase) sought.

The retro-compatibility of the program is provided to version 5.3.0 of PHP. With earlier versions of PHP, the file import is blocked because the function "Finfo" that identifies the mimetype of the imported file is not recognized. A small adaptation of the source code has therefore been necessary.

The developed application can run on any computer architecture with HTTP server Apache 2, PHP, and MySQL. It is successfully used on a local server LAMP (Linux, Apache 2, MySQL and PHP) and WAMP (Windows, Apache 2, MySQL and PHP) (Welling, 2009 & Valade, 2010).

Apache2, MySQL and PHP are universally recognized programs. They are installed by default on most web server from anywhere in the world, including those of the Ministry of Defence. In our case, the application has been installed on

Internet Explorer 6 and 9, Mozilla / Firefox (43) and Chrome (Version 52). Some javascript were used (apart from jQuery which is recognized on all browsers), the application works without any particular problem on all browsers. The part CSS and HTML5 are conform to W3C standards. The table 1 summarizes the prerequisites softwares required to install the application.

**Table 1- Summary of software prerequisites**

Part data server
<ul style="list-style-type: none"> <li>• PHP &gt;= 5.3</li> <li>• MySQL (or MariaDB)</li> <li>• Apache2</li> <li>• Disk space : 11Go</li> </ul>
Customer part
<ul style="list-style-type: none"> <li>• HTML5 compliant browser (Firefox, IE9, Chrome)</li> </ul>

Furthermore, the developed application is portable. It can be transported and run from a USB key or installed directly on a client workstation. Portability on Windows has been successfully tested on UniServer (WAMP Development Environment) which brings together in one folder a local server Apache 2, PHP programming language and MySQL database engine. After starting the Apache 2 and MySQL services, the application is available in "localhost" on the web browser.

#### B.2. Informatic Security

The Fields of the application are protected against XSS scripting and SQL injections (Seguy, 2012). At each data entry, these are cleaned before any SQL processing, through htmlspecialchars. The data sending method is the POST method. The connection to the MySQL database is performed PDO (connection method recommended by security experts). The most sensitive part of the application is the import document module. The application is protected by an authentication system preventing any user not connected to import files. Furthermore, the script is designed to prevent importing files other than PDF. The mimetype file is identified by the finfo function (> 5.3.0).

```
if ($mime_type != 'application/pdf; charset=binary') {
/* bloquage du fichier */ }
```

In addition chmod is applied to make the file "Unenforceable" (the file can be opened but not run such a program (possibly malicious).

```
chmod(UPLOAD_DIR . $name, 0644)
```

The import file is limited to 10 megabytes and the file name is automatically reformatted (removal of accents, any quotes, spaces). Security has also been taken into account. Indeed, user passwords are stored "hashed" (that is to say, encrypted) in the database. If it is compromised, there is no way to get

clear passwords, even with a password dictionary ("rainbow tables") (Seguy, 2012).

Passwords are "hashed" with SHA256 mixed with a "grain of sand" generic stored in the code and a "pepper grain" unique, randomly generated for each user and stored in the database. So each hash is unique and has no chance to appear in a dictionary, which makes a dictionary attack impossible.

The application only accepts passwords from 9 to 150 characters and contains at least 2 digits, one lowercase letter, one uppercase letter and one special character. According to the Kaspersky site, if the password hash is compromised, it would take four years of computing time on a (i7 processor for "crack" it. <https://password.kaspersky.com/fr/>.

### B.3. Development and structure of the database

The entire 1.5000 documents of the documentary database was listed and exported (via a command prompt) as a CSV file before importing it into a MySQL database. The keywords were extracted from the file name determined by the naming process via the keywords entered by the indexer from MeSH and separator "-".

The base structure comprises:

- 1 main table "documents" that contains the file name, upload date, author, and keywords. The documents retrieval is done on this table.
- 1 high table "keywords" that contains all the unique keywords existing in the database. The automatic function of auto completion queries this table.
- 1 table users that contains the list of users and their passwords "hashed" (encrypted).

### B.4. Exploitation of the database

When a search is performed on the database, it is queried via a SQL query LIKE type on the keyword field. The keyword field is the concatenation of all the keywords indicated for each document. A LIKE search allows to find in the database, all the documents whose the keyword field contains the searched keyword. The LIKE search was chosen to the detriment of the Search MATCH AGAINST because this latter is more difficult to implement in the code. In addition, tests have shown that a LIKE search is as fast as a MATCH AGAINST search on this field. The MATCH AGAINST method is usually more appropriate for LONGTEXT fields on which we try to do a full text search, which is not the case of the keyword field in the database.

## IV. BOUGAINVILLE : MANAGEMENT DATABASE

### A. User Management

As long as the user is not connected, it can only access the search functions. In online mode it can access all modules: research, editing documents, deleting documents, document changes, adding and deleting users.

### B. Research in the corpus

As long as the user is not connected, it can only access the search functions. The research includes two modules: a search module by keywords (5 in number) where the keywords are automatically added (pre-search in the database) (see Figure 1)

and a module that lists the last 100 documents imported into the database.

**Figure 1: Search module by keywords**

**BOUGAINVILLE** - [Connexion](#)

[Accueil](#)

### Recherche par mots-clefs

Mot-clef #1:

Mot-clef #2:

Mot-clef #3:

Mot-clef #4:

Mot-clef #5:

[Recherche avec opérateur "OU"](#)

The results are presented in a table which may not exceed 500 lines (ie, the search should be refined by other keywords) (see Figure 2).

**Figure 2: Presentation of the results of the search**

**BOUGAINVILLE** - [Connexion](#)

### Recherche par mots-clefs

17 résultats trouvés:

Fichier	Theme	Mots-clefs	Détails
<a href="#">zika-armee-2016.pdf</a>	etat-sante-armees	etat-sante-armees, zika-armees, zika, armee	<a href="#">Détails</a>
<a href="#">zika-armees-2016.pdf</a>	etat-sante-armees	etat-sante-armees, zika-armees, zika, armees	<a href="#">Détails</a>
<a href="#">zika-armees-bresil-2016.pdf</a>	etat-sante-armees	etat-sante-armees, zika-armees, zika, armees, bresil	<a href="#">Détails</a>
<a href="#">zika-armees-marine-usa-2016.pdf</a>	etat-sante-armees	etat-sante-armees, zika-armees, zika, armees, marine, usa	<a href="#">Détails</a>
<a href="#">zika-armees-serbie-2016.pdf</a>	etat-sante-armees	etat-sante-armees, zika-armees, zika, armees, serbie	<a href="#">Détails</a>
<a href="#">zika-armees-usa-2016.pdf</a>	etat-sante-armees	etat-sante-armees, zika-armees, zika, armees, usa	<a href="#">Détails</a>
<a href="#">zika-armees-usa-bell-2016.pdf</a>	etat-sante-armees	etat-sante-armees, zika-armees, zika, armees, usa, bell	<a href="#">Détails</a>
<a href="#">zika-armees-usa-chretien-2016.pdf</a>	etat-sante-armees	etat-sante-armees, zika-armees, zika, armees, usa, chretien	<a href="#">Détails</a>
<a href="#">zika-armees-usa-hotez-2016.pdf</a>	etat-sante-armees	etat-sante-armees, zika-armees, zika, armees, usa, hotez	<a href="#">Détails</a>
<a href="#">zika-armees-usa-long-2016.pdf</a>	etat-sante-armees	etat-sante-armees, zika-armees, zika, armees, usa, long	<a href="#">Détails</a>
<a href="#">zika-armees-usa-wite-2011.pdf</a>	etat-sante-armees	etat-sante-armees, zika-armees, zika, armees, usa, wite	<a href="#">Détails</a>
<a href="#">zika-armees-usa01-2016.docx</a>	etat-sante-armees	etat-sante-armees, zika-armees, zika, armees, usa01	<a href="#">Détails</a>
<a href="#">zika-armees-usa02-2016.docx</a>	etat-sante-armees	etat-sante-armees, zika-armees, zika, armees, usa02	<a href="#">Détails</a>
<a href="#">zika-armees-usa03-2016.docx</a>	etat-sante-armees	etat-sante-armees, zika-armees, zika, armees, usa03	<a href="#">Détails</a>
<a href="#">zika-armees-usnavy-2016.pdf</a>	etat-sante-armees	etat-sante-armees, zika-armees, zika, armees, usnavy	<a href="#">Détails</a>
<a href="#">zika-armees-wadell-2016.pdf</a>	etat-sante-armees	etat-sante-armees, zika-armees, zika, armees, wadell	<a href="#">Détails</a>
<a href="#">zika-vaccin-armees-dyr-2016.pdf</a>	etat-sante-armees	etat-sante-armees, zika-armees, zika, vaccin, armees, dyr	<a href="#">Détails</a>

File name is clickable. It leads directly to the document in .pdf format. Clicking on "details" to display the detailed list of information about the document: total keywords, name of the user who imported the document, date and time of the upload (see Figure 3).

**Figure 3: Details of the document**

**Vue détaillée du document :**

Thème	etat-sante-armees
Mots-clefs	etat-sante-armees, zika-armees, zika, armee
Date upload	19-08-2016 23:00:00 UTC
Uploader	rafael.vives
Fichier	<a href="#">zika-armee-2016.pdf</a>

### C. Amendment

Edit information of a document is possible from the detailed view of it if the user is connected. The user can include add / modify / remove keywords. However, it cannot replace the file with another. It should then remove the document entirely and information before to import a new one.

### D. Suppression

Deleting a document and the information is also possible from the detailed view if the user is connected. A confirmation is required before deleting.

### E. Addition

The interface for adding a document is similar to that for search keywords. Keywords (up to 5) must be filled in the fields (always with automatic auto-completion for easy entry). A "Select" button selects the document on the computer to import. The select button allows only adding file with the extension, pdf.

## V. EXAMPLE OF USE

The management of the Ebola epidemic that has raged in Africa in 2014-2015 and which the French armies have been involved from the beginning is a good example where the database developed enabled efficient reuse of the collected documentation throughout the epidemic period (Reynard, 2014).

Indeed, since the emergence of the first cases, a certain number of documentary products requiring validated scientific bibliographic corpus were developed in order to alert policy makers and experts of the Military Health Service by the threat associated with this disease, especially in relation to its risk of mortality and contagiousness very high and the absence of treatments and vaccines.

The documents of these syntheses were especially scientific articles from international journals, such Emerging Infectious Diseases, The Lancet Infectious Diseases ... collected from the MedLine database. Various reports of the WHO have been collected and the Weekly Epidemiological Report, a weekly newsletter written by this organization, as well as new issues of the journal Eurosurveillance.

Regularly, were also requested answers to questions raised by the large uncertainties related to the survival of the virus in

the environment, way of human transmission and the risk of global transmission, especially via air transport, thus requiring the collection of large volumes of document from Internet databases.

All of the documentation collected during this period has been capitalized in BOUGAINVILLE. The documents were "tagged" with keywords: ebola, virus, arboviruses, Guinea, epidemic 2014, biological risk... allowing later efficient search on the field of metadata (see Figure 4).

**Figure 4: Results of the search on Ebola**

163 résultats trouvés:			
Fichier	Theme	Mots-clefs	Détails
<a href="#">16-01-2014-ebola.doc</a>	pays	pays, afrique, gabon, 16, 01, ebola	<a href="#">Détails</a>
<a href="#">assessing-international-spreading-risk-associated-ebola.pdf</a>	biologique	biologique, ebola, assessing, international, spreading, risk, associated, e	<a href="#">Détails</a>
<a href="#">biblio-ebola-2014.doc</a>	biologique	biologique, ebola, biblio, ebola	<a href="#">Détails</a>
<a href="#">cas-ebola.ppt</a>	biologique	biologique, ebola, cas, ebola	<a href="#">Détails</a>
<a href="#">containing-ebola.pdf</a>	biologique	biologique, ebola, containing, ebola	<a href="#">Détails</a>
<a href="#">early-epidemic-dynamics-west-african-ebola.pdf</a>	biologique	biologique, ebola, early, epidemic, dynamics, west, african, ebola	<a href="#">Détails</a>
<a href="#">ebola-actualite-nicolas-2009.pdf</a>	biologique	biologique, ebola, ebola, actualite, nicolas	<a href="#">Détails</a>
<a href="#">ebola-actualite-zeller-2002.pdf</a>	biologique	biologique, ebola, ebola, actualite, zeller	<a href="#">Détails</a>
<a href="#">ebola-aéroport-jakobson-2015.pdf</a>	biologique	biologique, ebola, ebola, aéroport, jakobson	<a href="#">Détails</a>
<a href="#">ebola-animaux-de-compagnie-novembre-2014.pdf</a>	biologique	biologique, ebola, ebola, animaux, de, compagnie, novembre-2014	<a href="#">Détails</a>
<a href="#">ebola-anticorps-chien-humain-allela-2005.pdf</a>	biologique	biologique, ebola, ebola, anticorps, chien, humain, allela	<a href="#">Détails</a>
<a href="#">ebola-anticorps-singe-echec-protection-oswald-2007.pdf</a>	biologique	biologique, ebola, ebola, anticorps, singe, echec, protection, oswald	<a href="#">Détails</a>
<a href="#">ebola-bricaire-2014.pdf</a>	biologique	biologique, ebola, ebola, bricaire	<a href="#">Détails</a>
<a href="#">ebola-carte-oms-2009.png</a>	biologique	biologique, ebola, ebola, carte, oms.png	<a href="#">Détails</a>
<a href="#">ebola-chauvessours-afrique-reservoir-leroy-2005.pdf</a>	biologique	biologique, ebola, ebola, chauvessours, afrique, reservoir, leroy	<a href="#">Détails</a>
<a href="#">ebola-clinique-schiffelin-2014.pdf</a>	biologique	biologique, ebola, ebola, clinique, schiffelin	<a href="#">Détails</a>
<a href="#">ebola-congo-2003.pdf</a>	biologique	biologique, ebola, ebola, congo	<a href="#">Détails</a>
<a href="#">ebola-congo-oms-2004.pdf</a>	biologique	biologique, ebola, ebola, congo, oms	<a href="#">Détails</a>

In the daily management of the crisis that was initially sanitary, which then became mediatic and finally political, all documents could be searched in the database by its users via various keywords and their association.

This federated search allowed them quick access to recent, classified and indexed scientific information, about the epidemic and allowed them an efficient reuse of this information. Users could particularly follow the primary health events, such as scientific publications on the rapidly changing number of cases in a country, or the appearance of new cases in France by imports.

The database BOUGAINVILLE was also used to help military experts sent to support the CTS (Centre de Traitement des Soignants) in Guinea, before departure. In particular, they were able to consult sanitary, geopolitical and strategic documents of the country and the region to better understand their future environment.

Finally, users, during the crisis, could monitor scientific publications concerning the epidemic including therapeutic and vaccines (Reynard, 2014). The database has permitted them to better anticipate the risks of military personnel deployed during the operations and preserve the health of the civilian population and military that they had responsibility in Africa.

## VI. CONCLUSION

To manage the corpus of documents collected as part of Medical Intelligence process, the health monitoring service of the CSPA has developed a database called BOUGAINVILLE that has certain documentaries and informatics features allowing its users an interrogation of the

corpus by keywords. This database is a web application coded in PHP 7.0.9. It works with Apache 2 HTTP server and a relational database MariaDB 10.1 (derived from MySQL). It has shown its usefulness, particularly in the context of the latest Ebola epidemic to recover more quickly and efficiently scientific documents collected during documentaries requests and to follow scientific developments. It has enabled saving time and improving the life cycle of the document. However, this application can still be improved, particularly in terms of deployment to all users of the Military Medical Service and to allow a full text search.

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# New Paradigm in Speech Recognition: Deep Neural Networks

Dominique Fohr, Odile Mella and Irina Illina

**Abstract**—This paper addresses the topic of deep neural networks (DNN). Recently, DNN has become a flagship in the fields of artificial intelligence. Deep learning has surpassed state-of-the-art results in many domains: image recognition, speech recognition, language modelling, parsing, information retrieval, speech synthesis, translation, autonomous cars, gaming, etc. DNN have the ability to discover and learn complex structure of very large data sets. Moreover, DNN have a great capability of generalization. More specifically, speech recognition with DNN is the topic of our work in this paper. We present an overview of different architectures and training procedures for DNN-based models. In the framework of transcription of broadcast news, our DNN-based system decreases the word error rate dramatically compared to a classical system.

**Index Terms**—speech recognition, deep neural network, acoustic modeling

## I. INTRODUCTION

More and more information appear on Internet each day. And more and more information is asked by users. This information can be textual, audio or video and represents multimedia information. About 300 hours of multimedia is uploaded per minute [1]. It becomes difficult for companies to view, analyze, and mine the huge amount of multimedia data on the Web. In these multimedia sources, audio data represents a very important part. *Spoken content retrieval* consists in “machine listening” of data and extraction of information. Some search engines like Google, Yahoo, etc. perform the information extraction from text data very successfully and give a response very quickly. For example, if the user wants to get information about “Obama”, the list of several textual documents will be given by Google in a few seconds of search. In contrast, information retrieval from audio documents is much more difficult and consists of “machine listening” of the audio data and detecting instants at which the keywords of the query occur in the audio documents. For example, to find all audio documents speaking about “Obama”.

Not only individual users, but also a wide range of

companies and organizations are interested by these types of applications. Many business companies are interested to know what is said about them and about their competitors on broadcast news or on TV. In the same way, a powerful indexing system of audio data would benefit archives. Well organized historical archives can be rich in term of cultural value and can be used by researchers or general public.

Classical approach for spoken content retrieval from audio documents is speech recognition followed by text retrieval [2]. In this approach, the audio document is transcribed automatically using a speech recognition engine and after this the transcribed text is used for the information retrieval or opinion mining. The speech recognition step is crucial, because errors occurring during this step will propagate in the following step.

In this article, we will present the new paradigm used for speech recognition: *Deep Neural Networks* (DNN). This new methodology for automatic learning from examples achieves better accuracy compared to classical methods.

In section II, we briefly present automatic speech recognition. Section III gives an introduction to deep neural networks. Our speech recognition system and an experimental evaluation are described in section IV.

## II. AUTOMATIC SPEECH RECOGNITION

An automatic speech recognition system requires three main sources of knowledge: an *acoustic model*, a *phonetic lexicon* and a *language model* [3]. Acoustic model characterizes the sounds of the language, mainly the phonemes and extra sounds (pauses, breathing, background noise, etc.). The phonetic lexicon contains the words that can be recognized by the system with their possible pronunciations. Language model provides knowledge about the word sequences that can be uttered. In the state-of-the-art approaches, statistical acoustic and language models, and to some extent lexicons, are estimated using huge audio and text corpora.

*Automatic speech recognition* consists in determining the best sequence of words ( $\hat{W}$ ) that maximize the likelihood:

$$\hat{W} = \underset{W}{\operatorname{argmax}} P(X|W)P(W) \quad (1)$$

where  $P(X|W)$ , known as *acoustic probability*, is the probability of the audio signal ( $X$ ) given the word sequence  $W$ . This probability is computed using acoustic model.  $P(W)$ , known as *language probability*, is the probability *a priori* of the word sequence, computed using the language model.

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### A. Acoustic modeling

Acoustic modeling is mainly based on *Hidden Markov Model* (HMM). An HMM is a statistical model in which the system being modeled is assumed to be a Markov process with unobserved (*hidden*) states [4].

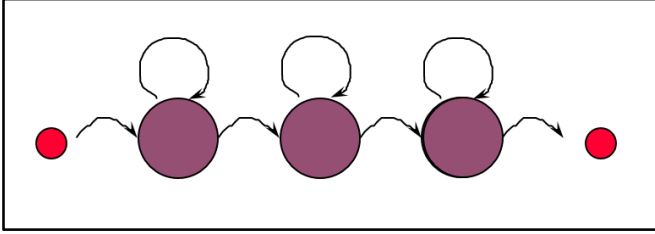


Fig. 1. HMM with 3 states, left-to-right topology and self-loops, commonly used in speech recognition.

HMM is a finite state automaton with  $N$  states, composed of three components:  $\{A, B, \Pi\}$ .  $A$  is the transition probability matrix ( $a_{ij}$  is the transition probability from the state  $i$  to the state  $j$ ).  $\Pi$  is the prior probability vector ( $\pi_i$  the prior probability of state  $i$ ), and  $B$  is the emission probability vector ( $b_j(x)$  is the probability of emission of observation  $x$  being in state  $j$ ).

In speech recognition, the main advantage of using HMM is its ability to take into account the dynamic aspects of the speech. When a person speaks quickly or slowly, the model can correctly recognize the speech thanks to the self-loop on the states.

To model the sounds of a language (phones), a three-state HMM is commonly chosen (cf. Fig. 1). These states capture the beginning, central and ending parts of a phone. In order to capture the coarticulation effects, *triphone models* (a phone in a specific context of previous and following phones) are preferred to context-independent phone models.

Until 2012, emission probabilities were represented by a mixture of multivariate Gaussian probability distribution functions modeled as:

$$b_j(x) = \sum_{m=1}^M c_{jm} \mathcal{N}(x; \mu_{jm}, \Sigma_{jm}) \quad (2)$$

The parameters of Gaussian distributions are estimated using the *Baum-Welch* algorithm.

A tutorial on HMM can be found in [4]. These models were successful and achieved best results until 2012.

### B. Language modeling

Historically, the most common approach for language modeling is based on statistical  $n$ -gram model. An  $n$ -gram model gives the probability of a word  $w_i$  given the  $n-1$  previous words:

$$P(w_i | w_1, \dots, w_{i-1}) = P(w_i | w_{i-(n-1)}, w_{i-(n-2)}, \dots, w_{i-1}).$$

These probabilities are estimated on a huge text corpus. To avoid a zero probability for unseen word sequences, smoothing methods are applied, the best known smoothing method being proposed by Kneiser-Ney [5].

### C. Search for the best sentence

The optimal computation of the sentence to recognize is not tractable because the search space is too large. Therefore, heuristics are applied to find a good solution. The usual way is to perform the recognition in two steps:

- The aim of this first step is to remove words that have a low probability to belong to the sentence to recognize. A word lattice is constructed using beam search. This word lattice contains best word hypotheses. Each hypothesis consist of words, their acoustic probabilities, language model probabilities and time boundaries of the words.
- The second step consists in browsing the lattice using additional knowledge to generate the best hypothesis.

Usually, the performance of automatic speech recognition is evaluated in terms of *Word Error Rate* (WER), i.e. the number of errors (insertions, deletion and substitutions) divided by the number of words in the test corpus.

## III. DEEP NEURAL NETWORKS

In 2012, an image recognition system based on *Deep Neural Networks* (DNN) won the *Image net Large Scale Visual Recognition Challenge* (ILSVCR) [6]. Then, DNN were successfully introduced in different domains to solve a wide range of problems: speech recognition [7], speech understanding, parsing, translation [8], autonomous cars [9], etc.[10]. Now, DNN are very popular in different domains because they allow to achieve a high level of abstraction of large data sets using a deep graph with linear and non-linear transformations. DNN can be viewed as universal approximators. DNN obtained spectacular results and now their training is possible thanks to the use of GPGPU (*General-Purpose Computing on Graphics Processing Units*).

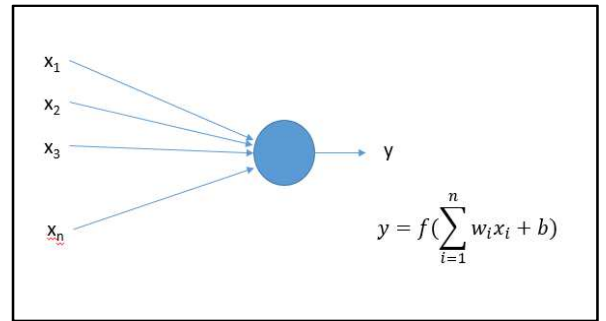


Fig. 2. Example of one neuron and its connections.

### A. Introduction

Deep Neural Networks are composed of *neurons* that are interconnected. The neurons are organized into layers. The first layer is the input layer, corresponding to the data features. The last layer is the output layer, which provides the output probabilities of classes or labels (classification task).

The output  $y$  of the neuron is computed as the non-linear weighted sum of its input. The neuron input  $x_i$  can be either the input data if the neuron belongs to the first layer, or the

output of another neuron. An example of a single neuron and its connections is given in Figure 2.

A DNN is defined by three types of parameters [11]:

- The interconnection pattern between the different layers of neurons;
- The training process for updating the weights  $w_i$  of the interconnections;
- The activation function  $f$  that converts a neuron's weighted input to its output activation (cf. equation in Fig. 2).

The widely used activation function is the *non-linear weighted sum*. Using only linear functions, neural networks can separate only linearly separable classes. Therefore, non-linear activation functions are essential for real data. Figure 3 shows some classical non-linear functions as sigmoid, hyperbolic tangent ( $\tanh$ ),  $ReLU$  (Rectified Linear Units), and  $\maxout$ .

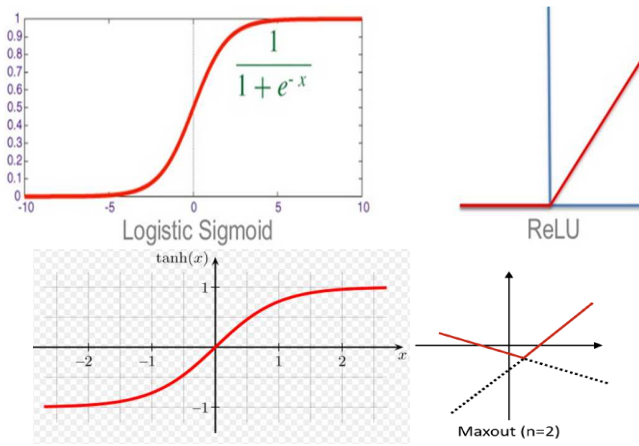


Fig. 3. Sigmoid,  $ReLU$ , tangent hyperbolic and maxout non-linear functions

### B. Training

The goal of the training is to reduce the error between the outputs computed on the training data and the target values. This supervised training consists in estimating the weights  $w_i$  of all neurons of all layers. Until now, there is no learning process that converges to a global optimum. The classical learning algorithm is based on stochastic gradient descent and only a local optimum can be achieved.

At each *epoch* (one *epoch* consists of one training cycle on the whole training set), the cost function  $E$  (difference between target output and computed output) is computed and the weights  $\omega$  are adjusted using:

$$\Delta\omega = -\eta \frac{dE}{d\omega}$$

$\eta$  is called the learning rate. In general, the learning rate is decreased during the training process [12][13].

Theoretically, the gradient should be computed using the whole training corpus. However, the convergence is very slow because the weights are updated only once per *epoch*. One solution of this problem is to use *Stochastic Gradient Descent*

(SGD). It consists in computing the gradient on a small set of training samples (called *mini-batch*) and in updating the weights after each mini-batch. This speeds up the training process.

During the training, it may happen that the network learns features or correlations that are specific to the training data rather than generalize the training data to be applicable to the test data. This phenomenon is called *overfitting*. One solution is to use a development set that should be as close as possible to the test data. On this development set, recognition error is calculated at each epoch of the training. When the error begins to increase, the training is stopped. This process is called *early stopping*. Another solution to avoid overfitting consists in using *regularization*. It consists in inserting a constraint to the error function to restrict the search space of weights. For instance, the sum of the absolute values of the weights can be added to the error function [14].

One more solution to avoid overfitting is *dropout* [15]. The idea is to “remove” randomly some neurons during the training. This prevents neurons from co-adapting too much and performs model averaging.

### C. Different DNN architectures

There are different types of DNN regarding the architecture [16]:

- *MultiLayer Perceptron* (MLP): each neuron of a layer is connected with all neurons of the previous layer (feedforward and unidirectional).
- *Recurrent Neural Network* (RNN): when it models a sequence of inputs (time sequence), the network can use information computed at previous time ( $t-1$ ) while computing output for time  $t$ . Fig. 4 shows an example of a RNN for language modeling: the hidden layer  $h(t-1)$  computed for the word  $t-1$  is used as input for processing the word  $t$  [17].

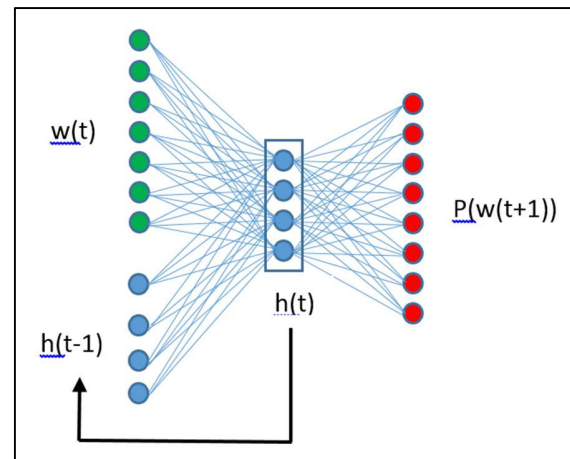


Fig. 4. Example of a RNN.

- *Long Short-Term Memory* (LSTM) is a special type of RNN. The problem with RNN is the fact that the gradient is vanishing, and the memory of past events decreases. Sepp Hochreiter and Jürgen

Schmidhuber [18] have proposed a new recurrent model that has the capacity to recall past events. They introduced two concepts: *memory cell* and *gates*. These gates determine when the input is significant enough to remember or forget the value, and when it outputs a value. Fig. 5 displays the structure of an LSTM.

- **Convolutional Neural Network (CNN)** is a special case of Feedforward Neural Network. The layer consists of filters (cf. Fig. 6). The parameters of these filters are learned. One advantage of this kind of architecture is the sharing of parameters, so there are fewer parameters to estimate. In the case of image recognition, each filter detects a simple feature (like a vertical line, a contour line, etc.). In deeper layer, the features are more complex (cf. Fig. 7). Frequently, a *pooling* layer is used. This layer allows a non-linear *downsampling*: max pooling (cf. Fig. 8) computes maximum values on sub-region. The idea is to reduce the size of the data for the following layers. An example of state-of-the-art acoustic model using CNN is given in Fig. 9.

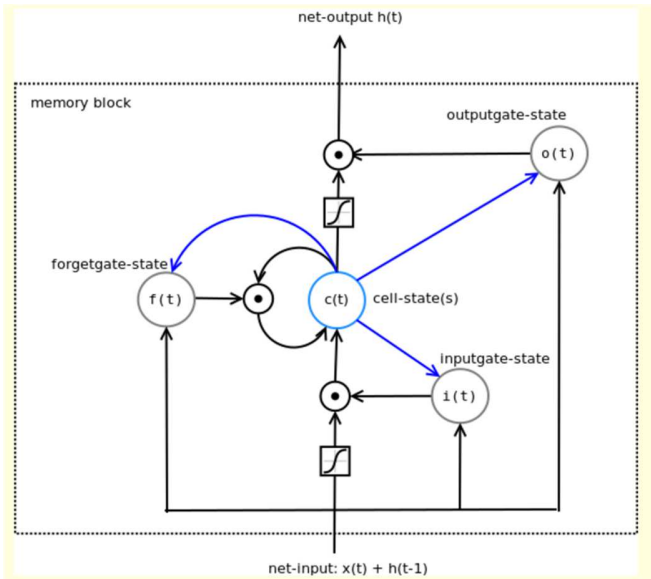


Fig. 5. Example of LSTM with three gates: input gate, forget gate, output gate and a memory cell (from [19]).

The main advantage of RNN and LSTM is their ability to take into account temporal evolution of the input features. These models are widely used for natural language processing. Strong point of CNN is the translation invariance, i.e. the skill of discover structure patterns regardless the position. For acoustic modelling all these structures can be exploited.

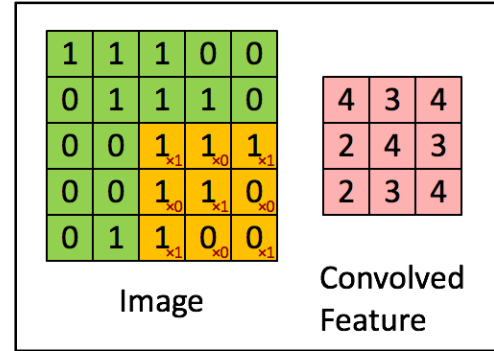


Fig. 6. Example of a convolution with a filter  $\begin{bmatrix} 1 & 0 & 1 \\ 0 & 1 & 0 \\ 1 & 0 & 1 \end{bmatrix}$

Original image is in green, filter applied on bottom right of image is in orange and convolution result is in pink.

A difficult DNN issue is the choice of the hyperparameters: number of hidden layers, number of neurons per layer, choice of non-linear functions, choice of learning rate adaptation function. Often, some hyperparameters are adjusted experimentally (trial and error), because they depend on the task, the size of the database and data sparsity.

#### D. DNN-based acoustic model

As said previously, for acoustic modeling, HMM with 3 left-to-right states are used to model each phone or contextual phone (triphone). Typically, there are several thousand of HMM states in a speech recognition system.

In DNN-based acoustic model, contextual phone HMMs are kept but all the Gaussian mixtures of the HMM states (equation 2) are replaced by DNN. Therefore, DNN-based acoustic model computes the observation probability  $b_j(x)$  of each HMM phone state given the acoustic signal using DNN networks [21]. The input of the DNN will be the acoustic parameters at time  $t$ . The DNN outputs correspond to all HMM states, one output neuron for one HMM state.

In order to take into account contextual effects, the acoustic vectors from a time window centered on time  $t$  (for instance from time  $t-5$  to  $t+5$ ) are put together.

To train the DNN acoustic model, the alignment of the training data is necessary: for each frame, the corresponding HMM state that generated this frame should be known. This alignment of the training data is performed using a classical GMM-HMM model.

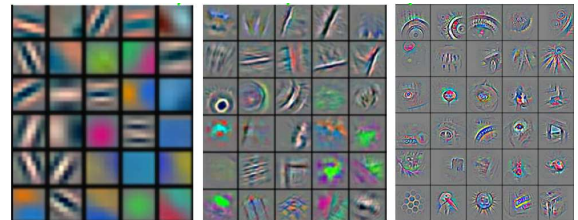


Fig. 7. Feature visualization of convolutional network trained on ImageNet from Zeiler and Fergus [20].



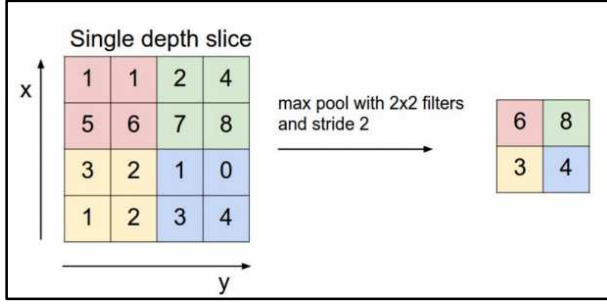


Fig. 8. Max pooling with a 2x2 filter (from www.wildml.com)

#### E. Language model using DNN

A drawback of classical N-gram language models (LM) is their weak ability of generalization: if a sequence of words was not observed during training, N-gram model will give poor probability estimation. To address this issue, one solution is to move to a continuous space representation. Neural networks are efficient for carrying out such a projection. To take into account the temporal structure of language (word sequences), RNN have been largely studied. The best NN-based language models use LSTM and RNN [23][24].

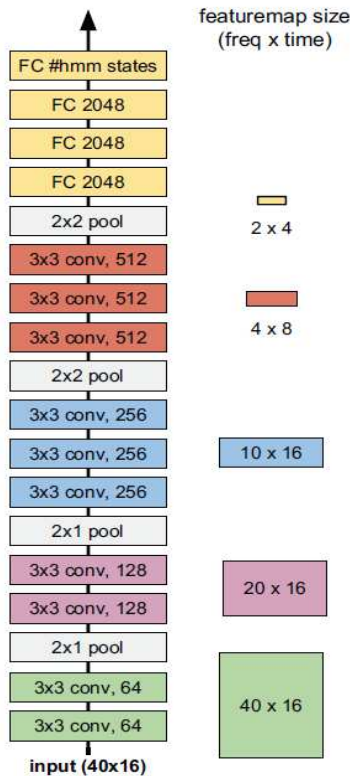


Fig. 9. The very deep convolutional system proposed by IBM for acoustic modeling: 10 CNN, 4 pooling, 3 full connected (FC MLP) (from [22]).

#### IV. KATS (KALDI BASED TRANSCRIPTION SYSTEM)

In this section we present the KATS speech recognition system developed in our speech group. This system is built using *Kaldi* speech recognition toolkit, freely available under the Apache License. Our KATS system can use GMM-based and DNN-based acoustic models.

##### A. Corpus

The training and test data were extracted from the *radio broadcast news* corpus created in the framework of the ESTER project [25]. This corpus contains 300 hours of manually transcribed shows from French-speaking radio stations (*France Inter*, *Radio France International* and *TVME Morocco*). Around 250 h were recorded in studio and 50h on telephone. 11 shows corresponding to 4 hours of speech (42000 words) were used for evaluation.

##### B. Segmentation

The first step of our KATS system consists in segmentation and diarization. This module splits and classifies the audio signal into homogeneous segments: non-speech segments (music and silence), telephone speech and studio speech. For this, we used the toolkit developed by LIUM [27]. We processed separately telephone speech and studio speech in order to estimate two sets of acoustic models; studio models and telephone models.

##### C. Parametrization

The speech signal is sampled at 16 kHz. For analysis, 25 ms frames are used, with a frame shift of 10 ms. 13 MFCC were calculated for each frame completed by the 13 delta and 13 delta-delta coefficients leading to a 39-dimension observation vector. In all experiments presented in this paper, we used MCR (*Mean Cepstral Removal*).

##### D. Acoustic models

In order to compare GMM-HMM and DNN-HMM acoustic models, we used the same HMM models with 4048 senones. The only difference is the computation of the emission probability ( $b_j(x)$  of equation 2): for GMM-HMM it is a mixture of Gaussians, for DNN-HMM, it is a deep neural network. Language model and lexicon stay the same. For GMM-HMM acoustic models, we used 100k Gaussians. For DNN, the input of the network is the concatenation of 11 frames (from  $t-5$  to  $t+5$ ) of 40 parameters. The network is a MLP with 6 hidden layers of 2048 neurons per layer (cf. Fig. 10). The output layer has 4048 neurons (corresponding to 4048 senones). The total number of parameters in DNN-HMM is about 30 millions.

##### E. Language models and lexicon

Language models were trained on huge text corpora: newspaper corpus (*Le Monde*, *L'Humanité*), news wire (*Gigaword*), manual transcriptions of training corpus and web data. The total size was 1.8 billion words. The  $n$ -gram language model is a linear combination of LM models trained on each text corpus. In all experiments presented in this paper, only a 2-gram model is used with 40 million bigrams and a

lexicon containing 96k words and 200k pronunciations.

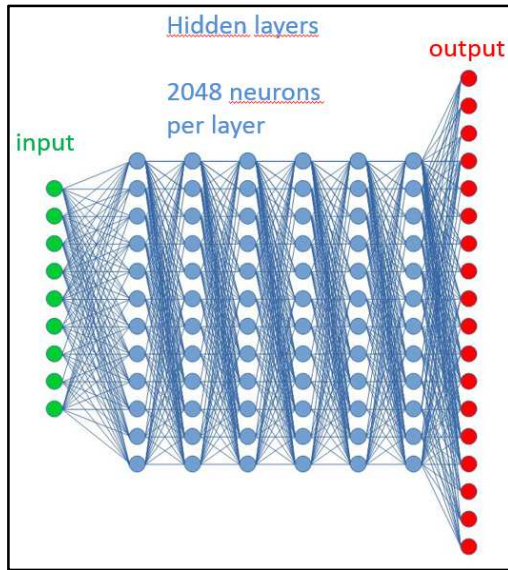


Fig. 10. Architecture of the DNN used in KATS system.

#### F. Recognition results

Recognition results in terms of word error rate for the 11 shows are presented in Table 1. The confidence interval of these results is about  $\pm 0.4\%$ . Two systems are compared. These systems use the same lexicon and the same language models but differ by their acoustic models: GMM-HMM and DNN-HMM, so, the comparison is fair. For all shows, the DNN-based system outperforms the GMM-based system. The WER difference is 5.3% absolute, and 24% relative. The improvement is statistically significant. The large difference in performance between the two systems suggests that DNN-based acoustic models achieves better classification and has generalization ability.

Shows	# words	GMM-HMM	DNN-HMM
20070707_rfi (France)	5473	23.6	16.5
20070710_rfi (France)	3020	22.7	17.4
20070710_france_inter	3891	16.7	12.1
20070711_france_inter	3745	19.3	14.4
20070712_france_inter	3749	23.6	16.6
20070715_tvme (Morocco)	2663	32.5	26.5
20070716_france_inter	3757	20.7	17.0
20070716_tvme (Morocco)	2453	22.8	17.0
20070717_tvme (Morocco)	2646	25.1	20.1
20070718_tvme (Morocco)	2466	20.2	15.8
20070723_france_inter	8045	22.4	17.4
Average	41908	22.4	<b>17.1</b>

Table 1. Word Error Rate (%) for the 11 shows obtained using the GMM-HMM and DNN-HMM KATS systems.

#### V. CONCLUSION

From 2012, deep learning has shown excellent results in many domains: image recognition, speech recognition, language modelling, parsing, information retrieval, speech synthesis, translation, autonomous cars, gaming, etc. In this article, we presented deep neural networks for speech recognition: different architectures and training procedures for acoustic and language models are visited. Using our speech recognition system, we compared GMM and DNN acoustic models. In the framework of broadcast news transcription, we shown that the DNN-HMM acoustic model decreases the word error rate dramatically compared to classical GMM-HMM acoustic model (24% relative significant improvement).

The DNN technology is now mature to be integrated into products. Nowadays, main commercial recognition systems (Microsoft *Cortana*, Apple *Siri*, Google *Now* and Amazon *Alexa*) are based on DNNs.

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# The Dynamics of Business Accelerators: A Multi-Country Study

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**Abstract—** Despite the strong development of business accelerators (BAs) in recent years, little is known about their characteristics. Aiming to fill this gap, this article investigates the practices of BAs through a multi-country study. We explore the screening process, business support, exit policy, strategic positioning and network dynamics of BAs. We use a qualitative research protocol employing semi-directed interviews with 25 accelerator managers. The results present the specificities of the BAs and identify some differences in selection processes, support practices and exit policies among BAs. We also describe the strategic positioning of BAs (born global vs. local, for-profit vs. not-for-profit and generalist vs. specialized). We identify three major elements that constitute the value proposition of BAs: an alignment of interest between BAs and startups, the ability to build strong networks and acting as an intermediate filter for investors. Finally, we present the theoretical and practical implications of the research.

**Index Terms—** Business accelerators, startups, Business Incubators, Innovation, Network, Business Model, Selection, Support, Exit policies.

## I. INTRODUCTION

Business incubators have enjoyed increasing success in recent decades. According to a recent study by the National Business Incubation Association (2010), the survival rate of startups using business incubators (BIs) is 87%, compared with 44% for startups that do not use incubators. These firms help increase entrepreneurial success and opportunity and intend to strengthen communities. However, recent studies underline some limitations in the business model of BIs: selection and exit issues, inadequate or insufficient networking and, most importantly, inappropriate incubation duration for high-tech firms with rapid innovation cycles and fast time-to-market (Alsos *et al.*, 2011; Bruneel *et al.*, 2012; Chan and Lau, 2005; Isabelle, 2013).

Since 2005, a new business model to support technology ventures has emerged: business accelerators (BAs). Accelerators are interested in achieving the same overall goals as BIs but do so in a very different way. First, BAs are usually for-profit organizations (Isabelle, 2013), and they generally

make an investment in the companies enrolled in their programs. BAs are also designed to be concise and generally take three to four months to complete. BAs act as very early-stage investors to accelerate the growth of startups.

The development of BAs is encouraged by governments and public institutions, who consider startups to be important levers for economic development and job creation (Henrekson and Johansson, 2010). Academic research interest in BAs is recent and growing (Bosma and Stam, 2012; Hoffman and Radojevich-Kelley, 2012; Isabelle, 2013; Malek *et al.*, 2013; Miller and Bound, 2011). Thus, little is known about the characteristics of BAs (Isabelle, 2013). The purpose of this research is to fill this gap and to *analyze the organizational and strategic characteristics of business accelerators*. We explore the screening process, business support, exit policy and network dynamics of BAs.

To do so, we developed a multi-country study based on a qualitative research protocol with semi-directive interviews of accelerator managers (Miles and Huberman, 1994). The data analysis derived from these interviews generated seven distinct themes that we divided into 33 subthemes. Based on this analysis, distinct results emerged concerning the characteristics of business accelerators.

The related literature is reviewed in section one. In section two, we describe the method used to analyze the BAs, and we describe our data. Sections three to five present and discuss the results. Finally, conclusions and implications for theory and practice are drawn.

## II. LITERATURE REVIEW

### A. Genesis and definition of Business Accelerators

The emergence of the so-called “Business Accelerator” model must be understood in the context of the development of the incubator industry, which was established in recent decades. Value propositions have changed through different generations of business incubators (Barbero *et al.*, 2012; Bruneel *et al.*, 2012;

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Grimaldi and Grandi, 2005; Hansen et al, 2000; Mian et al, 2012). The first generation of BIs offered office space and shared resources. The second generation provided coaching and training support as additional services that expanded the value proposition to accelerate the learning curve of incubating companies. In the third generation, access to technological, professional and financial networks was offered by BIs as an additional feature to foster access to external resources and knowledge (Bruneel et al, 2012). Allen and McCluskey (1990) discuss a business incubator continuum to describe the spectrum from a focus on real estate to capitalizing on investment opportunities and fostering new enterprises. In 2005, a new actor in the entrepreneurial ecosystem appeared, which is adding a new value proposition for rapid new venture creation: Business Accelerators (BAs).

The first accelerator, called “Y Combinator”, was established in 2005 in Mountain View, California (US) by Paul Graham and his team. The formula was to throw smart people together and provide them seed money to cover initial startup costs, cookie-cutter legal paperwork and to offer them an extensive network of business contacts. In addition to offering office space, Y Combinator serves as a network contact channel into the Silicon Valley ecosystem. The emergence of the first accelerator may be regarded as an *organically grown idea of an experienced and successful (Internet software) entrepreneur*. Y Combinator holds three-month-cycle programs twice per year in the Bay Area, near Silicon Valley, USA, and has funded over 630 digital startups. This concept of an accelerator was copied in 2007 by Brad Feld and his “Techstars” accelerator in Boulder, Colorado. He and his team established their model in four cities in the USA and focused on *integrating experienced entrepreneurs as mentors*. Furthermore, Feld and his team offered their model as a blueprint for others to establish accelerators, similar to a franchise system. Since then, accelerators have appeared around the world as a new and popular mechanism to create new ventures because the model offers a new and better allocation mechanism in the startup ecosystem (Hoffman and Radojevic-Kelley, 2012; Isabelle, 2013).

Nevertheless, there is no clear consensus in the academic community on the definition of a business accelerator. Malek *et al*, (2013) suggest that an accelerator is a type of business incubation program that allows entrepreneurial teams to connect with and access resources from investors and other important stakeholders. It is clear that BAs share some similarities with BIs. According to Carayannis and Von Zedtwitz (2005), BIs offer five services to tenants: access to physical resources, office support, access to financial resources, entrepreneurial start-up support and access to networks.

However, BAs have some unique characteristics. Except for an explicit focus on accelerating the growth of firms (Bosma and Stam, 2012), several features characterize an accelerator and distinguish BAs from BIs: a formalized application process, a high level of selection due to competition between new tenants, the provision of seed investments (usually in exchange for equity), a focus on teams and not on individuals, time-limited support comprising programmed events that includes intense

mentoring (usually over three months) and cohorts of startups accelerated by “grapes”. Finally, tenants who join an accelerator are “expected to interact and network” with the other tenants (Miller and Bound, 2011; Malek *et al*, 2013). In addition to these features, another attribute of an accelerator program is that it ends with a demo day in which the participating teams pitch in front of an investor audience to receive follow-on funding for their venture. This is actually the main purpose of an accelerator: to bring prepared, mentored and investment-ready, early-stage ventures together with investors who are looking to spend their money on good opportunities.

These characteristics therefore explain the popularity of the accelerator model through the institutionalized facilitation of cooperation among different actors in the start-up ecosystem that are dependent on one another. BAs serve both parties, bridging their needs. In this sense, BAs offer an innovative, allocative mechanism in the startup ecosystem. These characteristics (seen as a special set of features) also serve to distinguish BAs from other mechanisms, especially incubators and technology transfer institutions.

The emergence of BAs brings a new reflection to business incubation research. To better explore the characteristics of BAs, it is relevant to understand the limitations of BIs that encouraged the emergence of BAs.

#### *B. Explaining the growing success of business accelerators: Are incubators doing enough?*

Even if there is evidence that ventures supported by BIs succeed at a greater rate than non-incubated ventures, research reveals the ineffectiveness of some BIs (Aerts *et al*, 2007; Alsos *et al*, 2011; Chan and Lau, 2005; Scillitoe and Chakrabarti, 2010; Tamasy, 2007). Alsos *et al*, (2011) show that incubator management involves balancing a set of conflicting goals. Expectations are interdependent and involve sub-processes related to different stakeholders. Goals are not fixed to an operational context. Consequently, suboptimal solutions are chosen to balance and fulfill expectations sufficiently to ensure the survival of BIs.

The strong growth of BAs in recent years may be explained by three interdependent factors that are linked to the maladjustment of the BI business model to recent changes in the entrepreneurship ecosystem. First, the high speed of innovation and rapid access to the marketplace becomes a determining factor for startups, which need a rapid and reactive incubation business model. This characteristic may be incompatible with the incubation duration of BIs. Second, the development of BAs may also be explained by dysfunctional selection and exit policies in BIs. Third, the need for an effective and powerful network also explains the success of BAs’ business models relative to BIs.

### *The changing speed of innovation and time-to-market*

Incubators (especially public) do not generally have a strict focus on the amount of time a business will spend in the program. Tenants generally spend between 12 and 36 months in the program, but other incubators may have a longer time frame (Barbero *et al.*, 2012; Chan and Lau, 2005; Isabelle, 2013; Gabarret *et al.*, 2014). However, several researchers have emphasized the importance of innovation speed in high-tech sectors (Kessler and Chakrabarti, 1996) and for startups (Heirman and Clarysse, 2007). For Kessler and Chakrabarti (1996), innovation speed is the time between an initial discovery and its commercialization. Stalk and Hout (1990) note that the speed of innovation refers to the rate at which discoveries are transformed into rent-producing assets. Other studies underline the strategic placement of new products in firms' dynamic capabilities (Nelson, 1991). For Sonnenberg (1993), firms that are first coming to the market have a significant competitive advantage. According to Markman *et al.*, (2005), innovation is subject to rapid depreciation. Therefore, time is regarded as a scarce resource (Lawless and Anderson, 1996), especially for rapid-growth firms. In particular, the necessity of rapid innovation and time-to-market implies a major shift in the needs of new ventures: faster access to knowledge, intangible assets, and financial capital. Clausen and Korneliussen (2012) highlight the entrepreneurial orientation of BI managers to have a positive impact on the time-to-market of incubating firms. BAs provide an answer to this time constraint. With a short period of time focused on coaching, intense mentoring and networking, BAs offer a new way for the incubation process to match the speed of innovation, change in technologies and time-to-market.

Indeed, the changes brought about by the Internet explosion in the mid-1990s affected not only technology and knowledge-based ventures but also, consequently, the incubator industry (Grimaldi and Grandi, 2005) by providing a supportive context for the BA model. The main changes are as follows (Miller and Bound, 2011):

- The first change is a decrease in start-up costs (marketing costs to launch a new product or service via Google or Facebook instead of billboard campaigns or trade fairs; flexible office lending opportunities per hour or month that avoid the need to rent an office);
- The second change is a faster time-to-market, with the potential for rapid access to customers through the Internet and easier routes to revenues (the Internet as the main platform makes it quick and easy to find new customers, and online-payment providers such as PayPal and selling platforms such as App Stores facilitate finding new paying customers);
- The third change is the methodological novelties that effectively build new products and business models. These methodological developments may be subsumed under two major topics: lean start-up principles (Ries, 2011) and business model generation (Osterwalder and Pigneur, 2010). Lean start-up principles are based on customer feedback during the process of developing new

software and applications and adding to the substantive effectiveness of product development in the entire new venture process. Business model generation, on the other hand, focuses on creating business models quickly and integrating the models very early into the process of new venture creation (Osterwalder and Pigneur, 2010). Both methodological novelties are integrated into the development of accelerators and serve their higher effectiveness and efficiency, thus making it possible to develop a (prototype) product and business model during a brief three-month accelerator program, which otherwise may not have been possible.

- The fourth change is in the investment market. Private-sector investment conducted by business angels doubled from 15 to 30 percent between 2001 and 2007 (Miller and Bound, 2011). Therefore, the growing amount of available early-stage funding has also enabled the accelerator model to develop.

### *Dysfunction of BIs in selection and exit policies*

Assessing entry and exit policies has been found to be essential to understand the functioning of BIs (Mian, 1997). Other studies demonstrate that BIs' exit or graduation policies play a critical role in distinguishing between real estate and business development-focused BIs (Allen and McCluskey 1990; Bøllingtoft, 2012). Schwartz (2012) emphasizes timely graduation from BIs to lower the risk of failure afterwards. In addition, Aerts *et al.*, (2007) focus on the screening process of BIs and reveal a positive correlation between a balanced screening practice for potential tenants and BIs' tenant survival rate. Bruneel *et al.*, (2012) combine the two previous criteria and point beyond exit policies to strict selection criteria that should be imposed on BIs to fulfill their essential mission. In addition, with regard to the value propositions of different generations of BIs, the authors note that the latest generation offers access to networks as their main value added, in contrast to older generations of BIs. In combination with strict selection criteria and exit policies, tenants of the latest generation of BIs not only have shorter incubation periods but also are more likely to use a service portfolio more extensively (Bruneel *et al.*, 2012). Admission and exit policies are also noted by the European Commission (EC, 2002) as a differentiating factor driving BIs and their success.

The *selection* of incubatees is noted in the literature as crucial for the outcomes and functioning of BIs (Aerts *et al.*, 2007; Allen and McCluskey, 1990; Bergek and Norrman, 2008; Bruneel *et al.*, 2012; Hackett and Dilts, 2004; Hansen *et al.*, 2000). Selection criteria have been found to be missing in many BIs (Bergek and Norrman, 2008; Bruneel *et al.*, 2012). The careful selection of incubatees has a significant impact on the survival of new firms and consequently on the success of an incubator (Aerts *et al.*, 2007). Imposing strict selection criteria has been found to make the use business support services and networking opportunities more likely (Alsos *et al.*, 2011; Bruneel *et al.*, 2012). A recent survey shows that BIs often demonstrate selection bias or flexible selection, which may cause performance problems for the BIs or a lack of synergy

between their tenants (Alsos *et al.*, 2011; Chan and Lau, 2005; Clarysse *et al.*, 2005; Isabelle, 2013).

Clear *exit criteria* are often non-existent in BIs but are found to make timely graduation more probable (Barbero *et al.*, 2012; Bruneel *et al.*, 2012). Thus, the absence of clear exit criteria may affect the functioning of an incubator, as described in the in-depth study by Gabarret *et al.* (2014). The authors note several conflicts and tensions among different generations of incubatees due to an unclear exit strategy. This finding is problematic because previous research has noted that the capacity for older incubators' tenants to coach their younger peers can be a real success factor for BIs (Bøllingtoft, 2012; Fischer and Reuber, 2003). These studies show that an atmosphere of trustworthiness and mutual cooperation is necessary for an incubator and thus for its incubatees to thrive (Tötterman and Sten, 2005). This phenomenon could explain why exit criteria may be crucial to an incubator's functioning. By having clear selection criteria and exit policies, BAs tend to be more effective structures (Malek *et al.*, 2013), and they therefore benefit from the trust of stakeholders and external investors.

### ***The need for effective networks***

The idea that access to networks is crucial for new, incubated ventures to overcome their need for resources is nothing new (Hansen *et al.*, 2000; Hackett and Dilts, 2004; McAdam and McAdam, 2006; Rothschild and Darr, 2005; Sullivan and Ford, 2014). Birley (1985) highlights the importance of networks in the creation of new businesses, especially informal networks. Fischer and Reuber (2003) underscore the necessity of interactions between policy makers, external resource providers (e.g., venture capitalists, bankers and consultants) and rapid-growth firms such as startups. Strätling *et al.* (2012) add that trust is essential to achieve a successful relationship between startups and venture capitalists. Regarding BIs, Hansen *et al.* (2000) consider an organized network and institutionalized networking to be differentiating factors for incubators in securing preferential access to crucial strategic partnerships, talented employees and advice from experts. Both internal and external networks coexist in BIs (Soetanto and Jack, 2013). When institutionalized, this approach to networking is independent from personal contacts (Bøllingtoft and Uhløi, 2005; Hansen *et al.*, 2000). Ebberts (2013) shows that networking among new ventures in BIs enlarge the number of business assignments provided to partners. Rothaermel and Thursby (2005) demonstrate that network linkages between tenants of university incubators and supporting institutions (whether informal, formal or contractual) reduce the risk of new venture failure. Moreover, access to networks is critical to the survival of BI tenants (Bøllingtoft, 2012; McAdam and McAdam, 2008). In their role as a mediator between external partners and incubatees, BIs may leverage critical resources through potential customers, potential investors, employees and other partners, which are crucial for the survival of new ventures (Bergek and Norrman, 2008; Bøllingtoft and Uhløi, 2005; Scillitoe and Chakrabarti, 2010). In particular, relationships with networks of business angels have a strong

positive impact on new venture creation in BIs (Aernoudt, 2004). These relationships to networks are also linked to the competences and structures of incubators (Rice and Matthews, 1995; Schwartz and Hornych, 2008). Ebberts and Wijnberg (2012) demonstrate that the reputation of founding members has a positive impact on investment decision of investors. Moreover, hiring competent and professional management and delivering high-quality services are regarded as necessary for the success of modern technology incubation (Mian *et al.*, 2012), and this approach impacts the quality of an incubator network.

Despite the role of the latest generation of BIs in terms of networking, several studies (Barbero *et al.*, 2012; Colombo and Delmastro, 2002; Schwartz and Hornych, 2008) note the difficulties faced by startups in accessing adequate funding, especially high-growth firms in their early stages of development. BAs have attempted to overcome this disadvantage by focusing on preparing their entrepreneurs for their demo day with investors. Unlike incubators, BAs provide seed amounts of funding in return for equity in a participant's startup. This strategy aims to attract new investors, many of whom became reluctant and avoided the pitfalls of investing in technology ventures after the dot-com bust of 2000 and the great recession of 2008. Indeed, in recent years, it has become extremely difficult for start-up companies to obtain necessary funding. Traditional networks offered by BIs became insufficient (Hoffman and Radojevich-Kelley, 2012; Soetanto and Jack, 2013). Through their programs, BAs educate entrepreneurs about additional investment options. According to Hoffman and Radojevich-Kelley (2012, p.1), "there is a predominant gap in early funding, which forces startups to turn to accelerator companies to help fill the funding void."

It is clear that the requirements for new ventures and technological startups have changed in recent decades. More and more startups are applying to accelerator programs (Malek *et al.*, 2013), not just due to financial motivations but also because they need reactivity in the support they receive, face to the high speed of innovation and technology. At this level, BAs play a strategic role in helping entrepreneurs quickly launch and grow their ventures. It is therefore necessary to better understand the characteristics, practices and strategic issues of BAs. This paper intends to contribute to the knowledge on BAs by exploring and describing these dynamics.

### **III. METHODOLOGY**

We chose a qualitative research protocol based on open-ended interviews (Miles and Huberman, 1994) to conduct an in-depth investigation of the accelerators' characteristics.

#### ***A. Sample***

The sample consists of 25 accelerators that have been established in several countries: Bulgaria, China, Denmark, France, Germany, India, Israel, Italy, Japan, the Netherlands, Poland, Turkey, the United Kingdom, and the USA. Although a homogeneous sample is better for identifying relationships and building theory while avoiding atypical inputs (Fortin, 1996), a sample with many dissimilar components is useful

when the aim is to extend existing results with strong internal validity. Cook and Campbell (1979) propose an intermediate solution: using samples composed of deliberately different components to increase the external validity of the results. The principle of inference is as follows: because heterogeneity exerts a negative influence on the significance of the effect, if the relationship appears to be significant despite this disadvantage, then the results may be generalized. Therefore, a wide variety of actors and interviewees may compensate (to a certain degree) for a small sample size. For this reason, we chose a sample with a high degree of variety: 25 accelerator units (see Table 1 in Appendix).

The sample size is critical in qualitative research because a minimum size requirement is observed to ensure the internal validity of the research and provide a satisfactory level of confidence in the results. According to Yin (2013), size may be determined by replication or saturation. In this study, we determined the sample size using the saturation principle: theoretical saturation is reached when no further information to enrich the theory is found. The saturation principle is difficult to implement in practice because it is impossible to determine the cut-off point in advance, and researchers may never be completely certain that more information would not further enhance the research. As Cook and Campbell (1979) suggest, it is the researchers' responsibility to determine whether they have reached saturation; the process of adding observations is terminated when the most recently analyzed units of observation are found to contribute no new information. Our sample was formed using an iterative approach through telephone, face-to-face or email prospecting of international accelerators. Unlike the standard probability-based approach, the field for generalizing the results was defined not in the initial step but at the end of the process. Therefore, the sample is built gradually through successive iterations, with each component selected by reasoned choice (Fortin, 1996).

### B. Data collection

We conducted 25 semi-directive, face-to-face (or Skype) open-ended interviews with international accelerator managers. Our objective was to gather discursive data reflecting the managers' conscious or unconscious mental universe (Miles and Huberman, 1994). Interviews were conducted in 2013 and 2014. Secondary data were also collected from the accelerator websites as well as other official web resources: the National Business Incubation Association, the European Commission and the National Endowment for Science, Technology and the Arts (NESTA). We divided the pre-structured interview guide into seven themes, which was further subdivided into 33 subthemes (see Table 2 in Appendix).

The interviews were tape recorded to ensure that the collected data were exhaustive and reliable. The interviews were transcribed within 24 to 72 hours. The average length of these interviews is eighty five minutes.

### C. Data analysis

The data were analyzed in three steps via a discourse analysis based on a thematic content analysis (Miles and Huberman, 1994). First, the gross database was analyzed through thematic coding. This analysis consisted of determining the units of meaning (words, sentences or phrases related to one of the pre-determined subthemes) and counting the respective occurrences (to measure the weight of each in the discourse). The occurrences were noted in "intrasite matrices" (i.e., for each accelerator) that included personal observations and certain particularly striking or illustrative remarks by the interviewees.

Second, we synthesized all of the intrasite matrices into "intersite matrices" (double-entry tables for each theme, with the 33 subthemes in the columns and the 25 accelerators in the rows). The aim was to compare the managers' discourses concerning each theme and to identify the similarities and differences.

Third, we established "meta-matrices", or crossed tables for each theme, in which the responses of all of the managers were simplified using keywords and classified as variables. After identifying similar phrases, common themes and differences and even conflicts within certain statements, we were able to isolate the common features and differences.

## IV. RESULTS

Unlike the rare surveys dedicated to accelerators, the results of this survey show that there are no homogeneous practices between the BAs in our sample. They adopt practices inspired by the Techstars model but with adjustments suited to individual countries and the accelerators themselves. They also have different patterns and strategies.

### A. The operational practices of BAs

First, concerning *selection*, all of the BAs in the sample pursue a strict selection process. In general, the amount of applicants to BA programs is very high. The ratio of received applications to teams that are selected is at least eight to one. Microsoft receives 400 applications from which they ultimately select 10 teams. The selection processes are conducted in a multi-step manner, and applications must be made by a complimentary team, not by individuals. The reason cited for this policy is that it reduces the risk of failure due to a broader competence base. Further steps in the selection process include personal interviews and a final decision made by a selection committee.

The results also show differences in the selection processes of the BAs. One major difference lies in the people involved. For example, Startupbootcamp, Startup42 and H-Farm have many different stakeholders involved in the selection process, including investors, mentors, partners and/or sponsors. On the opposite end of the spectrum, in The Family, there is little variety in the stakeholders, and the management team ultimately decides which teams are selected. Another important



difference among the different BAs is that some stakeholders may propose teams directly (this is the case for H-Farm, Eleven, Startupbootcamp and Axeleo). When these stakeholders are investors, they may benefit from a preferential option to invest in the teams they proposed following the accelerator program.

In terms of *support*, all of the BAs have administrative support covered, including legal, human resources and accounting support, by retaining external partners. The focus of support, which nonetheless lies intensively on business development, is twofold. First, training on the development of business models and extensive training on how to pitch in front of investors is common. Second, the core of the support within all of the BAs is the mentoring of the teams by experienced entrepreneurs, advisers or industry experts with a solid reputation within their particular sector.

Several differences may be observed in the amount of support. The first concerns financial support: not all of the BAs offer pre-seed money to the teams, which is usually used to supplement living costs for the period during which the teams participate in the accelerator program. Accordingly, Microsoft, Orange and Startup42 do not take equity in the startups. Another difference derives from the curriculum of the different BAs. A particular focus on customer development and storytelling were mentioned as the most useful for the teams to progress in their investment-readiness (Microsoft). On the other hand, differences in formalization could also be observed, ranging from “laissez-faire” (The Family, Startup42) to more supervised processes (Microsoft, L’Accélérateur). Some of the BAs that pursue a “laissez-faire” style see themselves more in the role of connectors. The manager of Startup42 explains: “Our goal is rather for the startups to ask for something than to push them to do anything.”

*Fundraising*, combined with the exit policy, has been found to be the focal point of all of the operational processes within accelerators and the point to which all other activities aspire. All of the BAs have some sort of demo day, an institutionalized event in which the teams’ development is presented in front of a community of potential investors to solicit funding. This event also represents a graduation or an exit from the BA. Our results therefore show a clear exit policy for all of the BAs at the end of each program. The interviewed managers are convinced that having this exit policy is important to provide the teams a clear signal that the support is not extendable and to apply needed pressure on the teams. The manager for the BA Eleven indicates that this event creates “peer pressure. If you work next to a team which is progressing very well, and you know that you will be on demo day with that team, you can focus a bit more.” The findings suggest that the teams are brought to a place where they can be agile in the dynamic markets in which they will generally operate.

Our results show differences in support after the acceleration programs end. One difference concerns help in finding funding; a second is the possibility of remaining on the office premises for a certain period of time. A third difference among the BAs in conjunction with the exit policy is the existence of an alumni

network that grants startups access to events, other startups and partners in the particular accelerator program. In our observations, support and connection with the teams after they exit an accelerator program are generally linked to whether the BAs take equity positions in their startups.

## B. The strategic configurations of BAs

We identified several different dimensions that explain the strategic orientation of BAs.

The findings show a major differentiation in whether BAs are present in just one location or in multiple locations. In particular, corporate BAs established by multinational companies use their existing structures in different countries to open accelerators on different continents. This approach also reflects the notion of born-global entrepreneurs in action, as teams in these BAs may leverage their already provided international structures. Internal networks in different countries provide access to markets in these countries and the opportunity to internationalize rapidly. Orange BA explicitly offers access to its business units in 32 countries worldwide in its value proposition. Our results also show that the strategic objective of single-location BAs often involves building an innovative entrepreneurial ecosystem that is embedded in the development of the region in which it operates. One manager states: “I think we are providing social benefits, creating almost a thousand jobs and creating an innovation area” (H-Farm).

Our results show another important distinction in the configuration of BAs. While the literature has generally considered BAs to be for-profit entities (Isabelle, 2013), our results show that they may operate to generate a return on investment, or they may not. In other words, BAs can be either for-profit or not-for-profit organizations. All of the independent, private BAs in our sample were found to be for-profit, whereas the corporate and university-linked accelerators are not-for-profit organizations.

Further differences may also be observed in the range of strategic goals pursued by different BAs. Whereas for-profit BAs have the primary goal of gaining a return on investment at some point, not-for-profit accelerators have other strategic goals. Corporate BAs consider their operations to be open innovation platforms to enlarge their innovative capacity. University-linked BAs have been found to pursue their strategic goal of leveraging knowledge in the greater university environment and fostering an entrepreneurial talent pool. Interestingly, our findings also show a parallel objective in all BAs, which is to support local entrepreneurial ecosystems: “building the ecosystem is a goal on its own” (Eleven).

Our findings reveal a division of BAs between generalists and specialists. The BAs that we call generalists are industry agnostic and take on teams independent of sector; “everyone can apply” (Eleven). On the other side are the specialists, which take on teams from very specific industries and focus on vertical markets. One example is the UK accelerator Startupbootcamp

(called FinTech), which specializes in new ventures in the financial industry sector.

We may suppose the existence of a link between the degree of specialization of the BAs and the level of maturity of the entrepreneurial support ecosystems in the different countries we observed. Schwartz and Hornyh (2008, 2010) show that a higher degree of specialization for BIs is associated with greater performance than less specialized BIs. Several studies show that the incubator industry in Europe and developing countries is not as efficient and powerful as in the USA. The surveys of Colombo and Delmastro (2002) for Italy, Mian *et al.* (2012) for France and Özdemir and Ehitlu (2013) for Turkey illustrate this argument. Although ecosystems exist in every country included in our study, the levels of maturity of these ecosystems differ. Our findings suggest that the configurations of BAs are directly linked with the maturity of their ecosystem. Thus, a more mature ecosystem is likely to have more highly specialized accelerators. In Italy, for example, where the ecosystem is less mature (Colombo and Delmastro, 2002), the BA we studied is not focused on one particular industry; rather, it selects startups that have the same industry focus as the region in which the accelerator is located. Accordingly, the same configuration exists for the BAs in Bulgaria and Turkey.

These different configurations depend on both the strategic goals and the specificities of the environment they are acting in.

### C. Business accelerators: A new business model of incubation configurations of Bas

This study shows that BAs focus strictly on the business development of their teams. This focus on business development is expressed through the disappearance of the renting model and the inadequate focus that exists in the business models of many typical BIs. The managers of the BAs argue that startups need intensive knowledge and focused support more than office space. Moreover, one of the managers states that the “...value added is to connect teams with partners, mentors and investors” (Startupbootcamp).

This *allocative mechanism* is institutionalized and brings together the different stakeholders in the startup ecosystem. In addition, in contrast to other typical business incubators or science parks, this BA model provides an *alignment of interests*. Because there is no need to rent out space and gain revenue, the focus lies completely in supporting the teams and their startups. One manager of an accelerator notes, “We make money when our startups are successful ... if they succeed, we succeed ... the interests of founders and incubators are totally aligned” (Eleven).

The findings show that BAs have the ability to build *strong and large networks*. On an internal level, BAs encourage strong ties between the tenants to develop synergies and peer support. Concomitantly, the high-quality processes in terms of selection and support for startups is due to the powerful personal networks of BAs and their high level of specialized

competencies. The reputation and past experience of the founders of BAs (some are serial entrepreneurs), in combination with the high level of competence of the mentors, enable the BAs to connect their startups with appropriate stakeholders. In France, for example, many BI managers come from the public sector and therefore do not necessarily have useful and appropriate networks for startups: “*Our advantage in comparison to incubators is our network, which managers from public sector incubators usually don't have to support the startups*” (Axeleo).

Moreover, BAs consolidate their networks by maintaining strong ties with previous tenants. Some of the BAs benefit from the fact that they do not accommodate startups in house and thus are able to accept more teams. “*The more accelerated startups we have, the bigger the network is, and the more talents we have, we can see more interactions between startups, a lot of help and collaboration, and this is a great way to function and create synergies*” (L'Accélérateur). This approach enables the BAs to multiply their links and develop strong networks with former accelerated teams. The manager of The Family explains: “*We believe in the culture of mutual help and exchange between former and current accelerated teams ... It's like Silicon Valley's culture, where many entrepreneurs dedicate some of their time to help startups ... We want to implement this culture in France, and we do everything we can so former accelerated entrepreneurs never leave our network.*” This process enables the BAs to build a solid and large network of investors and potential partners.

BAs also they develop complementarity links with BIs. This complementarity may act in two directions. First, incubators can be seen as a source of projects. As one manager states: “*We see incubators as a feeder system into accelerators, so we look on incubators as a source where we can recruit from*” (Startupbootcamp). Second, a BI can be used after an acceleration program: “*My assumption is that some teams go to an incubator after my program*” (Startup42).

Thus, BAs successfully build internal networks (between the tenants), and external networks with investors, sponsors and BIs.

Our results indicate that BAs play an essential role in helping investors (business angels, venture capitalists) select relevant projects. BAs serve as a filter mechanism for many actors in the entrepreneurial ecosystem. They act as a platform by bringing different stakeholders together in the start-up arena. The managers of the BAs that we met argue that they minimize risk for investors and “*some of them send trainees to demo day ... they trust the quality of our job and our selection process*” (Le Camping). The managers consider that the investors do not have to examine hundreds of applications; the BAs are doing it for them. Moreover, our results reveal that BAs are an ideal outlet for venture capitalists (VCs) because they can provide the filtering necessary for early-stage investments. By building companies that already have revenue and references established during the acceleration program, the BAs are able to provide

already relevant companies to the VCs. The BAs act as a lever for the entrepreneurial ecosystem and as a facilitator for investors.

## V. DISCUSSION AND CONCLUSION

The purpose of our study was to explore the dynamics of BAs. To pursue this aim we investigated 25 accelerators through a multi-country study. Our results point out a particular functioning of BAs, in terms of practices and strategy and thus offer valuable new insights on the incubation / acceleration process of startups.

### A. Contribution to the theory

*First*, this research contributes to the recent and growing literature on business accelerators (Hoffman and Radojevich-Kelley, 2012; Isabelle, 2013; Malek *et al*, 2013, Miller and Bound, 2011). The majority of previous findings present general characteristics of BAs. Our results confirm this literature by identifying some commonalities between the BAs. However, accelerators are far from homogeneous and our research demonstrates that BAs develop heterogeneous practices and business models. This heterogeneity in BAs configurations may reflect the current dynamism of the startup ecosystem face to the growing demand of new ventures with diverse needs.

*Second*, this research brings new insights to the literature on networking needs of startups. Compared to previous literature on BIs (Cooper *et al*, 2012; Hoffman and Radojevich-Kelley, 2012; Ebberts, 2013; Soetanto and Jack, 2013), our research demonstrates that BAs implement successful practices to develop strong internal *and* external networks. The present study extends the findings of Ebberts and Wijnberg (2012). While they focused on reputation and past experience of managers giving them a large capacity for networking with investors (for finding funds), reputation also enhances the ability to mobilize mentors (for support) and partners (for sponsoring). Our results also confirm the survey of Aernoudt (2004), who considers that business incubators should work closer together with business angels and venture capitalists. This missing link between incubation and finance (Aernoudt, 2004) is filled by the BA mechanism, as it connects the investment community and trained startups.

*Third*, our study brings new knowledge on BIs governance and relationships among stakeholders. Alsos *et al*, (2011) indicate that the effectiveness of incubators is difficult to assess due to multiple, complex and volatile goals. There is a great risk that BIs aim for the goals that are easiest to measure and focus on short-term results. If incubator managers choose suboptimal solutions to balance the demands of different stakeholders, the long-term social returns of incubators could be questioned. This is not the case for the business accelerators we studied because the interests of all the stakeholders are aligned. Thus, this study opens up a successful case of building concordant interests between BAs stakeholders.

*Fourth*, our findings add to existing theory the BA as a new actor in the value-added business incubation continuum established by Allen and McCluskey (1990). By focusing purely on business development, it can be assumed that BAs create an elevated economic value. Furthermore, as it facilitates to mobilize a community of investors and at the same time leveraging entrepreneurial knowledge and know-how on a large scale, it can be seen as an extension of the business incubator continuum as it adds these new features.

### B. Contribution to the practice

This research provides useful insights for practitioners. BAs are enjoying an increasing success in the entrepreneurial support industry. This research shows that BAs act as a lever for the entrepreneurial ecosystem. BAs serve as a filter mechanism to many stakeholders (investors, incubators, institutions). They coordinate and institutionalize the relationships between these different actors by establishing links between them and the startup teams. The *alignment of interests* between the startups, the BA, and the investors may avoid potential conflicts and enhance communication. We should recommend that BAs reinforce their coordination role and mobilize other stakeholders which are less represented in their governance (e.g., government, business incubators, universities, etc.) in order to consolidate their ecosystem.

The popularity of BAs appears to have reached governments and policymakers. For instance, the French government has put out in early 2014 a two hundred million euro envelope to support business accelerators. We should recommend to clearly defining the shape of accelerators to avoid ambiguity with BIs. Indeed, face to this trend, there might be the necessity of BIs to rethink their incubation services. We envision three strategies.

*First*, BIs can choose the complementarity and *partnership* with BAs, BIs acting as a source of projects for BAs or intervening after the acceleration program.

*Second*, incubators can successfully adopt an accelerator's services. For instance, H-Farm in Italy began as an incubator and gradually implemented a BA program that meets the standards of the definition proposed in our study. This can be considered as an *imitation strategy*.

*Third*, as the BA model gains popularity, a trend of labeling can be observed. This approach generates the appearance of 'fake' accelerators, that we call *simulation strategy*. Several organizations may use the ambiguity of the BA definition to catch funds. Therefore, there is an emerging need to create a quality label outlining standards of operations and processes for BAs. Without such a quality label, the danger of diluting the strengths of a BA will be likely and will create confusion for founders of startups on where to go. In this sense, we suggest that teams should be very careful when looking at institutions that label themselves "accelerators".

### C. Limitations and future research

First, we faced difficulties to interview mentors and startup teams. Therefore our sample is limited to BAs' managers and results could not be triangulated. Further research is needed to consolidate the internal and external validity of the results.

Second, we could not get access to neither performance nor sustainability data of the accelerators. Reliable secondary data on these factors were incomplete. Additionally, the interviewed managers either refused to answer or declared that it was too early to assess the performance of the business model.

For future research, we suggest to consider the BA business model as in motion, which needs deeper investigation. The further dynamic development of this young industry has not proven to have models which can be regarded as sustainable yet. The for-profit accelerators, even the ones that started out very early, expect first tendencies of their long-term sustainability not before five to seven years after their start. Additionally, their financial sustainability is also dependent on future sell-outs of the companies they have an equity stake in. In this regard, the success of for-profit accelerators is hard to measure. Existing metrics (e.g., percentage of teams who received follow-on funding, number of applications received, number of engaged mentors per batch) are regarded as being helpful to measure the outcome of the activities of accelerators, but are not exhaustive to establish a comprehensive assessment framework for accelerators. Thus, further research has to be conducted to establish an assessment framework for accelerators, which fulfils the requirements of assessing all existent models equally.

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## APPENDIX

Table 1. Sample

<i>Business accelerator</i>	<i>Creation</i>	<i>No. of units</i>	<i>Type</i>	<i>Countries of the units</i>	<i>Specialized (Sp.) / Generalist</i>	<i>No. of teams / program</i>	<i>No. of mentors</i>
Eleven	2012	1	Independent	Bulgaria	Generalist	10-15	150
H-Farm	2011	1	Independent	Italy	Generalist	10-20	50
Le camping	2011	1	Public and private sponsors	France	Generalist	12	40
StartupBoot Camp	2010	8	Independent	Denmark Germany UK Netherlands Netherlands Netherlands Turkey Israel	Sp. (mobile) Generalist Sp. (financial innovation) Generalist Sp. (high tech) Sp. (NCF) <sup>1</sup> Generalist Sp. (media & advertising)	10	100 per location
The Family	2013	1	Independent	France	Generalist	10-20	3
Microsoft	2012	6	Corporate	India China France UK Germany Israel	Sp. (ICT)	10-15	100 per location
Orange	2013	4	Corporate	USA France Japan Poland	Sp. (mobile)	6-8	N/A
Startup42	2013	1	University and private sponsors	France	Sp. (engineering)	7-8	70
Axeleo	2013	1	Independent	France	Generalist	25	4
L'accélérateur	2012	1	Independent	France	Generalist	50	26

Table 2. Themes for data analysis

<i>Theme</i>	<i>Subthemes</i>
History of the accelerator	Creation Evolution
General characteristics	Size Location Number of mentors Number of tenants Governance / stakeholders
Selection	Actors implied in the process Selection process Degree of formalization Type of projects selected
Support	Type of support Complementary services Frequency of support Interlocutors (type, number, etc.) Accelerator's requests for each tenant Accelerator's requests for the mentors
Exit	Strategic goals of the accelerator Number of exits / year Average duration of the acceleration process Exit strategy Post-acceleration support Tenants' failure management

<sup>1</sup> NCF: Near Field Communications & Contactless Interactions Technologies.



# Segmentation and Classification of Opinions with Recurrent Neural Networks

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**Abstract**—Automatic opinion/sentiment analysis is essential for analysing large amounts of text as well as audio/video data communicated by users. This analysis provides highly valuable information to companies, government and other entities, who want to understand the likes, dislikes and feedback of the users and people in general. Opinion/Sentiment analysis can follow a classification approach or perform a detailed aspect level analysis. In this paper, we address a problem in between these two, that of segmentation and classification of opinions in text. We propose a recurrent neural network model with bi-directional LSTM-RNN, to perform joint segmentation and classification of opinions. We introduce a novel method to train neural networks for segmentation tasks. With experiments on a dataset built from the standard RT movie review dataset, we demonstrate the effectiveness of our proposed model. Proposed model gives promising results on opinion segmentation, and can be extended to general sequence segmentation tasks.

## I. INTRODUCTION

With the growing amount of users on the internet, social media and online shopping websites, a large amount of data is generated in which people voluntarily publish their opinion on products, stocks, policies, etc. Automatic systems are necessary to analyse such large data and derive facts from them. Accordingly, the area of automatic opinion/sentiment analysis is receiving interest from both industry and academia, with some challenges and tasks being held every year [1]–[4]. Research in sentiment analysis involves building systems and algorithms which can understand text from the perspective of the opinions or sentiments expressed in it [5], [6]. Sentiment analysis systems are very useful for industries to obtain a feedback on their products which get reviewed on social networks and online shopping websites [7]–[10]. Similarly they have been used for analysing sentiments in political tweets and election data [11]–[14]. Apart from text data, videos posted on the social media and news websites [15]–[19], as well as audio conversations from call centres [20]–[22], are analysed for sentiments.

A common task is to classify a given sentence or text as expressing positive or negative sentiments using a text categorization approach [23]. On the other hand, classifying sentiments at the sentence and document level may not provide a detailed analysis of the entity or product being reviewed. For example, the movie review - *The actors did their job but the characters are simply awesome*, attributes different level of opinions to different entities. In such cases aspect level

sentiment analysis [24] is performed. Aspect level sentiment analysis is concerned with identification of sentiment-target pairs in the text, their classification and also the aggregation over each aspect to provide a concise overview. (Although in practice, a method may not implement all these steps and in the same order.)

We focus on a sentiment analysis problem which is in-between sentence/document level classification and aspect level sentiment analysis. We investigate the problem of analysis of text which can contain segments corresponding to both positive and negative sentiments, with one following the other. For example, the review - *Comes with a stunning camera and high screen resolution. Quick wireless charging but the battery life is a spoiler*. Given such a text, our task is to segment (and classify) the text into parts of positive and negative segments. So, the goal is to automatically identify the segment '*Comes with a stunning camera and high screen resolution. Quick wireless charging*', classify it as positive, and have the segment '*but the battery life is a spoiler*' classified with negative sentiments. Similar to our previous example, in aspect level sentiment analysis, the text can have different sentiment-target pairs or aspects. However, our task is segmentation and classification of text based on opinions/sentiments, without performing a detailed aspect level analysis.

An important point to note is that, the segmentation models cannot simply rely on sentence boundaries, punctuations or any other linguistic features. As in the example we presented, the segment boundaries are not always at the end of the sentence. Another common scenario where the segmentation models cannot rely on such features is sentiment analysis on audio/video data. *Automatic Speech Recognition* (ASR) transcripts of these audio/video documents are used for sentiment analysis and they do not contain any kind of punctuation marks. To perform a robust segmentation and classification under such conditions, we propose discriminatively trained neural network models.

Developments in neural networks and deep learning has led to new state-of-the-art results in text and language processing tasks. Text classification is being commonly performed with compositional representations learned with neural networks or by training the network specifically for text classification [25]. Fully connected feed forward neural networks [26]–[28], *Convolutional Neural Networks* (CNN) [29]–[31] and also

*Recurrent/Recursive Neural Networks* (RNN) [32]–[36] have been used successfully. The approaches based on CNN and RNN capture rich compositional information and have been outperforming previous results on standard tasks in natural language processing. Of particular interest to this work are the Recurrent Neural Networks (RNN). Previous works have shown that RNNs are very good at modelling word sequences in text. Since our task is to segment a text sequence and classify the segments into positive and negative sentiments, we exploit RNNs to perform the segmentation and classification of opinions.

In this paper, we present our approach to train RNNs for segmentation and classification of opinions in text. We propose a novel cost function to train the RNN in a discriminative manner to perform the segmentation (Equation (12)). We evaluate our proposed model on the task of segmentation and classification of movie reviews into positive and negative sentiments. The dataset used in our experiments is built using sentences from the standard *Rotten Tomatoes* (RT) movie review dataset [37]. The rest of the paper is organised as follows. In Section II we present the previous works related to our work. We provide a description of RNNs in Section III. Our proposed model is presented in Section IV. Section V describes our experiment setup, including the experiment dataset, model training and evaluation measures. This is followed by a discussion on the results obtained with our model in Section V-C and the conclusion in Section VI.

## II. RELATED WORK

Classical sentiment analysis approaches traditionally relied on classifiers trained using sentiment specific lexicons or knowledge structures and other hand crafted features [5], [6]. These classical feature based approaches also tried neural networks for sentiment classification [38]. Maas et. al. [39] proposed models which automatically learned word features (or word vector representations) targeted for the sentiment classification. Neural network models and automatically learned word vector features came together to achieve state-of-the-art results on sentiment classification with the model proposed in [26]. Later, the application of deep learning techniques in natural language processing led to new state-of-the-art results on sentiment classification tasks [40], mainly with CNN [29], [30] and RNN [36] architectures. Neural network architectures, including both CNN and RNN, have been also applied for aspect level sentiment analysis [2], [41], [42].

In this paper, we explore RNN models for segmentation and classification of opinions/sentiments in text. As mentioned earlier, our task is in-between sentiment classification and aspect level sentiment analysis. Compared to earlier works using RNN for sentiment analysis [36], [43]–[45], we propose a novel method for discriminative training of RNNs for joint text segmentation and classification. Text segmentation approaches have been studied vastly in previous works. These approaches scan the text and determine the locations of segment cuts/boundaries based on coherence calculated between adjacent blocks of text. After the initial work in this area

[46], [47], most approaches used topic models and Bayesian approaches for text segmentation task [48]–[50]. We employ word embeddings [51], vector representations of words which carry both syntactic and semantic information of words and the context, to learn sentiment level cohesion of segments in text. As opposed to the methods relying on Bayesian and topic models, our approach can detect very short segments containing only few words.

More recently word embeddings from neural network models have been utilised for text segmentation in general [52] as well as specifically for sentiment analysis [53]. The approach in [52] uses an iterative refinement technique whereas the work in [53] is focused on finding appropriate phrase like segments which imply the correct sentiments (for example *not good* actually implies bad). In contrast to these approaches, we exploit *Long Short-Term Memory* (LSTM) RNNs to capture and remember the sentiment level cohesion, mainly to perform appropriate segmentation and classification of opinions and sentiments in text.

## III. RECURRENT NEURAL NETWORKS

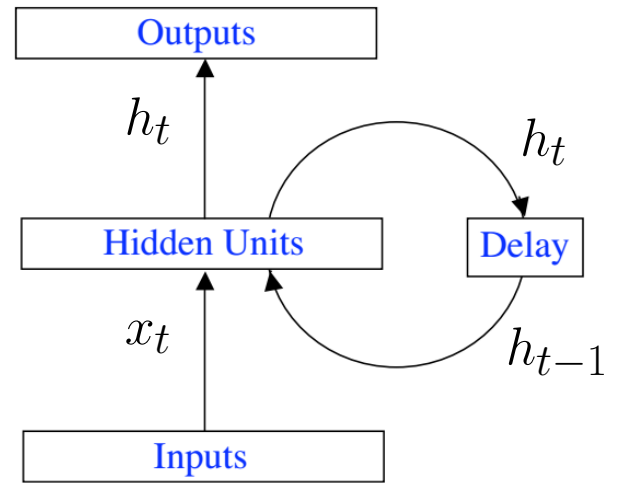


Fig. 1. Schema of Recurrent Neural Network (RNN)

Figure 1 shows a schema for a typical Recurrent Neural Network (RNN) (the most commonly used Elman network [54]). Similar to most neural networks, RNN has an input layer, a layer of hidden units and an output layer. Given a discrete input sequence  $\{x_t\}_{t=1,2,3,\dots,N}$ , a hidden layer activation  $h_t$ , is obtained using the current input  $x_t$  and the previous hidden layer activation  $h_{t-1}$ . The corresponding output  $y_t$  is then obtained using  $h_t$ . The computation of the hidden layer and output activations is given as:

$$h_t = f_x(x_t.W_x + h_{t-1}.W_h + b_x) \quad (1)$$

$$y_t = f_y(h_t.W_y + b_y) \quad (2)$$

where  $W_x$ ,  $W_h$  and  $W_y$  are the weight parameters at input, hidden and output layers,  $b_x$  and  $b_y$  are the bias parameters

at input and output layers,  $f_x$  and  $f_y$  denote non-linearity functions like sigmoid and hyperbolic tangent (tanh). Training the RNN involves learning the weight and bias parameters. Given a training dataset with input sequences and output labels, this can be achieved using gradient descent and error back propagation algorithms [55], [56].

As it is evident from Figure 1, the RNN can remember activations of the past inputs. This enables it to model sequences like discrete time sequences in speech signals, word sequences in a document, protein sequences, etc. However, training RNN requires error back propagation through time and as the length of the sequence/time increase it leads to vanishing and exploding gradient problems [57]. To address the more severe vanishing gradient problem, the Long Short-Term Memory (LSTM) cell [58] has become a popular alternative to the hidden layer unit in the classical RNN.

Figure 2 shows an illustration of the LSTM cell. The LSTM cell borrows ideas from a hardware memory cell, and as shown in the figure it consists of a cell state  $c_t$  and a forget gate  $f_t$  which controls the amount of past activations to be memorised and/or to be forgotten by the cell. The computations of the activations at the input gate ( $i_t$ ), forget gate  $f_t$ , cell state ( $c_t$ ), output gate ( $o_t$ ) and the hidden layer ( $h_t$ ) are given as:

$$i_t = \sigma(x_t.W_i + h_{t-1}.U_i + b_i) \quad (3)$$

$$\tilde{c}_t = \tanh(x_t.W_c + h_{t-1}.U_c + b_c) \quad (4)$$

$$f_t = \sigma(x_t.W_f + h_{t-1}.U_f + b_f) \quad (5)$$

$$c_t = i_t * \tilde{c}_t + f_t * c_{t-1} \quad (6)$$

$$o_t = \sigma(x_t.W_o + h_{t-1}.U_o + c_t.V_o + b_o) \quad (7)$$

$$h_t = o_t * \tanh(c_t) \quad (8)$$

where  $W$ ,  $U$  and  $b$  are weight parameters and bias with suffixes  $i$ ,  $f$ ,  $c$  and  $o$  denoting input gate, forget gate, cell state and output gate, respectively.  $\sigma$ ,  $\tanh$  denote the sigmoid and hyperbolic tangent non-linearities and  $V_o$  is another weight parameter at the output gate.  $*$  denotes simple (element-wise) multiplication and  $.$  denotes vector/matrix dot products in a multi-dimensional setup.

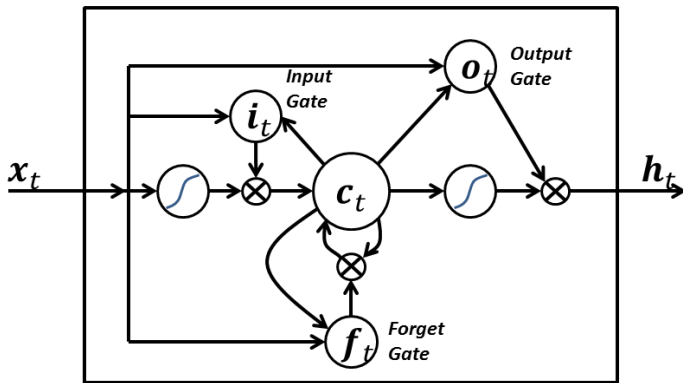


Fig. 2. Long Short-Term Memory (LSTM) Cell. (Taken from [59].)

#### IV. PROPOSED APPROACH

We propose a model based on LSTM-RNN to perform joint segmentation and classification of opinions/sentiments in text. More specifically we employ a bidirectional LSTM-RNN, in which there is a forward LSTM-RNN which models the word sequence from left to right and a backward LSTM-RNN which models the word sequence from right to left. In previous works, bidirectional LSTM-RNN are shown to perform better than unidirectional LSTM-RNN for modelling and classifying sequences [60]–[62]. However, we specifically choose bidirectional LSTM-RNN to compare and measure cohesion between past and future word sequences. In our task, it will enable us to detect changes in sentiments as well as in context, and hence to perform segmentation. At the same time, the activations from the bidirectional LSTM-RNN will be combined to perform a classification of sentiments corresponding to the segments.

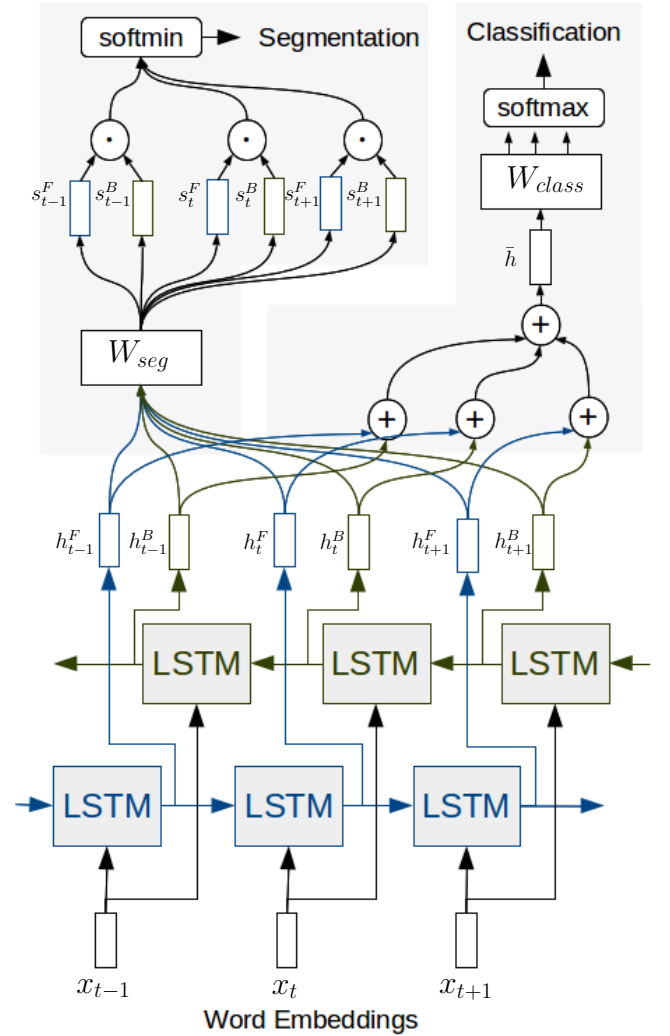


Fig. 3. Proposed model for joint Segmentation and Classification

Figure 3 shows the diagrammatic representation of our proposed model for joint segmentation and classification. As

shown in the figure, the model operates on word embeddings corresponding to words in a text sequence (denoted as  $\dots, x_{t-1}, x_t, x_{t+1}, \dots$ ). Following a bidirectional LSTM-RNN architecture, our model has two layers of LSTM-RNN. The hidden layer activation for the forward LSTM-RNN at time  $t$  is denoted as  $h_t^F$  and the hidden layer activation for the backward LSTM-RNN at time  $t$  is denoted as  $h_t^B$ . Compared to Figure 1, here the RNN schema is unrolled across  $t$ . The hidden layer activations of the forward and backward LSTM-RNN are obtained using Equations (3)-(8). These hidden layer activations ( $h_t^F, h_t^B$ ) are used in both the segmentation and classification sub-parts, shown in top part of the Figure 3.

We first present the segmentation part of our model, which is shown in the top left part of Figure 3. Each of the hidden layer activations of the forward and backward LSTM-RNN are transformed using a feed forward neural network as follows:

$$s_t^F = h_t^F \cdot W_{seg} + b_{seg} \quad (9)$$

$$s_t^B = h_t^B \cdot W_{seg} + b_{seg} \quad (10)$$

where  $W_{seg}$  and  $b_{seg}$  are weight and bias parameters of the segmentation feed forward network. Following the feed forward layer, the outputs corresponding to forward and backward LSTM-RNN at each  $t$  are compared as:

$$d_t = s_t^F \cdot s_t^B \quad (11)$$

where  $\cdot$  denotes a dot product. This dot product compares the similarity between the context until  $t$ , as captured in  $s_t^F$ , and the context following  $t$ , which is captured in  $s_t^B$ . Thus  $\{d_t\}_{t=1:N}$ , where  $N$  is the length of the text sequence, represents similarity across the text sequence and this similarity should be minimum at the segment boundaries. The similarity calculation is followed by a softmax function, given as:

$$\text{softmax}(d_{t*}) = \frac{e^{-d_{t*}}}{\sum_{t=1}^N e^{-d_t}} \quad (12)$$

The softmax function will give highest output probability to the lowest  $d_t$ . Additionally it will enable a discriminative training of the segmentation model, by maximising the likelihood of the true segmentation point ( $t^*$ , known at time of training), as compared to all the other points ( $t = 1, 2, \dots, N$ ).

Given the output of segmentation, the opinions/sentiments in the text segments can be classified using separate models which are trained for sentiment classification [27], [29], [30], [36], [63]. However, we would like to study the power of our model for joint segmentation and classification. Thus, in addition to the segmentation part, our model also has a classification part as shown in top right of Figure 3. The hidden layer activations of the forward and backward LSTM-RNN are averaged to form a single vector representation  $\bar{h}$  of the entire text, as:

$$\bar{h} = \frac{1}{2N} \left( \sum_{t=1}^N h_t^F + \sum_{t=1}^N h_t^B \right) \quad (13)$$

This vector representation of the text is then fed into a feed forward neural network as follows:

$$\hat{y}_t = \bar{h} \cdot W_{class} + b_{class} \quad (14)$$

TABLE I  
EXAMPLE OF REVIEWS FROM THE RT DATASET

Review	Sentiment Polarity
<i>an exhilarating experience.</i>	positive
<i>over-the-top and a bit ostentatious, this is a movie that's got oodles of style and substance.</i>	positive
<i>decent but dull.</i>	negative
<i>i suspect that there are more interesting ways of dealing with the subject.</i>	negative

where  $W_{class}$  and  $b_{class}$  are the weight and bias parameters of the classification feed forward network. This is followed by a softmax function, given as:

$$\text{softmax}(\hat{y}_{l*}) = \frac{e^{\hat{y}_{l*}}}{\sum_{l=1}^L e^{\hat{y}_l}} \quad (15)$$

The softmax function will give highest output probability to the highest  $\hat{y}_t$ . Additionally it will enable a discriminative training of the classification model, by maximising the likelihood of the true sentiment/opinion classes ( $l^*$ , known at time of training), as compared to all possible classes. In our experiments, we perform segmentation and classification of text containing two opinionated segments, which can be categorised into four classes as -, +, +-, ++ (with - denoting negative and + denoting positive).

## V. EXPERIMENTS AND RESULTS

In this section we first present a description of the dataset used in our experiments, followed by the details on our experiment setup and finally the results obtained from our experiments.

### A. Experiment Dataset

The dataset used in our experiments is built using sentences from the standard *Rotten Tomatoes* (RT) movie review dataset [37]. We obtained the v1.0 balanced binary dataset<sup>1</sup> containing 10,662 reviews. Each movie review presents a users opinion on a movie in about 1-2 sentences. Figure 4 shows a distribution in terms of number of reviews in the original RT dataset for different review lengths (in number of words). About 320 reviews have 5 or lesser words and about 1200 reviews have 10 or lesser words, which can be a severe problem for classical segmentation techniques based sliding windows and statistics of features in these windows. Examples of some reviews from the RT dataset are shown in Table I.

In our experiments we perform a 10-fold cross-validation using the balanced binary dataset of 10,662 reviews. In each fold 90% of the dataset (9596 reviews) are used to build our train set and remaining 10% of the dataset (1066 reviews) are used to form our test set. To build the train set for our task, we randomly sample two reviews from the 9596 reviews allocated for training and concatenate them as a training sample. It will

<sup>1</sup><https://www.cs.cornell.edu/people/pabo/movie-review-data/>

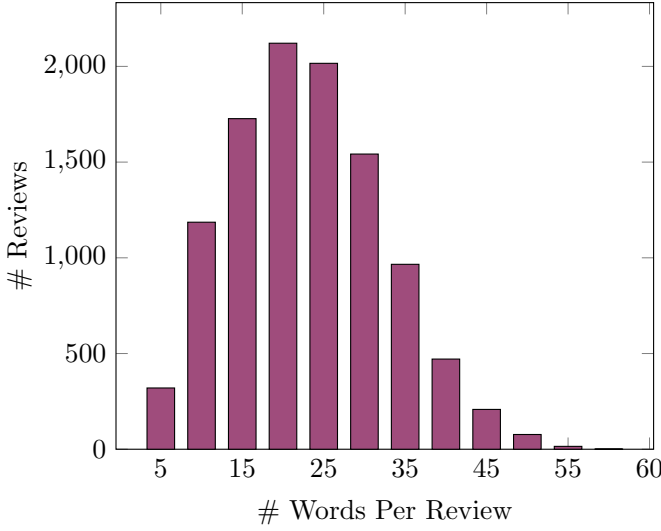


Fig. 4. Distribution of reviews in RT dataset based on review length

 TABLE II  
 EXAMPLE OF REVIEWS FROM OUR TRAIN AND TEST SET

Sample	Sentiment label	Segment boundary
<i>the jokes are flat, and the action looks fake. truly terrible.</i>	-	11
<i>a big fat pain. few films this year have been as resolute in their emotional nakedness.</i>	++	5
<i>... there are enough moments of heartbreaking honesty to keep one glued to the screen. an extremely unpleasant film.</i>	+-	16
<i>boisterous, heartfelt comedy. as green-guts monster movies go, it's a beaut.</i>	++	5

be given a sentiment label as -, +-, + or ++ (with - denoting negative and + denoting positive) depending on the sentiment labels of the individual reviews. This label will be used to train the sentiment classification part of the model, as discussed in Section IV. Additionally the length of the first review will be considered as the label for training the segmentation part of the model, as discussed in Section IV. A similar procedure is used to form our test set and its ground truth labels. Table II shows some samples from our training and test set, along with their corresponding classification and segmentation labels.

Figure 5 shows the distribution of segmentation boundaries (length of first segment) for the test set (in fold-0). This distribution is similar for test sets in all the 10 folds of validation. It indicates that the test set has segments of different lengths and difficulties to be identified.

### B. Model Training and Evaluation

As discussed in Section IV, our LSTM-RNN model operates on word embeddings. For our task the word embeddings are initialised with publicly available 300-d (300 dimensional) GloVe word vectors [64], originally trained over the Common

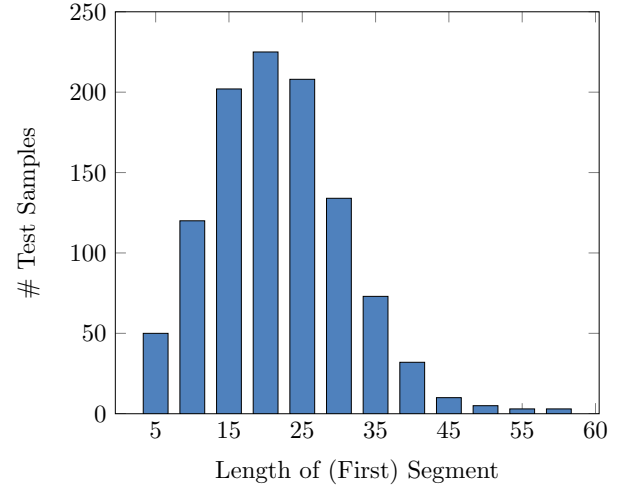


Fig. 5. Distribution of segmentation boundaries (length of first segment) for test set (in fold-0)

Crawl<sup>2</sup>. During model training these word embeddings are treated as model parameters and are updated by using back-propagation, so that the resulting word embedding representations are optimised for our task. Training of all the model parameters is performed with the ADADELTA [65] gradient descent algorithm, which provides an adaptive learning rate. For regularisation of the neural networks and to avoid over-fitting problem, we apply a word dropout [27], [63], with a dropout probability of 0.7. We also apply dropout to the non-sequential units of the LSTM-RNN, as discussed in [66], with a dropout probability of 0.5. Additionally we use an early stopping criterion which keeps a check on the classification error and it stops the model training when the error starts to increase (model over-fitting). The hyper-parameters are chosen based on experiments on the RT sentiment classification task in [27], [63].

As mentioned earlier, we perform a 10-fold cross-validation over the RT dataset. Since our task involves segmentation and classification, we will report *Segmentation Error Rate* (SER) and *Classification Error Rate* (CER), averaged over the 10 folds. The mis-classification of sentiments corresponding to the two segments (-, +-, + or ++) in a test set sample contributes to the classification errors. In segmentation, if the model gives a segmentation such that the segment boundary is more than 3 words away from actual boundary, then the segmentation is treated as erroneous and it contributes to the segmentation error.

### C. Model Performance

Table III presents the segmentation error rate and classification error rate results obtained with our proposed model. We present the results obtained with our model when trained only for segmentation, only for classification and for both segmentation and classification. Moreover we also present the

<sup>2</sup><http://nlp.stanford.edu/projects/glove/>

TABLE III  
MOVIE REVIEW OPINION SEGMENTATION AND CLASSIFICATION RESULTS

Dataset	Model	SER	CER
With full stop and comma	Segmentation Only	0.04	-
	Classification Only	-	0.33
	Segmentation + Classification	0.04	0.31
Without full stop, with comma	Segmentation Only	0.16	-
	Classification Only	-	0.33
	Segmentation + Classification	0.15	0.34
Without full stop and comma	Segmentation Only	0.22	-
	Classification Only	-	0.36
	Segmentation + Classification	0.25	0.35

results when the models are trained and tested on the dataset with full stop marks and commas, after removing full stop marks and after removing both full stop marks and commas. These punctuation marks may carry information for end of segments in the text and it is important to analyse how the segmentation model would perform with and without this information.

It can be observed from Table III, that our proposed model can perform almost perfect segmentation of opinions when the information about sentence boundaries i.e. full stops and other breaks i.e. commas are available. In this case the classification error rate is also lower and it slightly improves when the models are trained with both segmentation and classification cost functions. The segmentation error rate increases when the sentence boundary (full stop) information are not available in train and test, and the error rate reduces further when the commas are also removed. However, an error rate of only 22%, within a strict segmentation criterion of only 3 words, shows that our proposed model can perform even when the full stop and comma punctuation marks are not available. It is also observed that removal of the punctuation marks has a small effect, only 2-5% absolute, on the classification error rate.

We tried to analyse if the errors from our model are due to any particular type of segments or sentiments. In Figure 6 we present the distribution of segmentation errors (in fold-0) for model trained without full stops and commas. The distribution is plotted against length of the first segment. We can see that the distribution of segmentation errors is quite similar to the distribution of the lengths of the first segment in the test set, as shown in Figure 5. This implies that segmentation errors are evenly spread across segments of different lengths, and that the proposed model is not biased towards shorter or longer segments.

We also verified if the segmentation errors are biased towards particular type of sentiment classes (-, +, +- or ++). Again the segmentation errors were evenly distributed across these classes. The fact that the samples with same sentiment segments (- or ++), were not inducing more segmentation errors shows that our model not only learns segmentation of different type of sentiments but also segmentation of different levels of sentiments (of same polarity) and that of different contexts which carry sentiments of same polarity. We further

analysed the errors in sentiment classification and found that they are more or less evenly distributed for the different sentiment classes (-, +, +- and ++), confirming that the model is not biased towards any particular type of sentiment combinations.

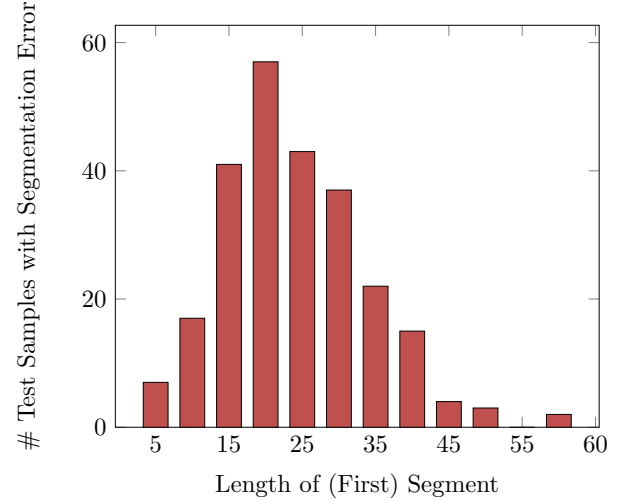


Fig. 6. Distribution of segmentation errors (in fold-0) for model trained without full stop and comma.

## VI. CONCLUSION AND FUTURE WORK

In this paper we proposed a recurrent neural network model with bi-directional LSTM-RNN, to perform joint segmentation and classification of opinions in text. Our proposed model was trained by optimizing network parameters using two cost functions, one for segmentation and other for classification. We introduced a novel method to train bi-directional recurrent neural networks for segmentation. The segmentation cost function compares the sentiment context in the past with that of the future, for every word position in the text, and uses a softmax function to maximise the segmentation accuracy. With experiments on a dataset built from the standard RT movie review dataset, we demonstrated the effectiveness of our proposed model. Our model can perform almost perfect segmentation with knowledge of full stops and comma, which carry information useful for segmentation. We also showed that the model produces good segmentation results even when it is trained and tested on data without full stops and comma.

In our work, we discussed segmentation in context of opinions in text. However, our model readily extends to other sequence segmentation tasks, for example - segmentation of topics in text and automatic speech recognition transcripts. Similarly it can be extended to speech and audio signal segmentation, by operating on automatically trained or pre-computed acoustic features. We are working on these extensions as part of our future work. Moreover, in this paper we focused our work on a sequence with two segments. In future we will extend our model to sequences with more than two segments.



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# Economic Intelligence and Knowledge Management, between divergence and convergence: Case study of Moroccan companies

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**Abstract—** In a rapidly changing environment both internally and externally, mastery of information and knowledge has become a major challenge for the organization to create value and maintain a sustainable competitive advantage (Teece & al., 1997). Economic Intelligence (EI) and Knowledge Management (KM) are two approaches for transforming information into knowledge. EI is concerned with the collection of strategic information from the company's external environment that is useful for decision-making in order to gain a competitive advantage (Williams, 2002); while KM is a process of collecting knowledge stored in employee instincts (Nidumolu & al., 2001).

In this context, the main objective of this article is firstly about the roles of the two systems KM and EI in the process of transforming information into actionable knowledge. In a second place, we examine the articulation between these two approaches, especially their elements of complementarity in order to respond to all the information issues of the company. We will defend the idea of a combination of everything that is strategic with what is tactical and operational as an objective in itself for any organization that wants to be sensitive and interested in the information culture; especially in a turbulent and uncertain environment.

An exploratory empirical study on the practice and articulation of EI and KM practices in large Moroccan companies will be carried out; whose main results will be drawn at the end of the article, concluding with recommendations and suggestions for improvements.

**Index Terms—** Economic Intelligence, Knowledge Management, Companies, Competitiveness, Financial Sector, Morocco.

## I. INTRODUCTION

In an evolving environment, the management of intangible assets has become an immense challenge for the company in order to create value and keep their competitive advantage. In recent years, a variety of companies has been forced to abandon traditional models and adopt new approaches capable of mastering scattered information and knowledge. This process of managing internal and external information has become a requirement in a turbulent and uncertain environment.

Successful organizations are the only ones that have the ability to acquire and exploit proprietary information that enables the development of competitive advantage through organizational and technological innovations (Porter, 1991). In this vision, an outward-looking approach (economic intelligence) and the inside (knowledge management) is seen as a strategic option or challenge to deal with these major changes taking place in the environment.

Firstly, the knowledge management approach (noted KM), which concerns the availability and coherence of knowledge created internally, its capitalization, its memorization and dissemination to all members of the company. Secondly, the process of economic intelligence (noted EI), which brings together all the practices of strategic intelligence (technological, competitive ...), practices of protection of the knowledge and all the strategies of influence or lobbying. These two approaches are now conceived as the focus of the abundant knowledge management system: producing, sharing, safeguarding and protecting knowledge from the internal environment (KM) and the external environment (EI).

In this framework of analysis, it seems essential to focus especially on the articulation of these two practices within the company. Hence the emergence of the main question of our research: How articulate or associate these two approaches of management of the knowledge within the company, and it is possible to imagine an integration of both Approaches?

In order to answer this question, this article will initially consist of the roles of the two information systems KM and EI in the process of transforming information into knowledge necessary for decision making materialized by of the action. In a second place, we will profile the ideal articulation between these two approaches, their elements of complementarity. We conclude this article by a set of cases of Moroccan companies deemed competent in this field.

## II. THE ROLE OF KNOWLEDGE MANAGEMENT AND ECONOMIC INTELLIGENCE IN THE INFORMATION PROCESS WITHIN THE COMPANY

Knowledge management and economic intelligence intervene in the same process of transforming information into exploitable knowledge. However, each of these approaches have different objectives and follow different methodologies within the company. EI and KM are conceived as information systems, compositions of procedures and tools oriented to learning processes that transform information into useful knowledge.

However, many terms are widely used without distinguishing them. The notions of information and knowledge are close enough and neighboring that they could be confused. In order to properly assimilate the resulting economic concepts, it is important to distinguish each concept from the other.

### A. Data, information and knowledge, what distinctions?

Gilles Balmissse (2003) proposes a distinction between data, information and knowledge through the following diagram:

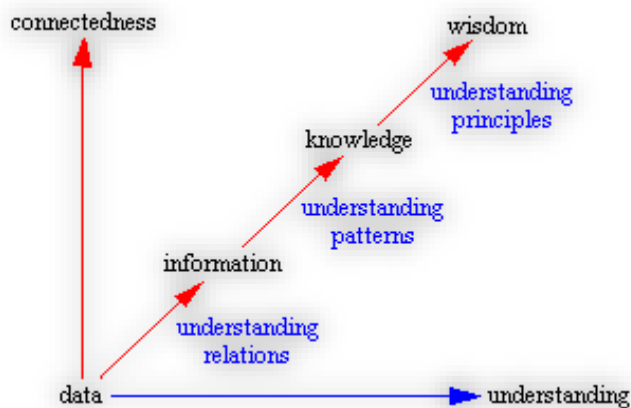


Fig. 1. Between data, information and knowledge "Model" <sup>1</sup>

#### 1) Data

The data is a raw, untreated and without context element. It does not undergo any interpretation and is collected by technical means. In computer science, for example, it is considered as a conventional representation for processing it. The data are objective facts that relate an event, such as simple observations (Davenport and Prusak, 1998). They may be numbers, words and events existing outside a conceptual frame of reference. Because of the lack of context, the data taken accordingly individually do not have much significance. However, it should be noted that the accumulation of data is therefore not information.

#### 2) Information

Information refers primarily to the action of informing, giving knowledge of a fact. It also refers to information or documentation about something or someone. It is an "element

of knowledge capable of being coded to be preserved, or processed or communicated"<sup>2</sup>.

In science, the term information also refers to what can be transmitted by a signal or a combination of signals<sup>3</sup>. Consequently, information is a social production, so that a fact becomes information it must be communicated to an audience<sup>4</sup>. The 2008 information dictionary treats information as a commodity that is salable, storable, exportable, treatable to specific needs and that can be made available to all cultures, languages and budgets. The same dictionary of information defines the term information as "a knowledge communicated for a use, by an individual for another individual, the information implies communication, that is to say an exchange of information between one or more persons. The information also implies a common code of understanding of the communicated content. Unlike knowledge, and a fortiori competence, information is external to an individual; it lives an autonomous existence and thus can easily be acquired in a market where supply and demand meet, etc."<sup>5</sup>

In decision theory, these are data that have acquired significance by being inserted into a context. It should be noted that the accumulation of data is therefore not information. According to Drucker in 2000, information is data or a series of data that makes sense. Information is also a message of a higher level of significance. It requires a medium, a transmitter and a receiver. It is also an object capable of processing, manipulation, manipulation very diverse through multiple supports.

The information is for personal use, therefore, there must be an interest for the receiver of the message, an interpretation of the data through a model:

$$\text{Information} = \text{Data} + \text{model of interpretation} \quad (1)$$

#### 3) Knowledge

Etymologically, knowledge means "to be born with". This term refers to the fact of "knowing a thing, having an exact idea of its meaning, characteristics and functioning"<sup>6</sup>. Since Platon with its famous "circle of knowledge", knowledge occupies a place of choice in philosophy; a whole theory is devoted to it. However, it is the subject of controversial debates. Ultimately, the philosophers agree on the definition of their elder Platon "Right opinion provided with reason"<sup>7</sup>. Moreover, a belief is provided with reason, when it is based on good reason to believe the thing in question.

<sup>1</sup> [Http://kmcenter.free.fr/km/connaissance.htm](http://kmcenter.free.fr/km/connaissance.htm), accessed 14 September 2016.

<sup>2</sup> L. Laville and A. D. Cattali, Dictionary of the other economy, des clés de brouwer edition, 2005.

<sup>3</sup> Dictionary Le Robert, Micro Pocket, Montreal. Canada, 1983.

<sup>4</sup> Hachette Dictionary, illustrated edition 2003.

<sup>5</sup> Serge. Cacialy, Coadic Yves-François, Pomart Paul-Dominique and Sutter Éric, Dictionary of information, edition Armand Colin, Paris 2006.

<sup>6</sup> Hachette Dictionary, illustrated edition 2003.

<sup>7</sup> Wikipedia, knowledge (philosophy) on [http://fr.wikipedia.org/wiki/connaissance\\_\(philosophy\)](http://fr.wikipedia.org/wiki/connaissance_(philosophy))

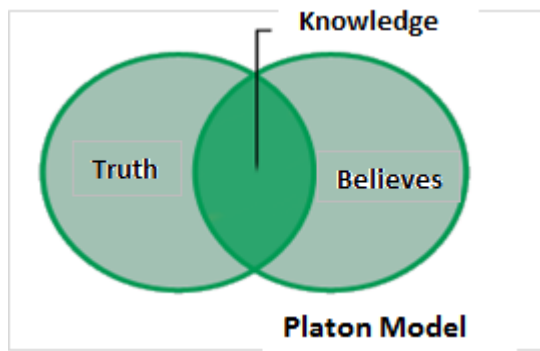


Fig. 2. The theory of knowledge according to PLATON<sup>8</sup>

This definition was later criticized for the truth of the belief, for a true belief is not necessarily knowledge. Other definitions came later to fill in its deficiencies in the definition, but none of them could be imposed. On the one hand, knowledge is the state of one who knows something. On the other hand, it is that object itself which is knowledge. Indeed, philosophy studies the cognitive sciences, as well as the rather varied processes of acquisition of knowledge such as perception, learning, experience, reasoning, memory, etc.

In epistemology, one of the branches of philosophy, knowledge is "the critical study of the sciences, of the formation and conditions of scientific knowledge"<sup>9</sup>; it is also called "theory of knowledge".

In the theory of decision, it is an information to which is added the understanding and the capacities of the individual who approves it. It should be noted that the accumulation of information is not necessarily knowledge.

In the same logic, G. Dosi (1995) makes the following distinction between information and knowledge:

--Information is a codified form of propositions corresponding to different states of the world, of properties, of explicit algorithms expressing instructions for realizing certain things.

-- Knowledge, for its part, includes a cognitive aspect, a code of interpretation of information, tacit knowledge, elaboration of algorithms and problem solving which confer a heuristic sense in the understanding of phenomena.

Davenport and Prusak (1998) define knowledge as "an evolving mix of experiences, values, contextualized information and expertise that provides a framework for evaluating and incorporating new experiences and information"<sup>10</sup>. They continue by arguing that knowledge is valuable information from the human mind that includes reflection, synthesis and a particular context.

This approach follows the following equation proposed by Manfred Mach (1995):

$$\text{Knowledge} = \text{Information} + \text{human interpretation} \quad (2)$$

This seemingly simplistic definition makes clear the explicit dimension of information and tacit knowledge. It allows seeing the part of subjectivity present in the knowledge that makes it possible to give meaning to the information, to situate it in a context according to Belmondo (2001). Finally, for Baumard (1999), knowledge is subjective because it is related to the individual or group of individuals who generates it. The modeling of knowledge in the organization shows two types of knowledge, one tacit and another explicit. Although Polanyi.M (1966) is considered the initiator, it is thanks to Nonaka.L and Takeuchi.H (1995), two Japanese experts in Knowledge Management, that the concept has been taken over and popularized. This typology has been highlighted in their book "The Knowledge-creating company, 1995"<sup>11</sup>.

--**Tacit knowledge:** The concept tacit knowledge was developed by M. Polanyi in 1958 in *Personal Knowledge: Towards a Post-Critical Philosophy*<sup>12</sup>. It shows that the development of all forms of knowledge, including in the scientific field, is inseparable from subjective experiences and "personal knowledge"<sup>13</sup>. Tacit or implicit knowledge has as a characteristic, firstly, to be internalized and therefore not communicable, and secondly, to be relative to situations or contexts of action (organizational, technological ...) <sup>14</sup>. It is therefore knowledge that individuals possess. It is not formalized and therefore difficult to transmit. These are skills, judgment, experiences, intuition, trade secrets, knowledge, tricks that an individual acquired and exchanged during relationships within his or her organization.

Nonaka and Takeuchi maintain that this tacit knowledge exists in the human mind symbolically. It is intimately tied to the individual's experience and is made up of intangible factors such as insight, subjectivity, beliefs, values, personal vision of the world, tricks and emotions. The subjective and intuitive nature of tacit knowledge makes it difficult to process or transmit in a systematic way. Closely related to the collaborators who hold it, tacit knowledge is the most widespread form of knowledge in companies or organizations. Many authors admit that it represents 85% of the overall knowledge of an organization. It should be emphasized that if tacit knowledge is to be communicated and shared in the organization, it must be converted into words or numbers that can be understood by all members of that organization. This process of conversion from tacit to explicit is called articulation or formulation.

<sup>8</sup>[http://fr.wikipedia.org/wiki/Th%C3%A9orie\\_de\\_la\\_connaissance](http://fr.wikipedia.org/wiki/Th%C3%A9orie_de_la_connaissance), accessed July 25, 2012.

<sup>9</sup> Hachette Dictionary, illustrated edition 2003.

<sup>10</sup> H.Davenport, L.Prusak, *Working knowledge: how organisations manage what they know*. Boston: Harvard Business School Press, 1998, page.199.

<sup>11</sup> Ikujiro Nonaka & Hirotaka Takeuchi, *The Knowledge-Creating Company: How Japanese Companies Create the Dynamics of Innovation*, Oxford University Press, 1995.

<sup>12</sup> Michael Polanyi, *Personal Knowledge: Towards a Post-critical Philosophy*, University Of Chicago Press, 1962.

<sup>13</sup> [http://www.wikiberal.org/wiki/Connaissance\\_tacite](http://www.wikiberal.org/wiki/Connaissance_tacite)

<sup>14</sup> <http://www.veilleinfotourisme.fr/difference-entre-connaissance-tacite-implicite-explicite-codifiee--34836.kjsp>

--**Explicit Knowledge:** It is formalized and transmissible knowledge in the form of reusable documents or supports. It gathers information, scientific knowledge and facts that can be codified, articulated and thus transferred formally through systematic methods such as rules and procedures according to the observations of Nonaka and Takeuchi (1995) as well as those of Polany (1966). Explicit knowledge is thus stored in the objective world, in directories such as books, manuals, databases, Intranets, notes, computer programs in the form of studies, reports, e-mails, newspapers...It is important to note that while explicit knowledge can be easily expressed in documents, it is less likely to lead to major innovations than tacit knowledge, which is the real source of innovation.

### B. The role of Economic Intelligence (EI)

Let us recall here the definition of Henri Martre (1994), "Economic intelligence can be defined as the set of coordinated actions of research, processing and distribution with a view to its exploitation, information useful to economic actors. These various actions are carried out legally with all the guarantees of protection necessary for the preservation of the company's assets, under the best conditions of quality, time and cost ..."<sup>15</sup>. Moreover, Alain Juillet<sup>16</sup> who adds that economic intelligence is the mastery and protection of strategic information for all economic players and for a triple purpose: the competitiveness of the industrial fabric, the security of the economy and companies and Strengthening influence; to conclude that economic intelligence thus covers both anticipation, protection of information and lobbying:

--Anticipation thanks to monitoring which can take various forms (environmental, legal, competitive, technological, commercial, accounting and financial), but which is always at the service of a strategy.

--Protection of the information and in a wider way of all the knowledge and the strategic assets belonging to an organization (deposit with the OMPIC, setting up of specific insurance contracts, information...).

--Lobbying and communication of influence.

Hence, elements are essential to economic intelligence:

--Technology: it allows the search, processing and distribution of information.

--Strategy: useful information is what the various decision-making levels need.

--Know-how: order actions around an uninterrupted cycle, generating a shared vision of the objectives of the company. This triplet gives every organization the ability to:

--Manage and exploit information, giving it meaning.

--Protecting its intangible heritage (protection of the capital of information, knowledge, and defense of the image ...).

--Act proactively on its environment (actions of communication, influence, promotion of the image, lobbying...).

If one adopts the definition of Alain Juillet, "the control and protection of strategic information for the purposes of

competitiveness", economic intelligence is really translated into a decision problem where information is the axis Central to the approach. Information is therefore essential for the decision-making process in the process of economic intelligence. The decision is materialized at the end of the process by action.

### C. The role of Knowledge Management (KM)

"Knowledge Management", "KM", or "Corporate Memory" are all terms used and designate the same concept: capital management intellectual organization.

Gilles Balmisse (2003) considers that "the confusion engendered by the existence of many terms to designate the same concept is accentuated by the different cultural approaches that knowledge management can have. Indeed, the introduction of a knowledge management approach is not universal. It is highly dependent on the culture of the country in which the company is located. In Japan, knowledge is essentially retained by employees in tacit form, while in the United States, the explicit aspect of knowledge is predominant and the technological aspect is fundamental. As for Europe, the approach is still in the research and development stage"<sup>17</sup>. Knowledge management concerns the identification and analysis of available and required knowledge and planning and control actions to develop knowledge assets to achieve the objectives of the organization (Macintosh, 1996). It amounts to provide the right knowledge to the right person at the right time so that it can make the best decision (Petrash, 1996).

Firstly, knowledge management is asserting itself in companies as a major stake because knowledge is a strategic resource and it provides a decisive competitive advantage. Secondly, the new technologies of information and knowledge offer new solutions to exploit knowledge.

A study by the Harvard Business Review "Knowledge Management: Philosophy, Process, and Pitfalls". Alternatively, gain a competitive advantage with the approach of the Knowledge Management application skills to create, move, assemble, harmonize, integrate and use information and knowledge. A company that makes knowledge management frequently use the most developed information and communications technology to make this transformation of information in useful knowledge, namely:

--The **Data warehouse** system for storing information.

--The data organization system such as an **ERP**, which classifies and give meaning to information.

--The data selection system as a **Datamining**, which draws the relevant information stored in the companies.

--The network system as an **Intranet**, for taking and distributing information.

--The electronic mailing system documents to the persons concerned as **Workflows**.

--The teamwork system as a **Groupware**, instrumented by software designed to improve communications tools, coordination and cooperation.

<sup>15</sup> Report of the General Commission of the Plan of 1994, "Economic Intelligence and Business Strategy" ("Martre" report).

<sup>16</sup> High official in charge of economic intelligence to the French Prime Minister appointed in 2003.

<sup>17</sup> G. Balmisse. Knowledge Management and Computer Tools. Paris: Knowledge Consult, 2003, page 06.



### III. THE ECONOMIC INTELLIGENCE (EI) AND KNOWLEDGE MANAGEMENT (KM): WHAT RELATIONSHIP?

#### A. The differences between the two approaches

The combination of appropriate economic intelligence and effective knowledge management will allow the transmission of the right information to the right person at the right time. Despite the intersections and the relationship between these two approaches, each has unique properties that differentiate it from the other as indicated in the table below:

TABLE I  
A COMPARISON BETWEEN KM AND EI<sup>18</sup>

Knowledge management	Economic Intelligence
Internal	External
Reactive	Proactive
Long-term perspective	Short-term outlook and long-term
Technology-based	Source-based
Depends on the skills (employees)	Environment (PESTL <sup>19</sup> )
Will and contributions of employees	Data, information, knowledge
Knowledge and information	

This table shows that there are real differences between the two KM and EI processes:

--KM is a process that focuses rather on internal information and knowledge resources. While EI is a process that focuses on external information and knowledge resources.

--KM tends to be more reactive in nature. However, EI tends to be more proactive especially in predicting the evolution of competition and the market.

--KM is associated with collaborative computing media that allow the sharing and dissemination of knowledge through applications such as groupware. Other parts, EI is more concerned with the primary and secondary sources of information for strategic decision-making.

--KM depends more on the willingness of employees through their knowledge and expertise regardless of technology provided by the organization. While EI depends on a wider field that is the policy environment, Economic, Societal, Technological and Legal (PESTL).

The process of processing information seems interesting to explain how these two practices work. In order for the information collected to be useful to the company, it must not remain gross. It will therefore undergo a thorough treatment so that it reveals its true wealth. This phase of information processing, because of its strategic nature, reflects the approach of economic intelligence. It is based on analysis and synthesis that the information gathered by the company can be transformed into knowledge useful for decision-making. Economic intelligence, designed to capture strategic information for the company, has a perimeter whose outlines are defined by the company's managers: actual and potential competitors, innovations in the activities developed by the company, technological evolution in the present, neighbor or potential domains of the company, risk management...

It has more precise objectives than the KM because of its history related to the day before.

However, the information dissemination phase is concise for EI since it is by definition at the strategic level of the company (the managers) but it is broad for the KM since it concerns all the players in the organization. The KM relies on knowledge management tools that enable the company to increase the value it creates by enabling the transformation of raw information into capitalized, disseminated and activated knowledge. It allows the sharing of knowledge, an objective that does not have economic intelligence, which preserves and protects this knowledge within a well-defined sphere of the company (the leaders).

From a technical point of view, the techniques of EI of those of the KM remain very distinctive. Some authors confirm this. For example, J. Okkonen & al. (2002) consider that EI technologies are devoted to the collection and analysis of information and KM to information and skills management. In the same sense, TR. Herschell and NE. Jones (2005) stipulate that EI technologies are those that deal with structured information for decision-making in the organization, while those of the KM are devoted to management and processing of unstructured information.

#### B. The convergence between the two approaches

As explained earlier, KM and EI have a single objective of strategic information and knowledge management based on crosscutting dissemination for effective decision-making. They bring together several activities connected together by information flows organized over time and whose only intersection makes it possible to conquer information and knowledge that can be actuated.

The process of transforming information into meaningful knowledge is to note on the one hand that EI's approach, by gathering information in the external environment of the company, fuels the KM process. On the other hand knowledge management offers the company a very important knowledge reservoir serving as a support for EI in order to select the most relevant and exploitable ones.

As a result, it can be seen that this complementarity between KM and EI is based on a triple human, technical, and organizational fit:

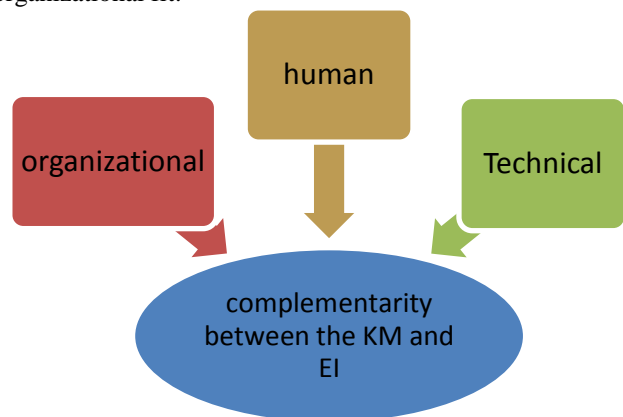


Fig. 3. Complementary elements between the KM and EI<sup>20</sup>

<sup>18</sup> Katherine Shelfer, Drexel University, 2004

<sup>19</sup> Political, Economic, Social, Technological, Legal and Ecological.

<sup>20</sup> Graph made by the author

1) **Technique:** C. Cook and M. Cook (2000) were already discussing the convergence between EI and GC technologies as both processes manipulate information technologies to acquire, store, produce, disseminate Information and knowledge. Data management techniques (datamining, data warehouses), collection and selection of knowledge (search engines), their dissemination (intranet, workflow) and collaborative tools generating new knowledge (groupware) and collaborative tools generating new knowledge (groupware). The integration of the two types of technologies, according to these authors, allows them to benefit from the two approaches.

2) **Organizational:** The KM manages the past and present knowledge of the company while the EI detects the strategic information vital to the future of the company, information that will be at the origin of the KM of tomorrow. It serves as a rudder to the KM to limit the risk of obsolescence of knowledge that would be focused on the internal environment of the company. In this sense, it seems to us that KM is more focused on the exploitation of existing knowledge whereas EI provides a cognitive framework for the exploration of new knowledge more suited to breaks in the trend.

3) **Human:** The importance of individual competences and the involvement of the actors in these two approaches.

Let us recall here the vision of F. Blondel & al. (2006) who see EI focus on information and knowledge external to the company and KM for internal information and knowledge. From a complementary standpoint, this distinction is not always clear, especially when attempting to apply this vision to the extended enterprise or to a cluster of firms or a cluster of competitiveness. However, for these authors the approximation of EI and KM can be done from two angles of view: the first is to note that EI, by collecting information in the external environment of the EI, Enterprise, fuels the KM process ". While the second "makes the KM the information system supporting EI, making it possible to extract the relevant information available within the company (database, people, and documentary databases) for strategic decision-making". To continue in the nuances of this convergence and complementarity of the notions of IE and KM, we point out the approach of D. Bretonès and A. Saïd (2006) which integrate them in a complete cycle making the KM the first essential step of the introspection of the organization before any EI process. Other authors such as A. Guilhon the Frammer Du Hellen (2003) already proposed that the KM "would have become the ultimate stage of economic intelligence, considered as an organizational process of information processing in order to create new knowledge ".

### C. Towards a pooling of the activities of the two approaches

The notion of "network" seems to be the key word for this mutualization of the activities of the two approaches. Mutual recognition and the creation of shared knowledge are the central concepts of such a device. These two aspects are the guarantee of the effective participation of the actors of the two approaches and the basis of subsequent communication between actors. Sharing requires effective cooperation, operational over time with periodic and / or continuous adjustments. However, the different definitions of cooperation that exist are always attached to other notions such as "collaboration" or "co-

decision". This conceptual tryptic constitutes an indispensable device for setting up a networked work.

TABLE II  
CONCEPTUAL TRIPTYCH OF NETWORKING

Hierarchical Levels	Definition
<b>Cooperation</b>	The cooperation appears when individual actions contribute to the actions of the other and vice versa.
<b>Collaboration</b>	Collaboration is about working together in the execution of a certain action, generating a common understanding and shared knowledge. The result is thus attributable to the entire group
<b>Co-décision</b>	The co-decision concerns the group decisions or inspired by the group, the players being either undifferentiated or with special status. The credibility and the creation of shared knowledge and mutual recognition are as important as cooperation.

In addition to the bases of the complementarity between the KM and the EI as already mentioned above and which form a triple human, technical and organizational suitability, a set of major difficulties arise in the operationalization of the activities of the two approaches.

Because of their different origins, potential difficulties may emergence, particularly in the following points:

- Expressions of information needs
- Identification of stakeholders
- Research, collection and storage of data
- Analysis, processing and validation of information
- Dissemination of information
- Evaluation and adjustment processes
- Coordination of actors
- Coordination of activities

## IV. CASE STUDIES OF MOROCCAN COMPANIES

We propose, in order to go deeper into understanding the two practices, to compare our conceptual framework with four cases of large Moroccan companies. We present the methodology chosen, the cases studied and the main empirical results.

### A. Methodology chosen

Our epistemological positioning corresponds to an interpretative logic and our reflection is part of a qualitative approach. This mobilized methodological aspect is based on a documentary analysis and an exploratory study of the cases of large Moroccan companies. If the phases of exploration and observation allowed us to design the framework of our research; it was a semi-directive interview lasting an hour on average with the directors and managers EI and KM that we made a long and thorough investigation deep through the collection of the rich elements, and which are the subject a more formal analysis. A maintenance guide was pre-treated, based on the questionnaire to collect mainly the qualitative and quantitative data, opened, closed or semi-closed, the questionnaire was administered directly to the heads of departments responsible for information management, in order to collect accurate information about the reality studied. The main topics covered are the characteristics of the respondent, the practices of EI and KM, the nature of the relations between EI and KM in the

company, the convergence of the two approaches as well as the prospects for development.

The practices of EI and KM are largely sensitivity and confidentiality. These are two practices on which very few companies agree to communicate. For the same reasons, we voluntarily assigned fictitious names to our studied cases. To process the results we used the SPSS version 16.0, as well as the software Sphinx Plus<sup>2</sup> specialized in the processing of questionnaires. The method used to analyze the data is the method of content analysis. In a first step, we carried out a vertical analysis of each interview using a thematic dictionary. We then conducted a horizontal analysis of all the interviews.

#### B. Presentation of Case Studies

We will deal, in the table below, with the characteristics of the activity of the studied companies and the organization of the services in charge of the management of the information within each one:

C1	<p>C1 is a leading institution in the Moroccan banking landscape. It has embarked on a dynamic of growth both in Morocco and abroad.</p> <p>It has a well structured EI and KM cell with members specifically assigned to information management activities (documentalists, archivists, librarians ...). This shows that she is aware of the stakes and importance of intelligence.</p> <p>These devices are an informational medium that observes and analyzes the sectoral environment, whose main task is to accompany managers in decision-making, to provide them with a global vision of their environment, by providing them with relevant information deemed to reduce The risks and relating to sector delimited.</p>
C2	<p>C2 that is a public limited company listed on the Casablanca Stock Exchange with a board of directors and with a fixed capital. It undertakes the following operations: Collection of resources, distribution of credits and marketing of banking products.</p> <p>Aware of the importance of information in its business, C2 has set up structures dedicated to information: a strategic intelligence unit, a data bank service, a Research &amp; Development department. These services are responsible for:</p> <ul style="list-style-type: none"> <li>--Analyze economic, financial and social information and monitor national economic news.</li> <li>--Monitor the evolution of the international environment and assess its impact on the competitiveness of the national economy.</li> <li>--Establish and develop forecasting and modeling tools.</li> <li>--Set up, use a process of collection, processing and dissemination of information and knowledge in the company.</li> </ul>

C3	<p>C3 is one of the top five leaders in the national insurance market. Thanks to its 65 years of experience and the wealth of its human capital, it has managed to stand out and gain a foothold in a sector as competitive as insurance and reinsurance. As the leading insurer of industrial risks and leading-edge risks, C3 strengthens its position as a maritime insurer and has a strong ambition to develop individual and professional segments, including PME's and PMI's. C3 is aware of the EI dimension and the KM is considered to be a strategic process with the ultimate goal of making a decision at an appropriate time. Its budgeting is necessary.</p>
C4	<p>C4 is a Moroccan commercial bank subsidiary of a French group. He has three main lines of business: network banking, corporate, investment banking, and asset management. The complementarity between these different activities constitutes a major commercial asset and a guarantee of financial soundness.</p> <p>Given that information is increasingly becoming a strategic weapon of competitiveness in an evolving environment, and aware of the importance and significant contribution of information management to its operation. C4 is in the process of introducing a An operational sector monitoring system enabling it to monitor all developments in the banking sector, anticipate changes, assist in decision-making and assess potential risks in order to maintain its sustainability.</p>

Establishment of EI and KM cells in the companies studied is very recent. These are entities of very small size, which depend directly on the general management. The organization of these two practices is very different from one company to another. The missions attributed to the improvement of the quality of information are in general very close:

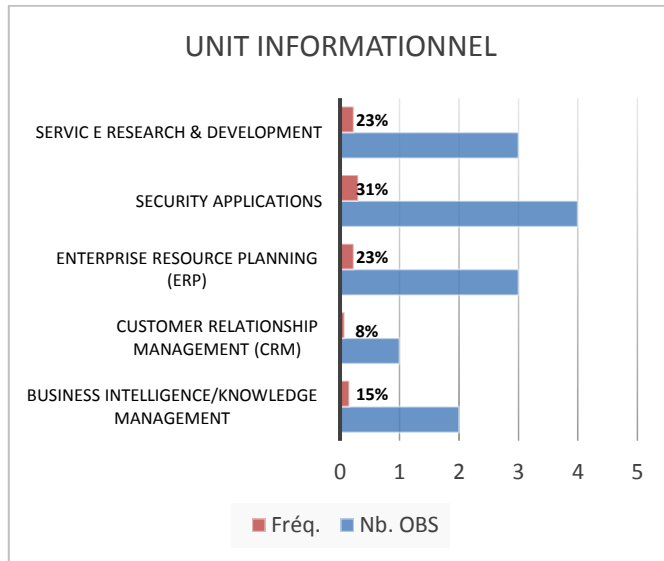
- Improved customer relations and loyalty through the detection of preferences and behavior.
- Better visibility of internal data processing processes.
- Faster and more judicious decision-making.
- Development of products, services offered, and their personalization.
- Improved compliance.
- Forecast sales and revenues.
- More flexible collaboration between teams and departments.

### C. Empirical Results

We present here the results of an exploratory study on the articulation of the practices of EI and KM in the three cases of large Moroccan companies. The first results on these practices, through a thematic analysis of interviews with EI and KM officials, helped shed light on the stumbling blocks and convergence forces.

#### 1) Institutionalization of information units

*Does your company have the following information units?*

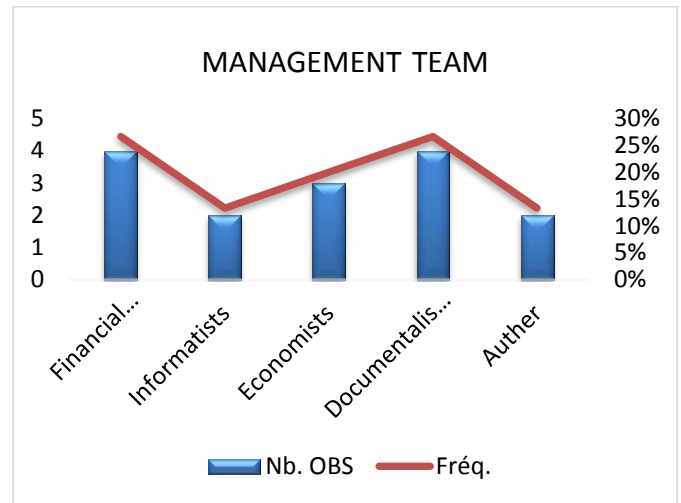


The nation's will to officially introduce KM and EI practices into the Moroccan entrepreneurial fabric is apparent only in the 2000s; So they are extremely recent processes. The majority of Moroccan companies studied have set up information management units within their organizational chart to convert R & D into compulsory support for the creation of value, wealth and strategic advantages.

Half of the executives interviewed said the information was not adequately hierarchical. Consequently, consolidating this information and providing performance indicators are considered necessary measures that these different information units must take to ensure the quality of the decision-making.

#### 2) Management Team

*What profiles are responsible for managing information in your company?*

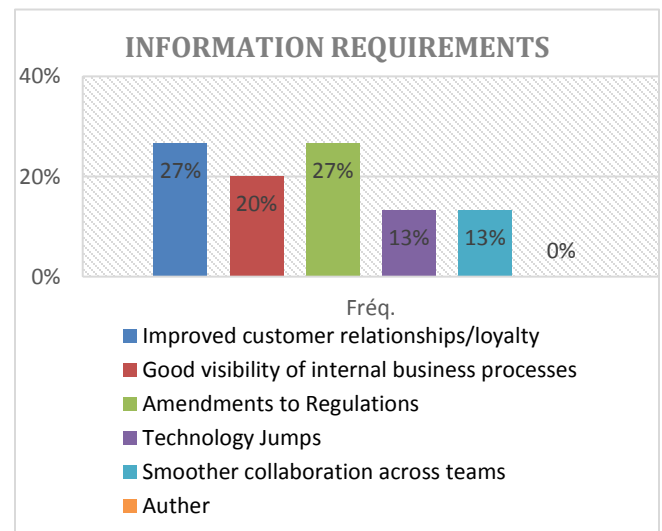


At the level of human resources, the involvement of the actors and the role of the management team of these two cells is evident. The entities of EI and KM have members specifically assigned to information and knowledge management activities (economists, computer scientists, financial engineers, analysts and documentalists).

However, the network of EI collaborators is denser because it is divided between the organization of the company and its external environment. Conversely, the KM network is located only internally, and involves fewer actors. Likewise, the involvement of the actors differs between voluntary adherence for the KM and adherence almost obligatory for the EI.

#### 3) Information needs

*What are the interests of an EI and KM cell?*

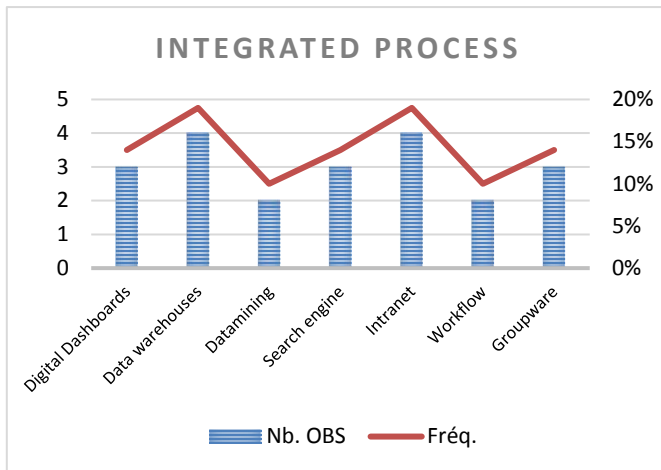


The process of EI and KM always starts with a definition of the information needs of the company. Knowledge systems have been set up in the context of conquering new markets already open to competition.

27% of business leaders cite know the preferences and behavior of customers where they will need to make the most effort to improve the quality of information in the coming years.

#### 4) EI and KM processes

**What are the processes used for strategic knowledge research, analysis and dissemination?**

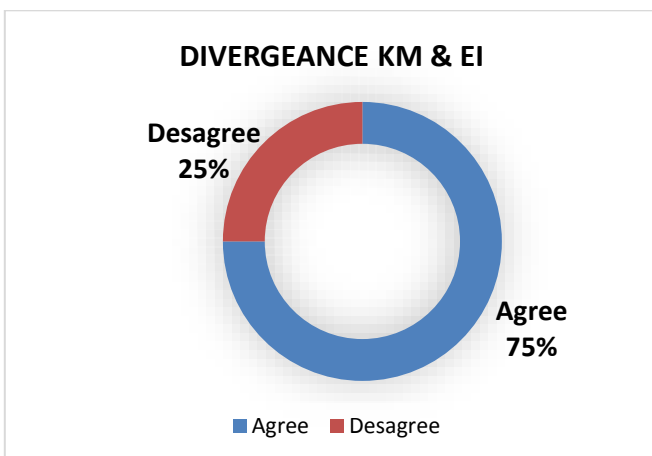


Moroccan companies are always looking for computer instruments (digital dashboards ...) enabling the personnel in charge of information management, to extract valuable information. According to the study, these are database management tools (data warehouses, datamining), collection and selection of knowledge (search engines), dissemination (workflow, intranet) and Collaborative techniques that create new knowledge (groupware).

Therefore, KM could be used to serve the EI process or could be designed as a provider of EI's technical infrastructure; The KM methodology (maintaining collaboration, accumulating knowledge) will develop the technical infrastructure choices and EI has been informed about these technical choices and information tools implemented. This finding has been proved by (Knip, 2004) in the sense of merge or design the terms of KM and IE in the same activity.

#### 5) Points of divergence between KM and EI

**Do you agree with the following statement: Knowledge Management and Economic Intelligence, is there a difference? And how?**



Indeed, both EI and KM rely on the development of the activity of these companies studied both internally and externally. However, beyond this apparent correspondence, certain differences have been noted in our study.

This convergence appears mainly in the different purposes attributed to each of the two approaches: KM aims to make knowledge management more efficient to improve the internal functioning of the company. On the contrary, EI aims to improve the decisions of the strategic direction. Therefore, these distinct goals separate the two entities from a more adjusted organizational and human collaboration. Finally, the area of intervention of the KM and IE is not the same. The KM cell intervenes following the solicitation of a service with the aim of accompanying it in setting up a new methodology that promotes the transformation of information into knowledge by the actors (distribution, capitalization, decision). Yet the involvement of the EI cell is mobilized on a long-term and long-term basis and it participates in-depth in the process of producing actionable knowledge.

#### 6) Difficulties in appropriating the two approaches:

Half of the companies surveyed report being dissatisfied with the management of strategic information that they have and that have problems related to:

- Lack of integration of the watch into decision-making.
- Lack of human resources or absence of personnel responsible solely for the management of information.
- Lack of language skills to exploit information or documents in rare languages (Japanese, Chinese, etc.), which is an obstacle to good international market surveillance.
- Insufficient technical and material resources.
- Scarcity of relevant information and delay in receiving it.
- Difficulty in identifying sources of information.
- Retention of information as a hindrance to monitoring the current international environment
- Legal and ethical difficulties.
- Very high cost to access the information sought.

## V. CONCLUSION

Our documentary and bibliographic study deals with the articulation between economic intelligence and knowledge management. The analysis tends to affirm the convergence of the two practices. EI and KM are indeed part of the same process of transforming information into actionable knowledge in order to improve the competitiveness of the company.

However, the first results of our study invite us to put this "theoretical" convergence into perspective: the two approaches diverge widely on two elements: the human resources component and the organizational component: their functions and practices differ; they intervene at phases of the knowledge management process and mobilize different actors.

The body responsible for EI is more involved in the transition from knowledge to action and remains focused on top and middle managers, while the one in charge of KM focuses on the phases of knowledge creation and mobilizes more the operational level. This requires complementarity. To return to the idea of Knip (2004), EI without KM or KM without EI may prove inefficient for the organization or even dangerous. This would deprive EI of its support or the KM of its rudder ... This convergence we recommend in the form of mutualization of the two processes within the organization, this mutualization suggests in our sense a fundamental notion which is the notion of networking, hence a sustained effort in terms of coordination of both And activities.

In such an approach, the human component remains the triangular stone of all success. Because of this, we return to the idea of Alain Juillet affirming, "EI is a state of mind".

Therefore, it is a whole state of mind that must be changed. Moreover, it is the same for knowledge management, so the two approaches are very sensitive and even responsive to the managerial culture and more specifically the information culture within the organization. The fundamentals in this new state of mind marking this advocated management culture centered on information are:

- Information is valuable
- Information develops in a collective culture
- Information is a raw material
- Information is a means of action

In the case of Moroccan companies, a great effort remains to be made in this direction, not all share the same degree of importance to the information heritage. A main constraint is not technical or organizational but remains a constraint of a human and more specifically cultural. We recommend a major project of upgrading and sensitizing the managers and administrative staff of Moroccan companies to the information culture in the company and especially of the enormous potential advantages for the company. We believe that the main players involved in this project in the Moroccan context are:

- The General Confederation of Enterprises of Morocco "CGEM"
- Ministry of Industry, Trade, Investment and Digital Economy;
- Ministry of Foreign Affairs and Cooperation (embassies and consulates of Morocco abroad)
- Ministry of Higher Education, Scientific Research and Training of Executives
- Research Center
- Think thank Moroccan

- Moroccan residents abroad
- Information Market
- Other administrations.

Finally, the effectiveness of a company depends on its ability to produce, distribute, maintain, refresh and protect all the knowledge resulting from its internal environment (knowledge management) as well as its external environment (economic intelligence). Hence the idea that we defend in our thesis and which consists in integrating the KM into the processes of the EI, thus the EI will help to feed the KM in information and knowledge; And in parallel the KM will become a useful source of information in strategic decision-making.

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# Lean IT Management To Service Operation Processes: Towards An Added Value Without Wastes

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**Abstract**—This paper proposes a management model by LEAN for Information Technology (IT), especially, in the context of service operation processes. In order to avoid potential wastes. The classic management of the events, incidents, access or problems, generates various wastes which impact on the golden triangle of cost, time and quality. Consequently, customer satisfaction. In technological environment, the service operation phase is visible part of the iceberg, through which customers perceive add-value. The proposed LEAN IT management Model aims to improve productivity and profitability, just by deleting of the wastes sources.

**Index Terms**—Lean IT Management, Wastes, Service Operation Management,

## I. INTRODUCTION

IT Service Management is performed by IT service providers through an appropriate mix of people, process and information technology [7]. One of the biggest challenge in IT management service is better respond to customers needs and just-in-time(JIT). To achieve this goal, is paramount to adapt a continuous improvement approach. LEAN IT Management can be seen as a accelerator to achieve this level maturity [19]. Our choice to apply Lean management to Service Operation has as goal to identify and eliminate sources of productivity loss and wastes in daily activities. Thus, the focus is on service operation of the Information Technology Infrastructure Library (ITIL), based in the fact that ITIL has proved the best adherence to Information Technology Service Management [5]. In service industry in particular around to Information Technology, any firm seeking to develop there, must adapt the New methods and tools to map the complexity of IT infrastructure resources and business processes, in order to adapt customers needs, and IT infrastructure capacity dynamically. Although emerging organizational models and business strategies can be driven by digital platforms and IT infrastructures [18]. In the following paragraphs we will give some more details on lean approach while proposing our Macro LEAN IT model.

## II. LEAN IT

The concept of Lean was first introduced by (Womack, Jones and Roos,1990) in order to describe the working philosophy and practices of the Japanese vehicle manufacturers and in

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particular the Toyota Production System (TPS) in the context of a study conducted by Massachusetts Institute of Technology (MIT), however the concept of Lean was more extensively defined and described by five key principles (Womack and Jones, 1996)

- Specify value : Specify what creates value from the end customers perspective.
- Identify value Streams : Map the value stream to understand value and non-value added steps.
- Make value flow : Make the remaining value creating steps flow.
- Let the customer pull value : Schedule the work based on customer pull.
- Pursue perfection : Strive for perfection by continually removing successive layers of waste.

The ultimate goal is to provide perfect value to the customer through a perfect value creation process that has zero waste [3]. Although the lean management can be applied to any system or process to identify areas of weakness and them improve thereafter [11]. In 2003 Mary and Tom Poppendieck in their book Lean Software Development: An Agile Toolkit were mentioned for the first time the application of Lean in the computer industry, they proposed using Lean practices in the information systems (computer architecture, software development. . . etc). Namely that Lean management especially, in scientific research is relatively new on IT horizon.

### A. Wastes

Waste is work that adds no value to a product or service [18]. Three major categories of the wastes have been identified by (Taiichi Ohno) and reported by (Womack and Jones) consist the core of the Lean Approach. The major Type of the Waste is the MUDA it contains seven waste categories following:

- 1) Over production: Product beyond what the customer has ordered [16].
- 2) Waiting: Sometimes referred to as queuing and occurs when there are periods of inactivity in a downstream process because an upstream activity has not delivered on time [11].
- 3) Extra processing: Extra operations such as rework, re-processing, handling or storage that occur because of defects, overproduction or excess inventory [11].
- 4) Inventory: All inventory that is not directly required to fulfill current customer orders [11].

Operation Management	Wastes Categories							Sources of the Wastes
	Waiting	Sur-Processing	Over-Production	Rework	Transport	Motion	Inventory	
Event Management	✓	✓			✓		✓	<ul style="list-style-type: none"> <li>•Demande variability customer</li> <li>•Excessive use of services in specific periods</li> </ul>
Incident Management	✓	✓	✓	✓	✓	✓	✓	<ul style="list-style-type: none"> <li>•Work waiting to be reviewed/approved/forwarded</li> <li>•Not understanding user/customer requirements and expectations, thus delivering ineffective solutions</li> </ul>
Problem Management	✓			✓			✓	<ul style="list-style-type: none"> <li>•Inadequately tested changes to service and systems</li> <li>•Defining service strategy without the stakeholders opinions</li> <li>Take technical decision without the presence of technicians</li> </ul>
Access Management	✓						✓	<ul style="list-style-type: none"> <li>•Delays between realization and verification</li> <li>•Excess information on local and shared drives</li> <li>•Unauthorized changes to service and systems</li> </ul>
Request Management	✓	✓					✓	

Fig. 1. Wastes categorization in Operation Management

- 5) Motion: Motion takes time and adds no value to the product or service [11].
- 6) Transport: The movement of product between operations and locations [11].
- 7) Reworks: Finished goods or services that do not conform to the specification or customer's expectation, thus causing customer dissatisfaction [11].

However wastes in IT are not easy to detect Because there is several crisscross of the automatic processing, and that of the human. But there are often result a deviation. Fig 1 shows the mapping between Operation management processes, Wastes, and deviations sources.

### III. OPERATION MANAGEMENT

In ITIL framework the Service Operation (SO) includes guidance on achieving effectiveness and efficiency in the delivery and support of services so as to ensure value for the customer and the service provider [14] In operation service phase, the IT-staff, management team, and customers have more exchange [1], through the requests fulfilling and incidents or problems solving. These interactions generate de several wastes. Those processes will be defined from the framework of best practice.

#### A. Service Operation Processes

The daily operations management from IT infrastructure, including five relevant basic management processes: Event management, Incident management, Problem management, Request management and Access management [20].

- Event Management : Monitoring and directs all event.
- Incident Management : concentrates on restoring the service as quickly as possible.
- Problem Management : involves root-cause analysis to determine and resolve the cause of events and incidents [14].
- Access Management : authorized users the right to use a service.
- Request Management : management of customer or user requests.

During our inquiry from the professional committee , it has been noted that these processes represents a rigidity and a lack of flexibility. So that means, they cannot adapt to customer's request variability and technological change. Consequently, it increases backlog of the reworks and inventory, show Fig1.

### IV. LEAN IT OPERATION MANAGEMENT

At this stage of the work it became clear that operation Management of IT service processes as an is described in best practices literature, assure not the best productivity. Our proposed model aims a continuous improvement approach for increase efficiency in daily operation, Show Fig 3. This model can be seen as layout that establishes an innovative routine in the business.

#### A. IT Service Operation Wastes

Since the event notification at a request fulfillment, several wastes have been detected, in Fig 2 opposite we were identified wastes sources in every categories of operation Management.

In event management the Demands variability customer and excessive use of services in specific periods, which

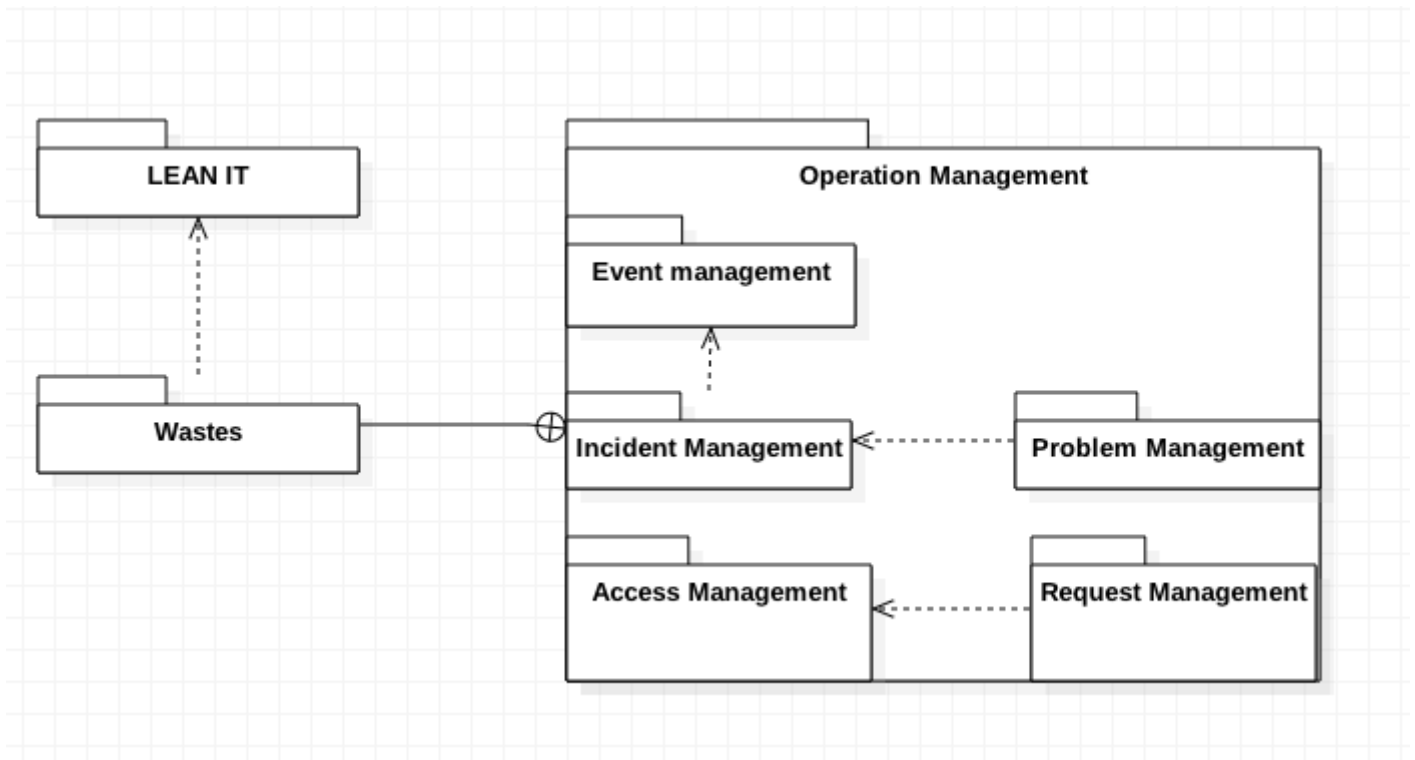


Fig. 2. Marco Lean IT Management Model

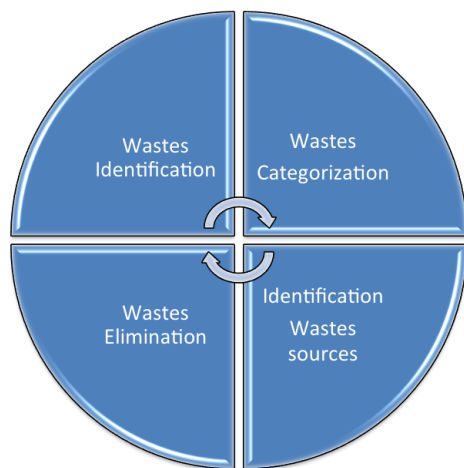


Fig. 3. Improvement Lean IT Management Model

generates the waiting, sur-processing, transport and inventory. In incident the not understanding user/customer requirements and expectations, thus delivering ineffective solutions may be caused any type of deviation. In addition, Inadequately tested and Leaving out important stakeholders generate waiting and reworks in problem management. Moreover, Delays between realization and verification impact the Access management. Finally, Unauthorized changes to service and systems and Excess information on local and shared drives shows a waiting,

sur-processing and inventory wastes in Event Management.

#### B. Macro Model to Service Operation improving

The proposed mode of LEAN IT improvement based on four steps. Show Fig 3. Firstly, Identify unnecessary activities in supply chain value [21]. Secondly, categorization, finally begin our diagnostic in order to eliminate waste sources. At last, deleting de variability which caused these wastes. This approach substitutes the Deming cycle (PDCA) for continuous improvement. The ultimate goal is the establishing a correlation between the level of maturity and continuous improvement and organizational problems and routines [10].

#### V. DISCUSSION

A typical application for strategy instruction as has been described in the standards references [13] does not guarantee for success, but rather innovate in order to conceive a specific approach and pragmatic for root out waste and inefficiency. In this study were selected Major productivity loss and variability which causes them. In addition, we propose a bottom-up approach opposite of top-down approach in the best practices frameworks such as Service continuous improvement [15]. In a previous work, Professor Ben Hicks (UK) highlighted four sources of waste in an information system which are: (Failure demand, Flow demand, Flow excess, Flawed flow) [11]. which explains that, it exists a correlation between the sources of wastes and information flows.

## VI. CONCLUSION

Lean IT Management is an accelerator to achieve the highly level of maturity. Establishing collaboration between stakeholders of the system, and promoting common sense is the ultimate reward of our Lean approach. The proposed model in this paper attempts, is initiates a critical reflection about best practices standards, and provide a viewing perspective for successful implementation of operation management throughout a LEAN IT Management.

## ACKNOWLEDGMENT

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# Teaching Competitive and Technological Intelligence methodology in Engineering School

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**Abstract—** This article was the result of a Competitive and Technological Intelligence (CTI) project with a group of Students in UniLaSalle France. The aim of this study is to propose a teaching CTI methodology applied to the energy cake case. Thus, the study of this case show the free monitoring tools used by the UniLaSalle students group and the important results about the competitive environment of energy cake.

**Index Terms—** Competitive and Technological Intelligence, Methodology, Monitoring tools, UniLaSalle France.

## I. INTRODUCTION

Competitive Intelligence is regarded as a specialized branch of Business Intelligence. Solberg Soilen [1] proposed the classification of intelligence studies in order to help us to place different forms of intelligence and to show how they related to each other. The first concept aims to collect and analyze data on specific and generic competitive environments, while the second focuses on the current competitors and analyze areas such as potential acquisitions-mergers and evaluate specific country risks [2].

Technological intelligence is defined as a process to determine patent and innovation trends [3], [4].

To propose a simple definition for these two concepts we propose:

Competitive Intelligence serve to identify, monitor competitors and decrypt their strategy. Technological Intelligence is to follow a technical and scientific domain in the time and, to monitor developments ([www.ie.bercy.gouv.fr](http://www.ie.bercy.gouv.fr)).

The growing of CTI tools to be used in different domain remains a challenge for the private and public organization. We present some tools taught and used in UniLaSalle<sup>1</sup> to show how to teach CTI methodology by using these tools and analyzing the important results of the energy cake project.

The students have decided to work on the Lactalis group, leader in the dairy industry, it has recently created a new line of sportive nutrition: Apurna.

The specificity of this range lies in its composition. All products contain "PROLACTA" which is a patented concentrate of milk protein. This ingredient has been developed by "Lactalis Ingredients" and target sports by answering three specific needs:

- Strength
- Endurance
- Recovery.

Lactalis launches a new range of energy (hyper protein) cakes named APURNA, how can it differentiate itself from its competitors on the cakes for sportive nutrition? A CTI system has been set up by students to resolve this problem.

To better understand the contribution of this paper, we propose how to teach the Competitive and Technological Intelligence methodology. Secondly, we discuss the methodology used, then we analyze the results depending on the tools used. This work has allowed us to identify the competitors and the technological trends in energy cake sector. Finally, we offer some recommendations to Lactalis Group depending on the CTI results.

## II. TEACHING CTI METHODOLOGY

As defined by the Association of Information and Documentation [5], the watcher is one who "feeds the makers of a company selected and processed information to alert them to changes in the environment (technical, competitive, economic, regulatory, etc.) of the company and help them in their decision making process."

In the literature of strategic intelligence, several definitions have been proposed, we cite as examples: i) the watcher is just one "who is able to set up a monitoring unit"[6]. ii) "to listen, able to anticipate environmental trends and endowed with an

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<sup>1</sup> The « Institut Polytechnique LaSalle Beauvais » merged on the beginning of January 2016, another high school for the training of engineers focused on academic programs in Agriculture sciences: ESITPA in Rouen, and became UniLaSalle.

insatiable curiosity" and a "tracker warning signs of the future" [7]. iii) the watcher is both an expert synthesis of records, a leader in his community, a facilitator of decision making and a flagman of threats and opportunities [8]. We selected these thesis definitions of Kislin (2007) [9] because it sums up the role of a watcher in establishing cell. This thesis models the interaction and collaboration between decision maker/ watcher in the form of a model called WISP (or "Watcher-Information-Search-Problem") to show the passage of the decision to issue informational problem.

The thesis of Palazzoli in 2011 [10] is a case that showed the double competence of the researcher in the field of Technology intelligence and biotechnology, as well as the usefulness of exploitation of patent information in a public research laboratory in order to identify technology development and bio-manufacturing niches in gene therapy and help decision making researchers in this direction. This researcher has developed his skills as an analyst on industrial property in the life sciences and not just a watcher who seeks patent information available in specialized databases (Espacenet, Patentscope) or commercial tools which allow to access to databases open or closed to facilitate the automated processing and improve the quantity of exploited patents (QPAT, Matheo Patent, Questel,...). Following this thesis, technological monitoring responded to several types of problems: How can we define technology development niches? ; What are the rules of the game between the market players and how to propose collaborative open source projects to promote the publication and sharing of knowledge or develop disruptive technology,...?

This literature review has enabled the construction of a Competitive and Technological Intelligence plan (Figure 1 and 2).

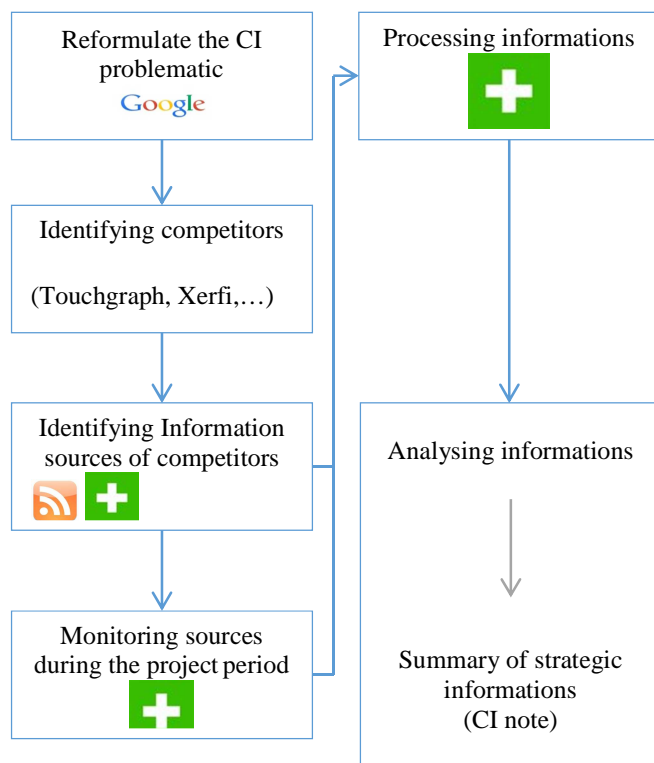


Fig. 1. The teaching Competitive Intelligence (CI) Methodology.

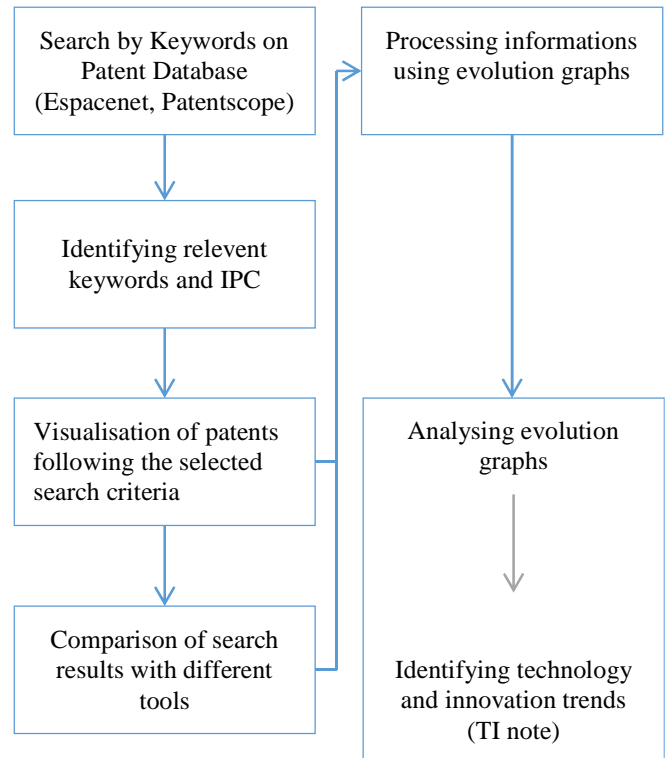
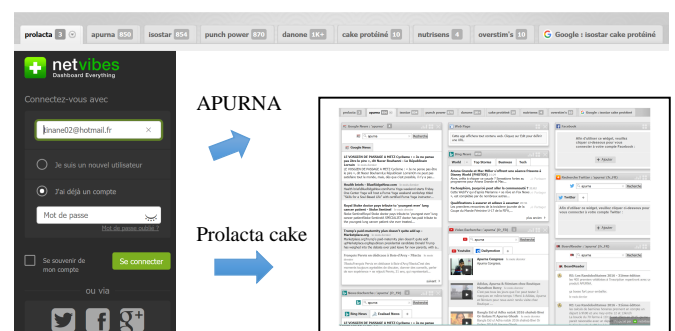


Fig. 2. The teaching Technology Intelligence (TI) Methodology.

After presenting the two methodologies, we have showed students with different functionalities of free two processes have been applied by the group of students, the results are presented in the following section.

### III. METHODOLOGY APPLIED BY STUDENTS

In order to conduct our Competitive Intelligence, we have implemented in a first step, a monitoring system for the Lactalis Company by using Netvibes. This study was released in the period from 22.09.2016 to 22.10.2016 by using free monitoring tools.



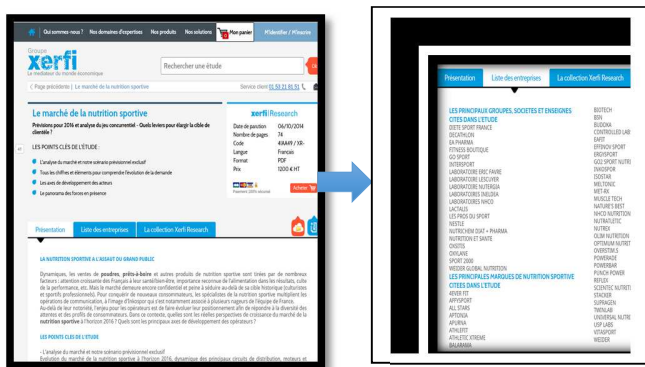
We have added widgets to create our page on Netvibes and made the most relevant information possible in real time. We have selected specific keywords targeted to the maximum of our subject and have chosen to look the following keywords:



APURNA, PROLACTA CAKE, etc for information on our subject. However, we have also set up a competitive intelligence on key competitors.

Consequently, we have achieved much information sources, we then found ourselves relevant informations.

Xerfi research has allowed us to find competitors at Lactalis and its APURNA brand. Many companies in this market are specialized on sportive nutrition, but few of them are direct competitors, so we chose to retain only 5, which we will detail later.



markets, which allows this product to be easily accessible (specialty store, appropriate GMS rays,...).

This product is easily positioned in marketing with notoriety: Lactalis is highly known in the nutrition market. Moreover Lactalis specializes in milk and not in cake making protein, hence its low diversity in taste compared to its competitors (Figure 3).

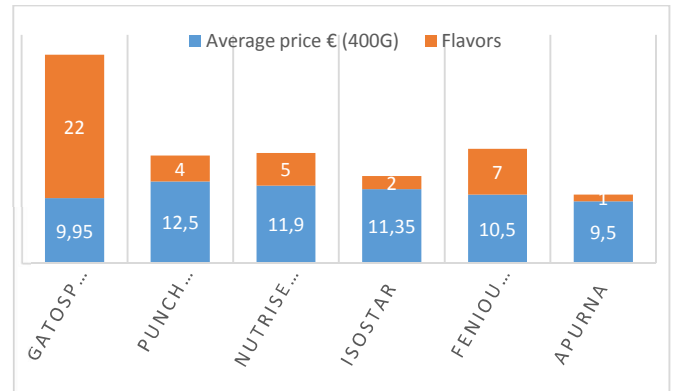


Fig. 3. Positioning the main competitors of APURNA.

Protein cakes of APURNA aimed the high level athletes in order to increase and improve their performance. Today, 5 million of people have used protein products.

Appendix 1 shows competitors sales of Lactalis, we have noted that all these companies are specialized only on sportive nutrition. They have a turnover of less Lactalis is a highly diversified company and present in many markets. The competitors are growing, such as Isostar that has a turnover in constant increase, + 46.64% between 2012 and 2013 and that has quickly become known in the international market.

We have noted that Isostar is a competitor that is growing in innovation. Even if Lactalis is an international company and leader in the food market, it needs to innovate its products. Since its inception, Isostar is investing every day to be ever closer to the sport, whatever their level, in order to bring themselves to the best nutritional solutions to help them achieve their goals.

For this, Isostar surrounds itself with experts, such as doctors and nutritionists, National Technical Directors, sports coaches, engineers in R&D, high-performance athletes, who work on optimizing existing ranges and actively participate in new product development.

The strength of this company is that it focuses primarily on: Nutrition and Health.

After the presentation of companies' competitive environment, we have moved to their technological environment.

#### B. The Technological Intelligence results

In order to know the position of Lactalis with its energizing cakes, we have first focused our Technology Intelligence on

In a second step, we present the key phases to conduct our Technological Intelligence:

1. Keywords search by using Espacenet<sup>2</sup>:
  - Energy cake, cake high protein, milk protein, sportive nutrition, milk protein mix, PROLACTA
  - Patent Searching filed by Lactalis
2. Selection of International Patent Classification (IPC):
  - A23L: associated with patent Lactalis
  - A23C: Milk Protein
  - A23J: Protein
  - A21D: Energy cake
3. Keywords search by using Patentscope<sup>3</sup> (crossing keywords and IPC) and patent Analysis

### IV. RESULTS OF STUDY

#### A. The Competitive Intelligence results

The market for vitamin nutrition (protein cakes) is already requisitioned by several competitors as OVERSIM'S, POWER PUNCH, Nutrisens, ISOSTAR and FENIQU MULTIPORT. We have studied the range of widths of each competitors that we used in our Xerfi study. Competitor products are more diversified, some brands offer over twenty different flavors notably "without gluten" or completely organic.

Lactalis is therefore placed on the market by focusing on a single product: a single taste, one recipe but is positioned at the best price. The Lactalis brand is positioned on a different

<sup>2</sup> Espacenet : BDD de l'OEB (<http://www.epo.org/searching-for-patents/>)

<sup>3</sup> Patentscope : BDD de l'OMPI (<https://patentscope.wipo.int/search/>).

patents concerning high protein cake. For this, we used Patentscope database that we seemed fuller in the results. For research, we have used the keyword "high protein cake" when we meet with these two IPC: A21D and A23L (identified earlier).

Using Patentscope database, we have found 11 relevant patents (Figure 4). We have observed while filing energizing cake in terms of patents is relatively new and is evolving in recent years. We suppose that it is a growing market.

After qualitative analysis, we also found that patents are very different from each other's. The used processes in the manufacture of energizing cake are varied and do not necessarily concern Lactalis uses of milk protein in their product.

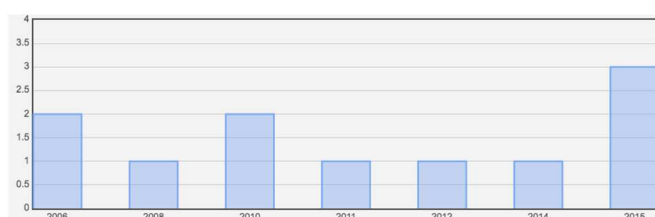


Fig. 4. Number of patents related to high protein cakes published between 2006-2015.

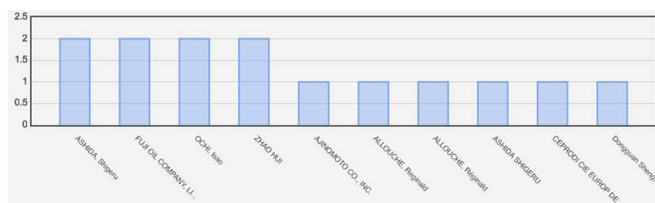


Fig. 5. Main applicant related to high protein cakes.

Finally we have noted that the patents do not concern any large food group or competitors mentioned before in Competitive Intelligence (Figure 5), making it difficult for us to position the energizing cake face competition. Therefore, we were interested in a second time to Prolacta innovation, detailed below.

For this second research, we used the keyword "Mix protein milk" and these two IPC: A23C and A23J. We found 35 patents (Figure 6).

We can see that the innovations of milk protein mixtures tend to stagnate. Among the major groups of the food industry in this market, Danone has filed several patents on those products, and thus seems to be a leader and innovator in this market. The actors in this area are few and this type of product is difficult to develop (Figure 7). This is probably an anticipation on the part of industry with regard to new diets of the population. Indeed, there is an emergence of intolerance and food allergies and special diets, such as vegan diets and without lactose.

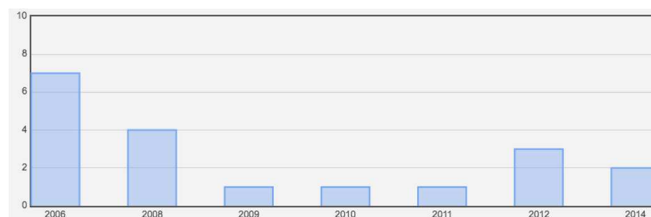


Fig. 6. Number of patents related to Prolacta published between 2006-2015.

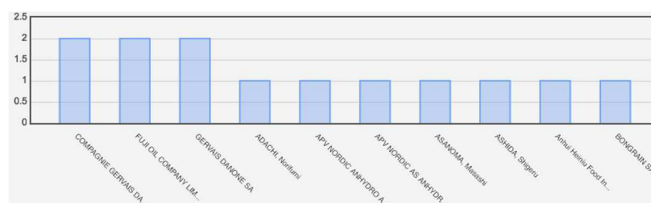


Fig. 7. Main applicant related to milk protein mixtures.

The CTI results that we can further show consistent development of new trends in this field.

## V. COMPETITIVE AND TECHNOLOGICAL INTELLIGENCE NOTES

To compose our Competitive Intelligence note, we propose three ones :

- The high-protein cakes are currently developing. Athletes want to be efficient while having fun, which leaves room for new opportunities for innovation in sportive nutrition. The industrial group Lactalis has anticipated this trend by proposing a new type of product to sweet trend based milk protein: the chocolate cake in the Apurna brand. With the specificity of its product, the group stands out from its many competitors.
- A favorable sociocultural evolution in sport, there is more and more messages advocating public health and welfare research.
- The products are more and more designated for large public, they develop new standards, and continuously improve convenience in packaging.

For the Technological Intelligence note, we observed a stagnation of innovation on the side of mixtures based on milk protein. This development is met by the appearance of new protein enrichment means lactose. Some competitors are already using new alternative protein sources in their ranges as PunchPower, which commercializes its cake of rice flour. Danone, has a strong presence on the dairy market, has previously focused its products to the general public. By this strategic choice Danone is not in competition to face Lactalis with Apurna.

## VI. RECOMMENDATIONS AND CONCLUSION

The CTI results suggest that Lactalis, on the managerial level, can develop new flavors and differentiate the range (gourmet products and formats...)

The implementation of this monitoring system has shown the pervasive role of students/watchers in the organization and coordination of steps in this process, from receipt of the request to the dissemination of results.

To conclude this study, the application of CTI methodology and the use of free monitoring tools allowed understanding of the evolution of the energy cake/product segment on the one hand and the strategies of the actors present in competitive and technological environment on the second hand.

This development can be a new problematic which shows the evolution factors of these food industries and the usefulness of all types of intelligence (market, technological or scientific...) for actors with whom they interact (research institutions, service providers, farmers...). As an example the thesis of Guénec (2009) [11] on methodologies for the creation of knowledge related to the Chinese market in an economic intelligence approach applied to agricultural biotechnology where it mobilized the Matheo Patent tool for achieving the Technological Intelligence [3], [4] on wheat hybridization techniques and understand both the issues of the state and the Chinese economic actors. Guénec (2009) [11] used other tools dedicated to data mining and information retrieval ("Information retrieval" [12]) to better understand the linguistic and structural environment of Chinese scientific databases.

Our case study provides evidence that the Competitive and Technological Intelligence (e-veille<sup>4</sup>) was most taught to be applied to business cases for purely pedagogic education using the free watch tools (Netvibes, Google, Xerfi, Espacenet, Patentscope...) to achieve these methodologies. Finally the monitoring of open data can be a full search. This study showed us how to live a research subject on which there was a real need, and yet too many uncertainties.

## APPENDIX 1: BENCHMARKING OF COMPETITORS

NUTRISENS	OVERSTIM'S	PUNCH POWER	FENIOUX MULTISPORT	ISOSTAR
53 MILLIONS €	15MILLIONS €	1 282 600,00€	906 900,00€	290 400,00€
International	Europe	France and île de la Réunion	France	International
A High growth  15% of turnover in the International	Including 20% for the export	A growth  + 22,28 % between 2014 and 2015		A constantly increasing  + 46,64 % between 2012 and 2013.

## ACKNOWLEDGMENT

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<sup>4</sup> See the definition of "e-veille" in Lexique de Gestion et de Management sous la direction de J.P. Denis, A.C. Martinet et A. Silem, 9<sup>ème</sup> édition, Dunod, 2016.

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# THE IMPACT OF IMPLEMENTATION OF ERP PERFORMANCE OF MOROCCAN COMPANIES: CASE OF SMES.

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## ABSTRACT

In recent years, the implementation of ERP is as a lever for development and inter-organizational collaboration. Despite the benefits of ERP, the success of their implementation is not always assured. The introduction of an ERP in a company requires organizational changes that may provoke resistance to cause adverse effects on the success of these projects. This article proposes a model and tests to evaluate the success of a system "Enterprise Resource Planning "(ERP) based on a measure of user satisfaction. Referring to the model DeLone & McLean (1992) [1] and the work of Seddon & Kiew (1994) [2]. The results of the exploratory study, carried out on 30 users in 20 Moroccan companies, shows that user satisfaction of ERP is explained by the quality of the ERP system, perceived usefulness and quality of information provided by this type of system.

In addition, these results revealed that user satisfaction depends on the quality of managing organizational change that can be measured by the user's involvement in the system's implementation, the quality of communication in such a project, and the quality of user's training.

We studied two groups of key players to answer our research question. The first group consists of end users. The second is composed of specialists in IS or ICT. The choice of these two groups is justified by our need to understand the success of SI and therefore include in our study as the IS-devel fears that the end users.

The interest in the dissemination of ERP in SMEs is generally limited to the study of the distribution of the tool in large companies. However, much research that focuses on the adoption of ERP in the SME emerged. But the majority of this research has been to scope the context of developed countries. Our research, it aims to study the diffusion of ERP in developing countries and specifically in Morocco.

## Keywords

*Enterprise Resource Planning (ERP), user satisfaction, quality change(QC), Information Technology (IT), information systems.*

## I. INTRODUCTION

The current context of global economic activity is characterized by a large and permanent competition as well as a large customer requirement for immediate and complex solutions. In this context, process control and continuous improvement become prerequisites for success. As a result, numerous companies around the world are trying to take advantage of an overhaul, using software packages, their information systems, and hundreds of them have opted for systems integrated management ERP (Enterprise Resource Planning) as a basis for the integration of their industrial management (Marbert, Soni & Venkataraman, 2000). [3]

The use of information and communication technologies (ICTs) such as ERP seems to be a great contribution to the profound changes in the functioning of companies. These packages make reference to information systems (IS) implemented to integrate the flow of information at the level of the entire organization. To achieve this integration between functional areas, ERP operate a centralized database that stores the collection and organization of data in "real time". Technological innovation of these software management can realize the old dream of the companies to have a single repository, and integrated their management information system (MIS) (Davenport, 1998) [4]; Rowe, 1999). Organizationally, the implementation of ERP is considered a change in the information system and in the process of guidance and control (Gomez et al. 2002).

In fact, if many companies are attracted by the ERP, it is because this is supposed to make gains in productivity and efficiency, including the ability to make more integrated organization. This integration concerns both automated business processes that information processed by the software (Perotin, 2002). [5] Indeed, integration is placed among the main reasons companies to equip an ERP (Marciniak 2001).

Lequeux (1999) [6] defines the ERP system as "a subset of the IS able to take over the complete management of the company, including accounting and financial management, production management and logistics, managing human resources, administrative management and the management of sales and purchases."

This study is interesting on two levels:

- The objective of this article is therefore to identify the drivers of satisfaction of users of ERP systems. On a finer way, we try to determine the satisfaction and enhance the need for good conduct ERP projects to increase the degree of the satisfaction. To do this, it was reduced to build a model for the explanation of this satisfaction.
- In what follows, we will try to review the state of the art in measurement of user satisfaction of IT before submitting the research model and the results of an exploratory study conducted with a sample of Moroccan companies.

## II. ERP AND ITS CONTRIBUTIONS FOR USERS

The evolution of computing, which is progressing towards greater information sharing and flexibility is a key factor explaining the growing success of ERP to companies. Despite the unquestionable progress they make today, ERP do not fully meet satisfactorily the needs of companies.

In the 90s, many leaders expressed their dissatisfaction with the IT solutions available. They are regularly offered management solutions too often ill-suited and / or inappropriate to the reality of their needs. Their expectations, still valid, essentially want the information systems allow one hand to organize the integration of information flows between units in the same transverse process management, and secondly to identify and disseminate a common language within the company via a detailed standardization of information related to the different functions. This would have led many companies to implement an ERP system at the heart of their overall information system (In Consumed, 2000).

Integrated management planning (ERP) often designated by the acronym ERP English term for "Enterprise Resource Planning" are very successful with companies and their implementation is a recast of the information system, but also a rethinking of management procedures within the organization. Thus almost all the major global companies are already equipped with ERP and more and more SMEs are looking to build a unified information system based on this software. (Mourlon and Neyer, 2002)

However, the ERP technology is not a magic solution; its benefits are the direct result of a preparation and an effective implementation accompanied by appropriate use. Thus, the successful adoption of an ERP is essentially based on a thoughtful preparation by the company.

### 2.1. Literature review on approaches, models and frameworks ERP success

This part focuses on literature research is the success to summarize the two theoretical backgrounds and empirical studies.

#### 2.1.1 successful frameworks for the evaluation of ERP

Development of a framework is the first step in the success of the assessment which must be adapted to the characteristics of the information system (Chand et al., 2005 [7] ; Irani et al, 2014 [8]; Stefanou, CJ, 2001 [9]; Uwizeyemungu and Raymond, 2010 [10]) many frameworks have been proposed taking into account several phases and dimensions of evaluation of the system's success: strategic, tactical and operational. Generally, the framework describes eight categories: theoretical basis, the research approach, the object of analysis, the unit of analysis, the prospect evaluation, data collection, data analysis and type methodology (Urbach and Smolnik, 2008) [11]).

### 2-1-2 The PAC Setting

This framework was developed by (Irani and Love, 2008; Irani, 2002) [12] to help managers and decision makers in the process of assessing the benefits of IT / IS. They argue that there is not a good framework to evaluate the impact of IT in the performance of the organization in the literature and they added that there is no good framework to select appropriate tools for IS investment. For these reasons, they try to offer a CCP framework for assessing the cost and benefits based on three concepts: Content, context and process. But we conclude after analyzing this framework it is too big and general to be applicable to conduct an evaluation of the success of the ERP system.

### 2.2 The measurement models of successful ERP system

Many models have been developed to evaluate the systems and the success of technology (Davis, 1989b; DeLone and McLean, 2003 1992 Gable et al., 2003; Ifinedo and Nahar, 2006; Sedera and Gable, 2010; Shang Seddon, 2002). These models have been validated empirically by numerous studies in the information system. The results show that many case studies are studied by applying the DeLone & McLean model success using a modeling approach structural equation (Dörr et al., 2013).

The strength of D & M model is its theoretical foundation based both on Shannon & Weaver communication theory and communication systems approach Mason (Mason, 1978; Weaver and Shannon, 1949). They claim that information is considered as an output of an information system that can be measured at three main levels: technical, semantic level and efficiency, referring to the mathematical theory of communication (Weaver and Shannon, 1949) and its levels to analyze the message following the communication system. Defining and measuring the output of any system is always difficult, especially if the output is rather intangible nature. Information output is represented in symbolic form, the concept of signs is essential to both the information and communication; it is considered a single system the key link in the way affect the other, and involves the system context and the sign its self (Mason, 1978)[13].

Beyond the combination of the two dimensions of causality and processes to explain the construction and confusion in the direction of D & M model (Seddon, 1997) other considerations would occur as the level considered to explain the success of an information system and the impact on performance. Success is the evaluation is not limited to internal factors according to D & M in their model based on the theory of Shannon and Weaver. For example the quality of the ERP system is not only a causal variable leading to success, but can also be seen as a result of other external factors, such as organization, innovation, and environmental factors (Bradford Florin, 2003; Ifinedo, 2011[14]; Sedera and Gable, 2010) [15].

### 2.3 The theoretical foundations

First, we present our conceptual model which is based on both theoretical and empirical background. This framework will be considered a success evaluation model of ERP system that combine causal processes and considerations for evaluating the success of the ERP project in three performance levels: The individual performance, the performance of the task force and performance Organizational (and Ifinedo Nahar, 2006; Ifinedo 2011; Ifinedo et al, 2010; Myers et al .., 1997). The levels of analysis included in this model were based on three theories: the first theory is the mathematical theory of communication used by DeLone and McLean is a success model to analyze the quality of the system and its impact on quality information on the one hand, and the impact of the quality of information in the efficiency users, on the other hand; The second theory is the theory of diffusion of innovation used to analyze and classify



the different factors in three main boxes: innovation factors, organizational factors and environmental factors; and finally the theory of the structure to analyze the contribution of the ERP technology in organizational performance.

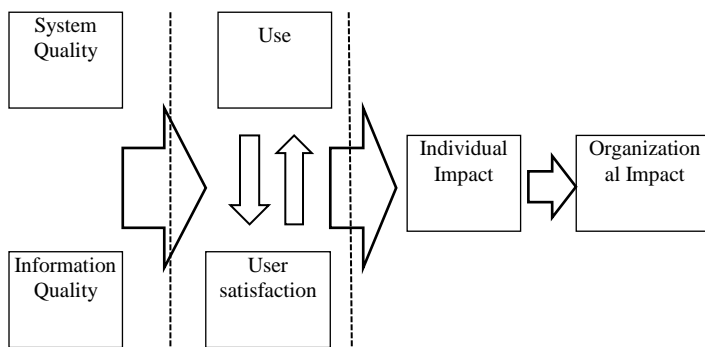


Figure 1: D&M IS Success Model (DeLone & McLean) 1992)

Beyond taxonomy of success, DeLone impact and McLean IS research indicating that the six dimensions of success are interrelated and interdependent. They should be considered as a whole and not separately. This leads the authors to the conceptualization of the model of success presented below.

The most scathing criticism on the model 1992 is that of Seddon which proposes to remove the dimension "use" model DeLone and McLean (1997).

The author explains that the use is a behavior and is only valid in a process. In another article soon with Kiew, Seddon says that "if a system is used, it must be Useful, and Therefore successful. HOWEVER, non-use Does not Necessarily mean a system is not Useful, May it simply mean que le potentiel --other User has more pressing things to be done "(1996 p. 92).

Starting from the main criticism that the model of DeLone and McLean incorporates both process causal dimensions of success, Seddon offers an adapted version of the model DeLone and McLean (Seddon 1997). This model separates the causal measures the success of the process that is using the system. Note that this model indicates that the quality of the system, the quality of information, perceived usefulness and benefits of individuals, organizations and society to use the system impacts user satisfaction. This satisfaction influences the expectations for the future use of the system, and therefore the use of the system process.

To answer for some critics considered troublesome, (DeLone and McLean, 2003) argue that their model is based on both process and causal considerations, the six dimensions of the model are interrelated rather than independent. Based on a process considered the first event of their model begins by creating an IS containing various specifics, the second event is the use of the system and its outputs. The final step is the impact result of this use on both individual and organizational performance. However, based on a causal dimension D&M explain the covariance between the independent and dependent variables to determine if there exists or not a causal relationship among the success dimensions. Combining taxonomy and success, this model was to help in the understanding of the possible causal interrelationships among the six dimensions of success.

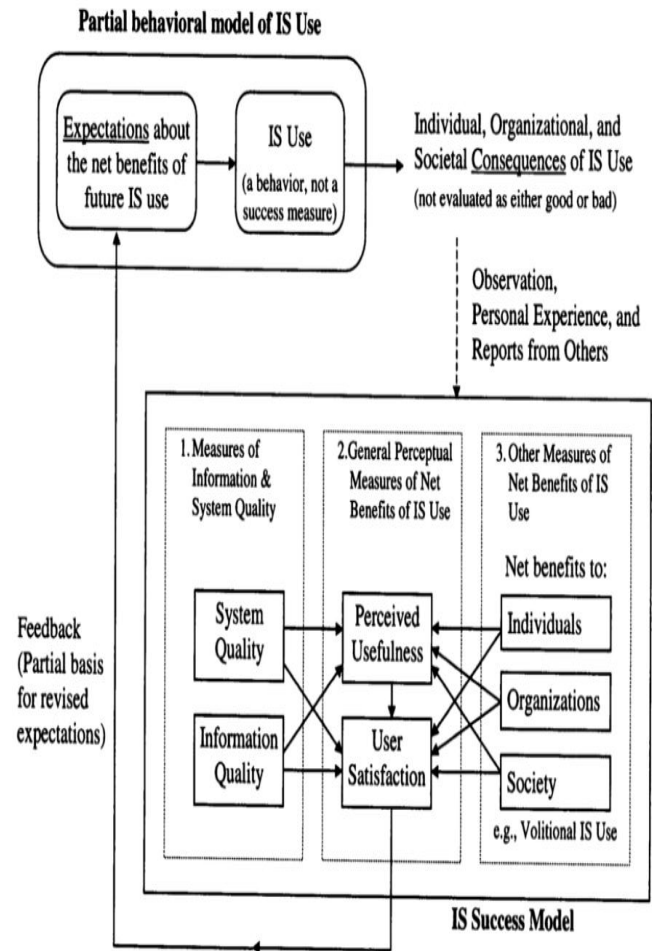


Figure 2: successful model IS 1997 Seddon

With the model DeLone and McLean, multidimensional concept of success in SI is better defined. Perceptual dimensions of the success model are multiple, interdépendantes and not independent (Petter et al. 2013). It is necessary for the your-ter as a whole to identify impacts on the success in the development or implementation of new SI. However, if success is the dependent variable in IF, what influences the success? It is this issue that treat Petter DeLone and McLean in a 2013 article.

The search for independent or explanatory variables influencing the model of De-Lone and McLean is common. To identify the factors or variables that influence the success of SI, Petter, DeLone McLean and examined more than six hundred articles over a period of fifteen years between 1992 and 2007. Using a methodology of qualitative literature review, these researchers have selected the hundred and forty-six hundred ar cles.

Many factors influence one or more of the success SI dimensions were found by the authors during their review of qualitative literature. The re-grouping categories such factors emerged naturally. Note that they are consistent with those proposed by Leavitt in the sixties (Petter et al. 2013).

#### 2.4 Why Moroccan businesses they opt for ERP?

The term ERP comes from the name of the method MRP (Manufacturing Resource Planning), industrial method used since the 1970s for the needs of management and planning of industrial production and computer-aided production management (CAPM).

## 2.5 gradual adaptation of ERP to small and medium enterprises

As to migration patterns, some companies opt for highly problematic solution to migrate their IT systems through process redesign while others opt for outright deportation of the existing.

Now this type of establishment "Big Bang" is desirable, particularly in the following cases:

- Lack of visibility or very difficult for the entrepreneur to have an overall vision and inability to set the main guidelines and actions.
- Existence of bottlenecks and sticking points of information between services; the implementation of ERP will provide an opportunity to everyone to overhaul their procedures.
- Excessive heterogeneity of the applications used and abundance of interfaces between business and auxiliary applications with the central accounting system.

If these reasons are excellent reasons to migrate to an ERP, they still constitute less additional risk factors. Also, entrepreneurs can often believe that the company's problems come integrated systems so that difficulties are only the reflection of other shortcomings.

In general, it should return to the main benefits and difficulties of ERP to determine whether the context of implementation of ERP is favorable or not.

Companies usually opt to deploy ERP for one reason following:

### 2.4.1) Organizational Factors

In view of concentration transactions (mergers and acquisitions) facing most industries and growth marked at several international groups, many companies are forced to include in their calendars projects migration to ERP, and, just as the parent company or other subsidiaries.

Moreover, partnership agreements and often require their contractors to implement the same management systems that their reference customers, and to ensure the exchange of data, transparency and reliability of information financial communicated to the third party.

### 2.4.2) Technical Factors

The evolution of information systems to more sharing, more integration and flexibility are key factors behind the growing success of ERP to companies. Today, as we will examine later, they do not yet fully satisfactory answer to the expectations of the latter.

Nevertheless, they represent the most promising path towards a more comprehensive computer.

### 2.4.3) prudential and internal control factors

Indeed, in accounting and financial reporting and management, ERP also provides an audit trail and traceability data, the ability to set up multiple quantitative and qualitative controls to increase assurance of the device internal control during the course of the various transactions through the "workflows" of validation and execution of manual data processing, semi-automatic or automatic.

The choice of a software package is an important decision for any company because it will affect its performance and expansion capability. Although each enterprise is different in its operation, it turns ultimately they are 90% identical in their functional requirements. They are thus motivated by all the above objectives, namely:

- Technical objectives and research of integrated information systems;
- Organizational objectives;
- Strategic and tactical objectives.

Added to this is also the hype and the will to implement best management practices on the market.

It is true that the ERP due to its considerable cost, meets the needs of large companies engaged in long-term projects and benefiting from substantial budgets.

However, the enterprise market is saturated, SMEs become customer "target" publishers, and this especially since these represent a very broad and representative sample of the economic fabric.

Nowadays, all factors converge towards democratization ERP offers:

- Adaptation of ERP tools offered by publishers to the specificities of SMEs / SMIs;
- Progressive reduction of costs of ERP offered by different vendors in the market, and that, because of the competition on market shares and the development of solutions for SMEs / SMIs;
- Saturation the groups and big business market, which redirects to other segments or SMEs / SMIs (individual enterprises excluded for the time being offers from ERP vendors because of their size and organization).

## III. DEVELOPMENT OF A MODEL SEARCH

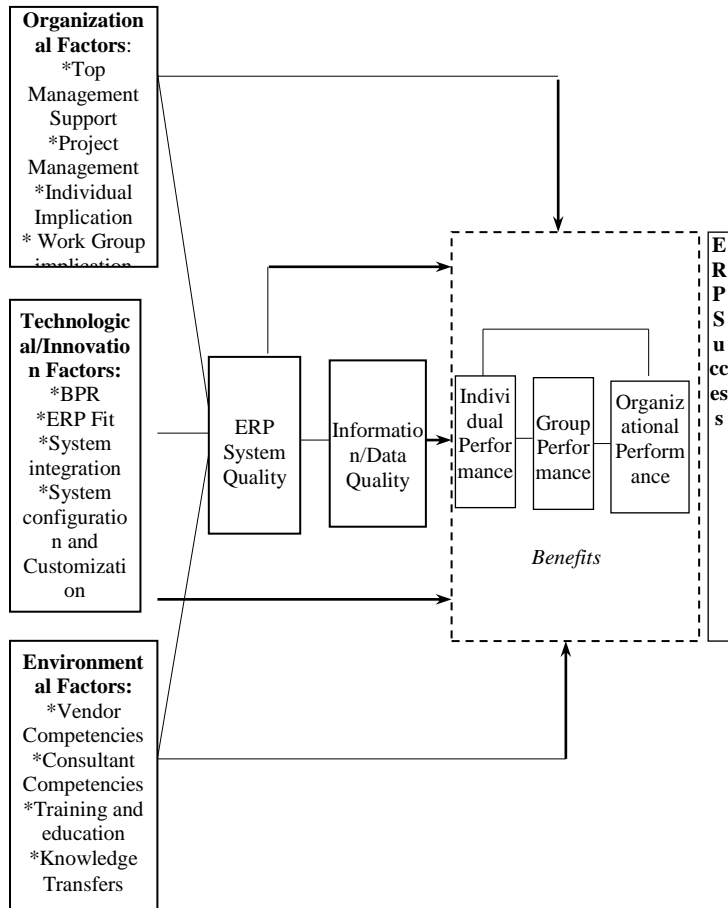
Therefore, the modes of efficient use of ERP systems require something other than a good computer. Moreover, several companies say they face serious difficulties in the implementation of an ERP system without the technical aspects are actually involved: this is due in fact to disregard and neglect of human and organizational factors (Anonyme1 1997).

Thus, and in support of some researchers (Bancroft, 1996; Kaemmergarrrd & Moller, 2000), the factors considered can be classified keys to the success of an engineering change by sub following dimensions: the involvement of management generally, user involvement, communication management, training and implementation strategy that also includes well the re-engineering of business processes (BPR) that the same approach of implementation of these systems.

Given the increased importance of engineering change in the success of ERP projects, adding a new dimension, which includes the sub dimensions mentioned above, proves wise for measuring user satisfaction IST, including an ERP system.

At the basis of this reasoning, it is assumed that an ERP system is effective at the individual level when its users are satisfied. This level of satisfaction is determined by a good quality system implemented in the company, a good quality of the information it provides a strong value perceived by users and good engineering changes necessary for its implementation.

Thus, the various built the model proposed for measuring user satisfaction of an ERP system, detailed below, may be diagrammed as in Figure 3.



**Figure 3:** The conceptual model of measuring user satisfaction of an ERP system

#### IV. DEVELOPMENT HYPOTHESIS

This dimension has been used extensively in the literature as the dependent variable success SI. DeLone & McLean (1992) fall within a number of 33 empirical studies published between 1981 and 1987 who enjoy success in terms of user satisfaction (Bailey et Pearson, 1983; Ives, Olson & Baroudi, 1983; Doll & Torkzadeh 1988 ...).

Melone (1990)[16] stated that there is no consensus on a conceptual definition of the construct of user satisfaction. Indeed, user satisfaction has been associated with many terms such as "need felt", "acceptance of the system," "perceived usefulness", "appreciation of MIS", "feelings" (Ives, Olson & Baroudi, 1983).

In general, this satisfaction was defined by "the attitudes and perceptions" (Lucas, 1975). In specifically, this satisfaction was defined as the result of the evaluation that individuals are on continuum "content - dissatisfied" (Naylor, Prichard & Ilgen, 1980); or the sum of feelings and attitudes towards each of a variety of factors affecting the situation (Bailey & Pearson, 1983).

However, it should be noted that the definition proposed by Seddon & Kiew (1994) will be the one used for this article because the items related to the "user satisfaction" dimension of their work will be adopted. Thus, satisfaction is defined as feeling "net" of pleasure or displeasure that results from an aggregation of all the benefits that a person hopes to receive from the interaction with the information system (Seddon & Kiew 1994).

#### 4.1 Quality system erp

This dimension is widely used in the literature (Doll & Torkzadeh, 1988; Davis, 1989; DeLone & McLean, 1992; McGill et al., 1999; etc.). It is a powerful determinant of the effectiveness of IT as well as user satisfaction. The quality of the system relates to the quality of application itself (the different system functionality, ease of use and learning). In addition, it summarizes some issues such as the lack of "bugs" in the system, the user-friendly interface.

Therefore, the hypothesis H1 states: "The better the quality of the system (ERP) is good, more satisfaction is high."

#### 4.2 Quality Of Information Provided By The System Erp

The concept of quality of information has been widely used as a key success factor in research in SI. In fact, this construct has been measured primarily by Bailey & Pearson (1983) and Doll & Torkzadeh (1988) as a measure among other satisfaction. This dimension usually includes attributes related to the quality of the information provided by the ERP system, such as the format of the information, clarity of information, accuracy of information, availability of necessary information in real time, the information content, etc.

Therefore, the second hypothesis H2 states: "The better the quality of information provided by the system (ERP) is good, more user satisfaction is high."

#### 4.3 Perceived Utility

This construct is defined by Davis (1989) as the degree to which a person believes that the use of a particular system would increase the work performance. This dimension has been considered as a factor affecting the satisfaction of users that it comprises, on the one hand, items related to the perceived ease of use and, on the other hand, those related to the perceived usefulness. Moreover, Davis (1989) shows that the acceptance of a technology depends on perceptions of users of this technology. Indeed, the Technology Acceptance Model (MAT) assumes two types of beliefs, perceived ease of use and perceived usefulness, determine the intent of the individual who influences the use of technology.

This allows, therefore, to bring forward the third hypothesis H3 namely: "The greater the perceived usefulness by users, the greater their satisfaction is high."

#### 4.4 Quality Of Change

As shown above, this new dimension can be understood by the five under following detailed dimensions.

##### 4.4.1 Involvement

To drive change caused by the implementation of an ERP system, it is essential that this project will become the project of the entire company: from top management to operational (Mckerise & Walton, 1995; Bingi, Sharma and Godla 1999; Rivard, 2000; Tomas, 1999.)

##### 4.4.1.1 The involvement of senior management

Indeed, the leaders are not called, only to finance the project but also to take an active role in managing change (Bingi, Godla and Sharma, 1999). This role is mainly to guide the overall operation, encourage local initiative, indicate very clearly the kind of organization that wishes to establish, define the corresponding steps of achievements, etc. (Mckerise & Walton, 1995).

##### 4.4.1.2 The involvement of users

Added to the commitment of senior management and middle management, the implementation of an ERP system can be conducted only by the involvement of the community of operational users and a user project manager full time representing the whole of this community (Tomas, 1999).

- H4e: "More training is very good, more user satisfaction is high."

## V. RESEARCH METHODOLOGY

Once part of the research is defined and the variables of the research are identified, it is important to conduct data collection. For this, a questionnaire, multi-scale, was built and tested with 10 users from both at different hierarchical levels as various services, and finally administered face to face in Moroccans' companies.

Given that companies have adopted ERP systems are not many, it was not possible to focus on a specific industry. The selection of the study population was guided by a single criterion are: the existence of an ERP system that is already operating at all levels (all modules are already functional) or at least a good part of the system ballast.

The different ERP vendors (Oracle Applications (Oradist) MFG / Pro (DISCOVERY) ADONIX X3 (STAR ENGINEERING), JDEdwards (LPI)) are selected as the starting point for the definition of the population.

### 5.1 Population and sample

We studied two groups of key players to answer our research question. The first group consists of end users. The second is composed of specialists in IS or ICT. The choice of these two groups is justified by our need to understand the success of SI and therefore include in our study as the IS-devel fears that the end users.

### 5.2 Data collection

We conducted semi-structured individual interviews lasting an average of 40 minutes between. These interviews were conducted face to face and some of them were conducted by telephone interview.

Data collection has collected a sample of 20 companies surveyed; representing an effective response rate (60.45%). However, it should be noted that the unit of this study is defined as the user of an ERP system. Therefore, the respondent is either the project leader or the leader or one of the senior or middle managers, or one of the last entry clerks. What mattered was the use of the ERP system.

we recorded interviews with the agreement of the interviewees then we have the completely transcribed. We proceeded by taking notes for three unrecorded interviews

According to interviews, the questions have evolved interlocutor's stimulus reasons or to deepen some of the topics discussed. Investigative questions were used to supplement or clarify an answer; questions of involvement have been adopted to clarify some answers.

The interviews to gather data about the caller, his organizational context on the participation of IS users and the success in IS.

## VI. RESULTS AND INTERPRETATION

It is important to note that the measurement scales were either adopted from previous work or created for the need of this research.

### 6.1 Descriptive analyzes of research variables: evaluation of measures

After proposing measures to the various concepts identified in the model and collected the data from the selected population, it is appropriate now to ensure the quality of these measures before making adequate statistical treatment. To do this, we made two types of tests for evaluating the measures namely: tests

However, it is important to note that the involvement of users could not be, in itself, a prerequisite for the proper conduct of change. The latter requires, in addition, good communication management.

### 4.4.2 Communication

Tomas (1999) said, meanwhile, that "good communication is vital to the success of the project. It's not to say everything at all times and to everyone. Without establishing a communication plan in due form which could be seen as too formal and would often out of step with the expectations and realities, it is important to conduct regular communications, direct and targeted for different populations: management, operational teams, end users, implementation teams, etc. ".

In addition to good communication during an implementation project of an ERP system, it is inevitable to provide training to users.

### 4.4.3 Training

Training is seen as an important factor to facilitate change in the organization and introduction of new technologies (Mckerise & Walton, 1995). This training aims mainly to prepare staff and help them adapt to their new tasks in order to be successful organizational change. It is not intended, only use new systems but also the understanding of new processes and their integration into the system. Hence, training is an ongoing process and updating a challenge (Bingi, Godla and Sharma, 1999).

### 4.4.4 The implementation strategy of an ERP system

The implementation of an ERP system means a continuous learning cycle in which the organizational process supported by ERP systems is aligned gradually with the company's goals. Lequeux (1999) says: "Far from leading a purely IT project, the adoption of ERP should be an opportunity to reconsider the mechanisms and improve the flow participating in the operation of the business, even to consider a business process reengineering or BPR, Business Process Reengineering ".

#### 4.4.4.1 The Business Process Reengineering (BPR)

Moreover, the re-engineering of business processes and implementation of ERP systems are inseparable. They should be carried out simultaneously in order to obtain the best fit between the technologies and processes. This adjustment requires considering the role of ERP systems such as infrastructure, which now support the process and no longer functions and, therefore, improve their organizational effectiveness.

#### 4.4.4.2 The ERP system implementation approach

Akkermans and Helden (2001) have focused on ERP systems implementation approach while trying to show that the incremental approach, scalable, based on continuous improvement is a key success factor in the implementation of a project

This hypothesis derived secondary hypotheses for sub dimensions of engineering change. They are formulated as follows:

- H4a: "More user involvement, the greater their satisfaction is high."

- H4b: "More DG is involved in the project implementation of an ERP system, more user satisfaction has increased."

- H4c "The implementation approach can increase user satisfaction more than the radical approach."

- H4d: "More communication is good, most users are well satisfied."

Transcribed interviews and notes of other unrecorded interviews were imported into the SPHINX software to achieve coding theoretical aim. We preferred this approach to content analysis because it "is much more than simply consisting operation to assign categories to the data. In fact, it is a conceptualization of business that differs from conventional coding procedures implemented during the content analysis as it passes through a set of reflections: discovering data, asking questions about data, try to interpret and give meaning, reorganize the data and find answers to provisional data relationships "(Point and Fourboul Voynnet 2006 p. 62).

Following the import of our data, we began our routine coding process and we have created a node interview. A sphinx under node is a set of materials (sentences, paragraphs, text, audio or video, etc.) grouped by a common theme. Our choice to create a node by interview allows us to group all about each speaker separately to facility future treatment of our data. Then we added these attributes to nodes to categorize our interlocutors. For this, a "person" classification was established with the attributes' name, sex, occupation, end user (Boolean), IT specialist (boolean) and enterprise ". This allows comparability of interviews with interlocutor's profiles.

During our Phase systematic coding, we deducted a code tree (nodes) of our literature review. These codes were classified as "from the literature" in Sphinx. To follow, we coded our interviews with this analysis grid.

Finally, more inductively, we let our own codes emerge from our interviews. These are also shown below. For this, we have pro-sold in three stages. First we extract a word cloud showing the most frequently mentioned words in our interviews. We have seen that the words of at least five characters and have eliminated the irrelevant words such as combined-auxi auxiliaries or some adverbs. After analyzing the resulting cloud, we have selected some words and have classified them into sphinx as "emerald-giants". Second, we carefully read our interviews and have extracted new codes. Finally, to close our systematic coding, we coded our interviews with this new analytical framework of emerging codes.

## 6.2 Explanatory analyzes of research

The results of the scoping study are summarized as follows:

- Therefore, we can see that with these ERP systems, offering rich functionality to businesses, ease of use and learning as well as a user-friendly interface, the interviewees felt no frustration against the ERP system. Instead, they argued that it is possible for them to become proficient in the use of this system.

- In fact, the "good" quality of information is made possible by the informational integration offered by ERP systems. This integration promotes the exchange of information between departments, can give greater coherence to the organization and therefore helps coordinate certain processes in the company (Perotin, 2002). This will lead to user satisfaction as their objectives are achieved.

- Thanks to the benefits of the ERP system, users receive these packages useful because they allow them to optimize the operation of the business cycles by reducing internal processes and synchronizing decentralized activities. Specifically, these ERP systems allow users to perform their jobs faster, easier, while enjoying greater added value.

- In fact, although all the companies surveyed have completed the formation of a project team, only 11.9% of managers belong to this team. The rejection of this hypothesis can find its reason in this small percentage of involvement of Moroccan leaders in the ERP project team.

- For the factor "cooperation of users with the project team," it should be noted that there is no significant relationship between this factor and satisfaction. This can be explained by the fact that the majority of respondents (78.3%) are members of the project team and therefore there is no need to talk about cooperation between the project team and users.

- User satisfaction is affected, therefore, by the number of measures or actions taken to improve the acceptance of the project and not by the frequency of meetings organized.

- This satisfaction is mainly marked by external assistance publishers that are to say both the number of services offered by these vendors and the quality of that training. However, this satisfaction is not affected by the number of services offered by the project team but by the quality of their services. Also, note that satisfaction is not determined by the quality of the documentation provided by publishers.

- We see no factor affects user satisfaction of an ERP system or the implementation strategy (reorganization process) nor the implantation. It is obvious that this dimension is decisive the conduct of the ERP project. However, it is noticed that in most cases, the user is much more interested in the analysis of the final results and does not dwell on the project approach or intermediate results. Typically, these users do not appropriate the implementation of an ERP system methodology.

## VII. CONCLUSION

A result even intermediate, is a result ... We present here the states of our exploratory qualitative analysis. They do not answer to the research question but later will be needed to respond.

Once the measures have been evaluated and the new structures are identified, we proceeded to test hypotheses. This part, devoted to the operationalization of the model and test hypotheses, has identified the following results.

Results thus obtained confirmed the work of DeLone & McLean and those Seddon & Kiew. These results have shown that this satisfaction is explained:

- Primarily by the quality of the system, the quality of information provided by this system and the utility perceived by the users;

- Partially by the quality of engineering changes needed to implement the ERP system. It is true that the data analysis performed could provide only partial verification of this dimension engineering change because, firstly, user involvement, communication and training partially affect that satisfaction on the other hand, the other two sub-dimensions i.e., the involvement of the top manager and the implementation strategy does not seem to affect the satisfaction.

Notwithstanding, the results presented are limited to the sample of enterprises and should be interpreted with caution given the nature and sample structure, but also methods of data collection used.

It is important to note that future research should be directed towards the new way of "Management Information Systems": evaluating the success of ERP systems. In addition, we can consider further use of research variables in this model. It seems necessary to consider a more precisely the concept of "quality of engineering change," or override variables to study to eliminate those that are redundant and introduce other variables, such as those relating to culture, user profiles, etc.

So it will be wise to take this model while increasing the sample size to allow better analysis to improve results. This

should be possible since the number of Moroccan companies that are in the process of implementing ERP systems is increasing.

Through this article, it is important to note the prominence that ERP systems are currently in Moroccan companies. In fact, these integrated management systems, which are increasingly "backbone" of the IS of the company, need special attention, including in their implementation and evaluation.

However, the current trend concerning the implementation of ERP systems shows that user satisfaction of a IS especially those ERP systems increasingly depends on more than one dimension as well as organizational managerial: he s 'comes to engineering change. Indeed, it seems that there is an increased importance of the effort required in order to conduct an implementation project of an ERP system, mainly in terms of user this research work provides a new tool for the practitioners by allowing them a better understanding of the project of success of the ERP system.

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# Conceptualization of triangular relationship between CRM, Regulation and QoE: Case of Moroccan mobile services industry (February 2017)

A. AMINE, M.OUBRICH, 7<sup>th</sup> SIIE/IEEE International Technology Management Conference (SIIE/ITMC), February 2017

**Abstract—** This paper aims to identify the items that explain the relationship between three concepts CRM, QoE and Regulation. In the Customer Relationship Management (CRM) area, many companies are looking for a tailored approach that will support their strategy of involvement with customers. All of CRM solutions providers such as Microsoft, Oracle, SAP and Salesforce offer CRM apps to companies who want to build a comprehensive and scalable customer engagement strategy. CRM becomes more "customer centric", so some editors talk about the experience Relationship Management (XRM) instead of (CRM) because it is not just managing customer accounts and prospects, but it is a tracking of experience from the beginning to the end, will the buying process, the After-sales and activities of customer support. In this paper, we present a conceptual model as a blueprint for service providers who want to make the (CRM) a means to offer customers an experience in line with expectations (QoE). Beyond the application and technology side of (CRM) that providers offer, we seek to demonstrate the importance of managerial and organizational parameters of (CRM) and the complexity of the determinants of customer experience (QoE). We will also discuss the role of regulation as a moderating factor in the cause and effect relationship between the (CRM) bests practices and (QoE) from Moroccan mobile industry.

**Index Terms—**CRM, QoE, Regulation.

## I. INTRODUCTION

THE mobile services industry is flourishing and users are increasingly demanding a high level of quality of service. In this context, companies must increase their competitiveness in their customer service and set-ups, so the user experience becomes the most crucial factor for application and promotion of services related to mobile technology.

Today's mobile phone operators are competing within a regulated framework close to the national authority of regulation (ANRT), which is the guardrail telecommunications sector. In this environment, three actors operate together on dynamic interaction, carriers offer their customers a wide variety of services that are quite similar

from one operator to another, customers are always searching for a quality of experience (QoE) and a regulator (ANRT) who aims to implement and sustain the conditions for fair competition in the market. On one hand, operators interact with their customers through CRM practices inspired by their marketing strategies and rolled out through their procedures and technological support. On the other hand, the customers expect an extremely high quality of service (QoS) and subjectively perceive the utility and usability (Qp) of these mobile services. In fine, the regulator (ANRT) helps to establish a legal environment that enables sector development by participating in the development of legislative and regulatory framework. The regulation authority helps to reduce user costs while giving them greater access to quality telecommunications services by ensuring good market conditions. This triangular relationship between the actors of mobile services industry leads us to study the impact of (CRM) and regulation (ANRT) on the customer experience (QoE).

Our objective is to explore the determinants of CRM and those of the quality of the customer experience in order to study their causal relationship. The customer relationship is a subject of great interest, especially in the domain of service activities/interactions due to the importance of the "supplier-customer" interface to achieve a high quality of the realization of service (QoS) [1]. In addition, services have now become a priority; they are by nature "moments of truth", which makes them more sensitive to good perceived quality (QP) in the exchange relationship [2]. Furthermore, the quality of experience (QoE) is a subjective measure of the adequacy of a service which the customer was expecting.

In the literature, we found that there is little empirical research focusing on the measurement of the CRM impact on QoE (research gap). In addition, the decision to integrate the regulation as moderating variable into the relationship between CRM and QoE returns to the fact that in early 2016, the Regulation authority (ANRT) considered that the VoIP services provided by over-the-top content (OTT) entered on the telephony field whose exploitation is subject to licensing. ANRT asked the operators to "block" these OTT services, sparking a major controversy with the public and Moroccan youth in particular [3].

Therefore, it is important to understand the causal relationship between CRM practices, regulation activities and (QoE) in order to establish a conceptual framework. Firstly, we begin by drawing from the literature definitions and theoretical foundations of those concepts. Secondly, we present the research methodology and the results of exploratory studies. We conducted two qualitative studies, one was with thirteen CRM practitioners and the second was a focus group with users of mobile services. Thirdly, we estimate by the structural equations the conceptual model based on the impact of CRM and Regulation on QoE.

## II. THE THEORETICAL FOUNDATION OF THE TRIANGULAR RELATION STUDIED

THERE is no theoretical framework embracing the triangular relationship of the mobile telephony sector. However, we propose to place this causal relationship on the intersection field of all paradigms that imbedded the latent dependent variable (QoE), the explanatory variable latent (CRM) and the latent moderating variable (Regulation).

For this purpose, we will share our theoretical framework on three parts. The first part will contain a literature review of CRM. The second part will describe several theories, related to different area as psychology and sociology that explain the concept of QoE. On the third part, we will present essentially the famous regulation theory borrowed from the economy science.

### A. An overview of CRM concept: definitions, functions, models and theories

CRM is a strategic concept, which draws its basis from economic and social exchange theories and relationship marketing [1]. The supporters of transactional exchange paradigm as Coase (1937) and Williamson (1985) study the customer-supplier relationship in its absolute transactional sense [4], [5]. The paradigm of social exchange supported primarily by Hakansson (1982) raises the importance of the social relationship that promotes greater transactional exchange [6]. Other authors such as Marion (2001), Parvatiyar and Sheth (2001) and Arndt (1979) bring the notion of relational exchange that takes into account both transactional and social exchange with a concept of relationship sustainability over a long period [7], [8], [9]. Since 2000, supporters of the new technology approach as Plakoyiannaki and Tzokas (2002), Grabner and Modritscher (2002), Chang and Young (2007) and Coovi (2010) defend the role of technology in CRM [10], [11], [12], [13].

CRM can be defined as a business strategy oriented towards the customer [14]. This strategy is supported by information and communication technology and aims to facilitate and improve relationships with customers [15]; [16]. Several definitions have been developed by several authors (see Table I); it appears that the CRM is seen as both a business strategy and a technological process.

The depth and specificity of different CRM definitions can be seen in the form of CRM layers. For instance, Trepper (2000) propose three categories: operational, analytical and collaborative CRM [17]. Collaborative CRM includes

exchange channels with the customer [18], while the analytical CRM enables the analysis of information gathered [19], and finally the operational CRM, which aims to industrialize the company's daily contacts with its customers through a pre-established process [20].

According to Lambart (2010), CRM is the business process that provides the structure and the way for how customer relationships are developed and maintained [21]. Specifically, the CRM process is divided into several stages combined with practices. These ones are defined by Chen and Russell (2007) as a set of actions taken by the company to retain current customers and attract potential ones [22]. These practices include customer segmentation, database marketing, personalization and one-to-one marketing, proactive selling, cross-selling and loyalty program [23]. While Shaw (1999) defines CRM as an interactive process for achieving the optimum balance between corporate investment and the satisfaction of customer needs to generate the maximum profit [24]. Objectives and CRM functions are multiple; it is a way to get superior financial performance [21]; [25]; [26], a differentiator with a competitive advantage [27], [28] and a long-lasting contact support for customer loyalty through long-term relationships [29]; [30]; [31].

CRM also allows the company to customize and improve the quality of customer service [29] and to share customers knowledge within and between offices [29] and consequently to achieve profitable growth [30] and performance. Moreover, CRM is considered as a strategic approach oriented toward processes [21]; [32], [33], it is cross-functional [21]; [32], a mutual value creator for the buyer and the seller [21]; [25]; [32].

The analysis of the most important and various CRM models that we found in the literature review allowed us to highlight some determinants (see Table II). Strategy, people, technology, and processes are all important factors in CRM [12].

All models which are found in the literature review are predictive, conceptual and integrators of factors which explain CRM. Our theoretical contribution will be to study the determinants of CRM and their relationship with QoE.

TABLE I  
CRM APPROACHES

CRM as a business strategy	Parvitiyar and Sheth (2001), Buttle (2001), Howlett and Rodger (2002), Thieriez (2002), Zablah, Beuenger, and Johnston (2003), Singh and Agrawal (2003), Peppers and Rogers (2004), Peelen (2009), Alard and Guggémos (2005), Swift (2000), Peppers, Rogers and Dorf (1999), Rūta Urbanskienė and al (2008), Hobby (1999), Nurdilek Dalziel and Fiona Harris (2011), Aihie Osarenkhoe and Az-Eddine Bennani (2007), Douglas M. Lambert(2010)
CRM as a strategy supported by technology	Lamparello (2000), Mckim (2002), Crosby Johnson (2001), Gosney and Boehm (2000), Dionne (2001), Glazer (1997), B.Ramaseshan and al (2006), Alard and Guggémos (2005)
CRM as a technological process	Bose (2002), Isolet (2003), Xu (2002), Missi and al (2002), Ryals and Payne (2006), Khanna (2001), Stone and Woodcock (2001), Ramano and Fjermestad (2003), Frock (2000), Kutner and Cripps (1997), Ja-Shen Chena, and al (2009)

TABLE II  
SUMMARY OF THE DETERMINANTS ACCORDING TO DIFFERENT CRM  
MODELS

Determinant	Model	Summary Model	Author
Strategy	The model of the IDIC methodology	Identify, differentiate, Interact, Customize	Peppers and Rogers, (2004)
Strategy, Process, HR, Organization, Customer Centric.	Balanced Scorecard	The calculation of the performance: financial perspective, perspectives related to the customer, internal processes to the business, organizational learning	Kaplan and Norton, (1996)
Customer centric	Model based on the several stages of customer life cycle	- Initialization or Acquisition - Maturation and rupture	Dwer and al., (1987)
Customer centric, Organization and culture, HR, Process, Technology	The CRM Value Chain	Primary level are centered on customer and support conditions are focused on profitability	Buttle, (2000)
Strategy Process Technology	The model of the strategic framework CRM	- The development strategy - The Information Management - The value creation process - The process of performance evaluation - Multi-Channel Integration	Payne, (2006)
Organization and HR	Service and profit chain model	There is a link between satisfaction and employee motivation and customer satisfaction	Heskett and al , (1994)
Strategy	An integration framework of CRM implementation strategy	- Analysis - Formulation and strategy selection - Implementation of the strategy	Osarenkhoe and Bennani, (2007)
Process	Measures framework of CRM Impact on economic added value	Impact on sales, cost of goods sold, total expenditures, inventory investment, other current assets, and investment in fixed assets	Lambert, (2010)
Strategy Culture Contexte	Conceptual framework for overall CRM	Macro Factors: internal and external to the company Micro factors: marketing activities, customer focus, buying behavior. Conceptual framework for overall customer relationship management	Ramaseshan and al., (2006)
Technology Strategy HR	Challenges for overall customer relationship management	-Technology -Economy and market -Regulatory Framework -Culture and Social	Ramaseshan and al, (2006)
Process HR Technology	CRM Implementation	The successful implementation of a CRM requires an integrated and balanced approach of technology, processes and human resources	Injazz and Popovich, (2003)

### B. Theoretical Framing of QoE construct: Approches, models and theories

The customer experience is an interdisciplinary concept that has been the subject of research in various fields including economics, psychology and management [34].

The customer experience is considered as a new concept that refers to all the emotions and feelings experienced by a customer before, during and after the purchase of a product or service [35]. It is a source of satisfaction and loyalty influence [36]. Pine and Gilmore (1999) were the first who have studied the concept of the customer experience and they showed that the customer experience can be a new area of competition [37]. Providing an optimal and a positive customer experience is important, because it affects customer satisfaction and creates an emotional connection with the brand. It therefore enhances customer loyalty [35]. The quality paradigm is the theoretical basis of the QoE, through disconformity theory based on the measurement of the gap between customer expectations and performance of the product or service [38]; [39].

The American school, known as SERVQUAL [40] a conceptualization of perceived quality seen in ten dimensions and refined in five dimensions: reliability, helpfulness, insurance, tangibility and empathy. While the Nordic School defended by Grönroos (1990) is based on the work of Swan and Combs (1976) and identify two dimensions of service quality, the technical quality (what the customer receives) and the functional quality (what the customer perceives) [41], [42]. Theories of psychology have also treated the customer experience including the ergonomic psychology theory in the context of human-technology interaction that revolves around usefulness, usability and acceptability [43], [44]. Other psychosocial theories analyze the subjective component of the customer experience, mainly the Theory of Reasoned Action (TRA) [45], the Theory of Planned Behaviour (TPB) [46] and the Interpersonal Behavior Theory (IBT) [47]. For Soldani and al. (2006), the term (QoE) refers to the perception of the user on the quality of a particular service [48]. It is expressed in human feelings as "good", "excellent", "poor", etc. Soldani and al. (2006) highlight in their research, focused on UMTS networks, the difference between QoS and QoE, stating that the quality of service (QoS) is inherently a technical concept[48]. It is measured, expressed, and understood in terms of technical features, mechanisms and procedures between the user equipment and the network, which usually makes little sense for the end user. Many methods have been proposed to evaluate QoE subjectively and objectively[49]. QoE, is a subjective measure of the adequacy of a service compared to customer expectations. It measures the "rendering" of the use of a service and how a user perceives the conviviality of a service, the satisfaction level that comes with a service in terms of conviviality, accessibility, continuity and integrity of the service [48]. The literature review allowed us to highlight two different approaches of QoE (See TableIII):

-Th QoE as objective and subjective measure of the customer experience.

-The QoE as an evaluation of customer perception, the gap

between expectations and performance.

TABLE III  
QOE APPROACHES

QoE	
Objective and subjective measure	(Kilki, 2008), (Rehman and al., 2011), (Xin and al., 2012), (Mitra and al., 2011), (Régis, 2007), (Hassenzahl, 2008), (Nguyen and al., 2013)
- Assessment of customer perception - Gap between expectations and performance	(Rehman and al., 2011), (Fiedler and al., 2010), (Chumpitaz and Swaen, 2004), (Gentile and al., 2007), (Lefranc, 2013), (Johnston and Kong, 2011), (Johnson and Mathews, 1997), (Chen, and EIZARKI, 2011).

We pinpoint through the literature review that QoE is a topic that concerns more and more researchers and service providers. We realized that many authors explained QoE via a set of determinants, and proposed theoretical, exploratory, analytical, predictive or measuring integrator models (Table 4). On the one hand, objectivist researchers like Soldani and al. (2006) and Mitra, and al. (2011) focused on objective factors such as QoS and context [48], [49]. On the other hand, subjectivist researchers such as Qing and al. (2013), Schmitt (1999), Garg (2010), Hektner (2007) and Harman (1990), interpreted QoE toward the human dimension and its complexity [34], [50], [51], [52], [53]. But Xin (2012), Nguyen (2013), Gong(2009), Moller and al. (2009), Perkis (2006), Lefranc (2013), Kilki (2008), Geerts and al.(2010) and Laghari and al. (2011, 2012, 2013) recognize an inclusive approach that integrates objective and subjective dimensions in order to explain the QoE [54], [29], [55], [56],[57], [36], [58], [59], [60], [61], [62]. We sum up in (table IV) all of these models and we identify the main determinant that should be considered in the QoE.

TABLE IV  
QOE MODELS

Model	parameters
QoE prediction model (Yu and al, 2012)	MOS, Small root mean squared error (RMSE), Low time consuming
An AHP (analytic hierarchy process) based model for the evaluation of customer experience in banking sector (Garg and al, 2012)	Sensory Affective Cognitive Behavioral Relational
Experience Sampling Method (Hektner and al, 2007)	Biology, Culture, Behavior, Subjective Experience in Context, Interaction of Individuals and Environments, Experience Fluctuations, Well-Being. Dimensions of experience in Social Science Research: Challenges, Skills, Affect, Activation, Cognitive Efficiency, Motivation.
QoE assessment approach (Nguyen, 2013)	User score-mean opinion score
The intrinsic quality of experience (Harman, 1990)	Intentionality of experience Perception and understanding Inverted spectrum

Relation between Customer Experience and Behavioral Intentions(Path Analysis) (Qing and al., 2013)	Customer behavioral intentions , Perceived value, Experience.
Strategic framework for Experiential Marketing (Schmitt, 1999)	Strategic experiential modules (SEMs) including Sensory experiences (SENSE); Affective experiences (FEEL); Creative cognitive experiences (THINK); Physical experiences, behaviors and lifestyles (ACT); Social identity experiences that result from relating to a reference group or culture (RELATE).
Model-Based Approach to Measuring Quality of Experience,” (Gong and al, 2009)	Integrity, Retainability, Availability, Usability, Instantaneousness.
A Taxonomy of Quality of Service and Quality of Experience of Multimodal Human-Machine Interaction (Moller and al, 2009)	Objective QoE Factor: QoS-influencing, system behavior and performance Subjective QoE Factor: quality perception and judgment processes Technological Domain: user, the system, and the context of use
Model for analysing Methods for measuring customer (Garg and al, 2010)	Experience Audit Walk-Through Audit Service Transaction Analysis
Model for Measuring Quality of Experience. (Perkis and al., 2006)	Measurable parameters : Non-measurable parameters
Model of customer experience management ( Lefranc, 2013)	Relevant experience (by management), Expected experience (by customers), Proposed experience (by the company), Experience (by customers).
Algorithm to determine and predict QoE. ( Mitra and al, 2011)	Bayesian networks (packet loss, delay, location, Bandwidth), Utility theory, context spaces theory (Satisfaction and technology acceptance).
Framework for analyzing Quality of Experience in Communications Ecosystem, (Kilki Model, 2008)	Human Attributes (Needs, happiness and experience) QoS of the network Application performance Business (SLA, ARPU, churn)
Linking an Integrated Framework with Appropriate Methods for Measuring QoE,” (David Geerts and al, 2010)	Context: social-cultural, situational, international, Business : ICT product, use process, Objective Factor: QoS, Subjective Factor : user aspect.
High level diagram for QoE interaction model in communication ecosystem. (Laghari and al, 2012)	Human Roles and Domain, Human Demographic Attributes, Technological Domain, Business, Objective QoE Factor, Subjective QoE Factor, Contextual Domain,

### C. The theoretical framework of regulation

Approaching the customer experience in a regulated environment cannot be done without shedding the light on the theory of regulation.

The business dictionary defines regulation as a ‘Principle or rule (with or without the coercive power of law) employed in controlling, directing or managing an activity, organization or system. The regulatory authority, formed or mandated to carry out the purpose or provisions of legislation, enforces usually regulations, which are also called “regulatory requirement”’.

The concept of regulation has been defined differently (see Table. V), depending on the political and legal context of each country and the status and the nature of the institutions linked to this function [63]. Researchers found that even economic system took different forms in different nations. The same causes do not always produce the same effects everywhere [64].

TABLE V  
REGULATION DEFINITIONS

<i>Regulation definitions</i>	<i>Authors</i>
Regulation is a substitution of a competitive logic for a monopolistic configuration.	(T. Penard and N.Thirion, 2007). [65]
The alternative solution ("second-best solution") to pure competition without public intervention, impossible or imperfect by residual natural monopolies	(Newbery D. M., 2000) [66]
Simulation of competition	(Kahn A.-E, 1988) [67]
The introduction for the maintenance of competition on the market and the implementation of public policy and the guarantee of public service delivery.	(Varone F. et Genoud C., 2001) [68]
The liberalization, in other words the introduction of competition in monopolistic sectors, is not, as the ambiguous term "deregulation", it is a quantitative reduction of public intervention, but rather its transformation.	Arentsen M. and Künneker R. 1996. [69]

The regulatory authority is a structure that meets one or more specific functions of regulating a liberalized sector [63].

Genoud (2004) describes three essential functions of regulation: technical, economic and socio-political. Technical regulation comprises all the provisions to define and control the technical standards of the installations and equipment of the industry concerned. This form of regulation seeks to ensure the safety, compatibility, integration and standardization of those installations and equipment [63].

The Market regulation is the first step in the economic regulation of a liberalized network industry. Its main objective is to introduce competition and ensure its smooth operation. It also consists of regulating the modalities and the price of access to the network by third parties which must "use" the existing monopoly infrastructures to provide their services.

The competition regulation, the second component of the economic regulation of a liberalized sector, focuses on the enforcement of the competition law and the monitoring of anti-competitive behavior, fusions and acquisitions and consumer protection.

The socio-political regulation depends on the implementation of related public policies and the regulation of the public service, which encompasses the definition and the production of public service or universal service in terms of quality, access and prices.

T. Penard and N.Thirion (2007) describe regulation functions based on three points, as an instrument of public policy, as an another way of intervention of the State on the market and as an establishment of a situation of competition [65].

Genoud (2004), in his study of the public service utilities, compared the telecommunications, electricity and road sectors and proposed two issues, namely the opening up to competition of formerly monopolistic sectors and the regulatory process that accompanies it [63]. The author asserts that the comparative analysis of the stakes for the electricity sector in Europe shows that, behind the diversity of contexts and types of regulation, a certain convergence can be observed which can give rise to the emergence of common model of a state "regulator".

In this paper, we consider the regulation theory as the theoretical referential given its functions and dimensions. The regulation theory considers three main entities: the individual, the firm and the State as social actors. These players evolve within economic systems and negotiate the regulation environment. For the proper functioning of the system, it is necessary for each of these actors to contribute to the sustainability of this ecosystem benefit from its advantages in one way or another.

The theoretical origins of the regulation concept refer to the market economy's macro-institutional foundations namely the institutional forms and the accumulation regime [70]. For the regulation theory, institutional forms correspond to the coding of one or more fundamental social relations. At its launch in the 1970s, the regulation theory borrowed from Marx's analysis the dynamics of capitalism, from the Annals' School the need to put in long historical perspective and from the post-Keynesians tools of macroeconomics [71].

The theory of regulation has continued since then to develop in new directions: theory of the state, money, macroeconomic formalization of various growth plans, sector analysis, prospective alternatives to Fordism, finally contribution to general theory of institutions. It has continued to develop its concepts, methods and expand its scope [71]. This theory presents itself as a direct competitor of the theory of general equilibrium constitutive of the neoclassical paradigm. It took off in the mid-1970s around the work of Michel Aglietta, Andre Orlean, Bernard Billaudot, Robert

Boyer, Benjamin Coriat and Alain Lipietz [63]. It was about finding the origins of containment of the Thirty Glorieuses growth [70] and studying crises in general and the economic periods of stability or instability. Regulationists focus on destabilizing factors during a crisis [70] and try to find which institutional configuration helped to overcome crises [72].

Through its combination of economic theory and history, the theory of regulation is a relevant means of analyzing crises and changes. Throughout history of economy, regimes of accumulation have been followed during crises. Robert Boyer (1986) shows that these crises are of two kinds: conjectural and structural [73]. The cyclical crises appear within the existing regulatory process. Structural crises constitute a questioning of the mode of regulation.

The purpose of regulation was originally to influence the market structure of existing products and services in order to extend its control over innovative products, to design, to develop, to commercialize and to set the requirement of standardization.

Penard, T. and Thirion, N. (2007) emphasize the relationship between regulation and redistribution policy. The redistribution consists essentially of two modalities [65]. On one hand, the creation of a universal service designed to guarantee a minimum of service to consumers, according to the criteria of affordability and equality and the devolution of a number of prerogatives to local authorities in order to reduce territorial inequalities in the digital domain on the other hand. The aim was to ensure that openness to competition did not result in the exclusion of the most modest consumers. The risk is averted by the introduction of a universal service, originally guaranteed by the historical operator and opened to a plurality of operators. Regulation goes hand in hand with a concern for social justice which removes it from a purely economic and competitive perspective of its role.

The regulation refers to inequalities in access and use of information and communication technologies. The use gap is called the second level digital divide [65].

### III. EXPLORATORY STUDY OF THE TRIANGULAR RELATIONSHIP: METHODOLOGY AND RESULTS

The research objective of this paper is to look for determinants that contribute to explain how CRM and Regulation practices influence QoE. Therefore, to study the relationship between variables, we chose the exploratory qualitative studies. To sort out this relationship, we position ourselves within a positivist perspective based on the hypothetico-deductive approach. This epistemological position aims to draw a state of the art to build an adequate theoretical framework for this relationship and derive hypotheses that will bring forward a more representative reality (Miles and Huberman, 1994) through three qualitative studies [74].

In order to determine the main items of the three variables

studied, we carried out an exploratory research approach. As a first step, we explored the determinants of CRM practices through semi-structured interviews, in a second time we tried to understand the determinants of the quality of the customer experience through a focus group and in the third step we explored The determinants of regulation towards the activity report of the ANRT.

#### A. *Exploratory qualitative study of CRM : semi-directive interviews method*

In this paper, we present an exploratory qualitative study in terms of CRM practices in the mobile phone industry. The sample is about 60% of practitioners among telephony mobile operators, 16% for a vital service provider and 24% of SS2I. The interviews were carried out according to an interview guide constructed at the base of the determinants of CRM identified from the literature review and we have summarized it in Table n°2.

For data analysis, we collected, recorded and transcribed data by Transcriber Application. To this end, we mobilized the content analysis method [75]. Moreover, with the Sphinx Lexica, we treated and coded all the answers and we analyzed the verbatim by following the method of parsing (syntactic unit is a sentence) and semantic (the semantic unit is a key idea) [76]. Following this analysis, we got answers segments that we have grouped around recurring key ideas that revolve around the five factors (Strategy, Process, Organization, Personnel and Technology).

However, for more objectivity, we also opted for a statistical analysis of key ideas through coding categories [76], and standing out the words forming these categories. With the method of multiple correspondence analyses (MCA)<sup>1</sup>, we have five sets of contingency tables that intersect in multiple matrices, key ideas as variables for each practitioner. Then we treated statistically the contingency tables by XLSTAT to study:

- The rate of inertia<sup>2</sup> which measures the practitioner's opinions dispersion around the variables (key ideas) from the center of gravity (CRM determinant) as two factorial axes.
- The factorial axes are the most active components of CRM determinant and around which the variables and observations disperse. These are the main terms or combinations formed by matching variables to observations and the observations of each variable (absence, presence, recurrence).
- The variance of the distribution of the practitioners notices by qualitative variable associated with the variance of the distribution of variables per practitioner around factorial axes represents the eigenvalue.<sup>3</sup>
- The total inertia rate is the sum of the eigenvalues. When the inertia ratio is high, it means that there is a strong dependence between variables and observations, if the total inertia ratio is low, the variables are independent toward observations.
- The cumulative percentage of inertia indicates the level of inertia or dispersion over the entire point cloud and can

<sup>1</sup> The Multiple Correspondence Analysis (MCA) is a statistical method to study at least the association between two variables, observations (CRM practitioners) and terms of observational variables (absence, presence, recurrences).

<sup>2</sup> Inertia ratio is the sum of the projected variances.

<sup>3</sup> This is the projected variance of inter-qualitative variables for a variance inter-practitioners.



explain the categories of similar profiles. In our research, we have practitioners who share the same point of view about the correspondence of the CRM determinants.

#### Results and interpretations:

We interpreted the answers segments and found that CRM practitioners mostly confirm the existence of a customer-centric CRM strategy and perceive CRM as a software tool with the objective of quality of customer service, satisfaction, customer loyalty and profitability of the company. Other objectives were mentioned but with less frequency, for example performance, segmentation, complaints management, customer knowledge.

In addition, the CRM is considered by a minority as a call center job. CRM is a project that is often supported by top management but without specific function in the organization. It is located halfway between the marketing function, the business function, the customer service function and sometimes the ISD. The CRM process descriptions by practitioners, allowed us to deduce a perceptual schema CRM process. This scheme focuses on the phase and the quality of interaction with customer, customer data collection stage, qualification of customer data integration and multi-channel communication.

Thanks to the ISO certification standards, charters, scripts and quality procedures, CRM process is considered efficient and cover among other aspects of the company's business, billing and claims management. The efficiency of CRM processes respectively depends on: targeted training around CRM and delivered to the team which in most cases is conducted to work in networks, sensitization and assessment system of CRM human resources and their professional skills.

According to the data analysis, the most cited CRM tools are the specific solutions (SAP CRM, Salesforces, Zohoo, Chugar, Microsoft Dynamic CRM, CRM-SQL software Vocalcom, Nobelsysteme) or other management solutions. They are either integrated into ERP, operated in open source configuration, internally developed or developed with the help of a professional integrator.

We noted the positive feedback toward practitioners dashboards generated by their CRM. The periodic sales tables, marketing campaigns and performance are the most cited and produce management indicators, predictive and performance indicators. They are deployed in the decision making on several levels. However, it must be said that CRM practitioners still expect more accessibility, flexibility, reliability and independence of their information technology solutions to impact the customer experience and to know them better in order to satisfy them.

The analysis of the CRM determinants components by MCA method allowed us to identify for each determinant the total inertia ratio and the asymmetric graph of associations of ideas.

#### **The CRM strategy determinant (CRMSTRAT)**

The inertia of the key components of CRM strategy is 3,923. This is the highest value of the calculated rate. It indicates that there is a high practitioner's opinions concentration around the CRM strategy variable and mainly its perception as an information technology tool, customer-oriented approach,

segmentation and claims management means, satisfaction etc ... this concentration is measured around the gravity center of all CRM strategy components with the first three eigenvalues  $\mu = 0.492$ ,  $\mu = 0.376$ ,  $\mu = 0.318$ . These values are close together and involve a high association between correspondences of practitioners opinion concerning the CRM strategy formulated by the variables listed in Table n°VI.

Eigenvalues, inertia percentage and percentage of accumulated inertia:

TABLE VI  
THE23 FACTORIAL AXES

Total inertia ratio :3,923

	F1	F2	F3	F4	F5	F6	F7	F8
Own value	0,492	0,376	0,318	0,280	0,253	0,227	0,198	0,188
Inertia (%)	12,542	9,579	8,106	7,142	6,446	5,775	5,055	4,801
%accumulated	12,542	22,121	30,227	37,369	43,815	49,590	54,645	59,446

	F9	F10	F11	F12	F13	F14	F15	F16
Own value	0,166	0,147	0,144	0,131	0,124	0,113	0,098	0,094
Inertia (%)	4,232	3,743	3,674	3,335	3,153	2,874	2,501	2,396
%accumulated	63,679	67,422	71,095	74,43	77,584	80,45	82,959	85,356

	F17	F18	F19	F20	F21	F22	F23
Own value	0,090	0,088	0,084	0,081	0,078	0,077	0,077
Inertia (%)	2,283	2,252	2,138	2,071	1,979	1,961	1,961
%accumulated	87,638	89,890	92,029	94,100	96,078	98,039	100,000

For table TableVI we have:

- The first line represents the rank of the factorial axis considered,  $p = 23$  factorial axes,
- The second line shows the eigenvalues of the matrix associated with each axis,
- The third line gives the inertia ratio explained by the axes,
- The last line gives the cumulative inertia ratio (that is to say, explained the subspace formed by the axis and the previous).
- The first three values together account for over 30% of the total inertia opinions of practitioners according to CRM strategy determinant (point cloud), so we can therefore consider other significant factorial axes that represent a combination of correspondences (variables strategy and practitioners). We can extend the factorial space to F13 with over 77% of the total inertia of the point clouds,
- The items we will consider for our study are: **Customer centric vision, IT Tool and Satisfaction**

#### **The CRM Process Determinant (CRMPROC)**

The determinant CRM process is in the second position with inertia ratio of 2.6. The analysis of CRM process asymmetric graphic components and observations shows that there are three different categories of profiles but closely spaced. The majority of practitioners category which recognizes the existence of the CRM process confirms its efficiency and described it as a series of phases : customer interaction stage, customer data collection stage, qualification

and treatment of data customers stage, quality interaction with the customer, billing, Claims management, through procedures and certifications that enact the script and interaction with the costumer in order to satisfy and offer them the QoS. Also there is a class of practitioners who focuses on respect of charters, CRM procedures and scripts, the quality of customer interaction and multi-channel integration with communication channels and finally another groups who perceive CRM process through the interaction with the customer stage, customer data collection stage and the multi-channel integration with the communication channels in the CRM (Table n°VIII).

The first three eigenvalues are:  $\mu = 0.413$ ,  $\mu = 0.348$ ,  $\mu = 0.316$ , they are close together which explains that there is a significant association between concepts that explain the CRM process.

TABLE VIII  
SEMANTIC RECURRENCES RELATED TO CRM PROCESS ACCORDING TO PRACTITIONERS.

Concepts	Number of occurrences
Interaction with the customer step	18
Integration multi channels with CRM	16
Qualification and customer data processing	15
Efficiency procedure	11
Collecting customer data step	10
Claims Management	9
Quality of interaction with the customer	8
Billing	8
Charter, user guide, scripts Respect	7
Quality of Service	5
ISO certification, internal procedures	5
Satisfaction	3
Existence of CRM procedures	6
absence of CRM procedures	1

*Own values, inertia percentage and percentage of accumulated inertia:*

Total inertia ratio: 2,6

TABLE VIV  
THE 12 FACTORIAL AXES

	F1	F2	F3	F4	F5	F6
Own value	0,413	0,348	0,316	0,297	0,249	0,196
Inertia (%)	15,902	13,387	12,149	11,422	9,571	7,548
%						
accumulated	15,902	29,289	41,439	52,860	62,432	69,980
	F7	F8	F9	F10	F11	F12
Own value	0,187	0,155	0,138	0,114	0,099	0,086
Inertia (%)	7,211	5,978	5,312	4,370	3,823	3,327
%						
accumulated	77,191	83,169	88,480	92,850	96,673	100,000

For table VIV, we have:

- The factorial axis rank is  $p = 12$ ,
- The first 3 values together account for over 41% of the total inertia practitioners opinions in relation with CRM process

determinant. We can think about other factor axes that are significant and represent the combination of correspondences (process variable and practitioners). We can extend the factorial space to F5 with more than 62% of the total inertia of the point clouds.

- The items we will consider for our study are : *The Step of customer interaction, Qualification and customer data processing, Integration multi channels with CRM and Customer Data Collection (Customer Journey).*

### **The CRM organization determinant (CRMORG)**

The determinant of CRM organization gives us an idea about CRM position inside the service provider's organization. Its inertia ratio is 2.286 and it comes third after the process.

The interpretation of practitioner's conceptual schema raised three positions categories with average dispersion. There is a category of practitioners where the CRM is positioned at the top management level and largely deviates from the two other categories. The second category positions CRM into sales function level with an average concentration of observations around this variable. The third category consists of practitioners who share their opinions around a CRM organizational position that integrates marketing function, IS Direction, management services and customers, n-1 levels of top management, sales office... (see TableVV).

The first three eigenvalues are  $\mu = 0.413$ ,  $\mu = 0.315$ ,  $\mu = 0.281$ , they are less close together which explains that there is a less significant association between the variables representing CRM Organization.

Table n° VV: Semantic recurrences according to CRM organization

Concept	Number of occurrences
Top management	9
Business function	8
Existence of responsible unit	7
Management services and clients	6
Marketing function	5
Customer Relationship Centre	4
Level N-1	3
IS Direction	3
Marketing Officer	3
Networks Team	3
Claims Management Centre	2
Sales Management	2

*Own values, inertia percentage and percentage of accumulated inertia:*

Total inertia ratio : 2,286

TABLE VVI  
THE 12 FACTORIAL AXES

	F1	F2	F3	F4	F5	F6
Own value	0,41	0,31	0,28	0,22	0,20	0,17
Inertia (%)	3	5	1	5	4	9
%accumulated	18,0	13,7	12,2	9,85	8,91	7,84
	77	76	89	7	4	8
	18,0	31,8	44,1	54,0	62,9	70,7
	77	53	43	00	14	62

	F7	F8	F9	F10	F11	F12
Own value	0,149	0,133	0,124	0,094	0,087	0,081
Inertia (%)	6,526	5,817	5,404	4,132	3,801	3,560
%accumulated	77,288	83,105	88,508	92,640	96,440	100,000

For table VVI, we have:

- We considered twelve factorial axis  $p = 12$ ,
- The first tree values together account for over 44% of the total inertia practitioners opinions related to CRM Organization determinant, Also we can take into account other factorial axes. We can extend the factorial space to F5 with more than 62% of the total inertia of the point cloud.
- The items we will consider for our study are: *organizational structure and (top management, business function, Management services and customers, marketing functions...) and responsible Unit of CRM.*

#### The CRM technology determinant (CRMSTECH)

The technological component of CRM comes in the fourth position with a total inertia ratio of 1, 81. There are several categories of profiles relatively dispersed according to their CRM expectations but concentrated into two categories. The first category of practitioners use the following software CRM: Integrated CRM software in the ERP, CRM-SQL, VOCALCOM, NOBELSYSTEME, Software GRC, EFBI Platform, Microsoft Dynamic CRM, SAP CRM, Salesforces, Zohoo, Chugar and other software managements such as ELAG, and business management software. They are interested in reports generated by the CRM and indicators that these reports occur. (see Table VVII).

While the second category is a minority of practitioners who are aware of the importance of CRM software and dashboards they generate but don't use it in their own activities, but they are involved as SS2I; in other words as, assistant work of master in CRM solutions integration.

These results reflect the overall vision of the recently study published by the Gartner Institute for the year 2014 "Magic Quadrant for Business Intelligence and Analytics," especially at the point of operational and decision-making ability of CRM Solutions that are greatly raised in this report. This one highlights also, that "historical leaders of the CRM market: Oracle, Microsoft, IBM and SAP are this year the big" losers "in this study with a speed loss on the clear quadrant.

The first three eigenvalues of CRM technology determinant are  $\mu = 0.360$ ,  $\mu = 0.234$ ,  $\mu = 0.193$ . They are less close which explains that there is less and less an important combination between concepts that represent the CRM technology.

**Table VVII:** Semantic recurrences on CRM technology according to practitioners

Concept	Number of occurrences
Specific software	9
Other software	6
Dashboard	2
Performance report	5
Operational ability : Accessibility and Flexibility	8
Excellent experience, satisfaction and customer knowledge	7
Managements indicators	6
Performance indicators	6
Sales report	4
Marketing campaign report	4
Periodic reports	4
Independence	4
Profitability	4
Performance	4
Predictors	3
Reliability	3
Management report	2
Sale force automating	3
Zoning report	2

Own values, inertia percentage and percentage of accumulated inertia:

Total inertia ratio:1,81

	F1	F2	F3	F4	F5	F6
Own value	0,360	0,234	0,193	0,161	0,158	0,156
Inertia (%)	19,875	12,943	10,666	8,898	8,754	8,638
%accumulated	19,875	32,818	43,484	52,383	61,137	69,775

	F7	F8	F9	F10	F11	F12
Own value	0,124	0,114	0,096	0,078	0,076	0,059
Inertia (%)	6,840	6,313	5,312	4,321	4,201	3,239
%accumulated	76,615	82,927	88,239	92,560	96,761	100,000

Table VVIII. The 12 factorial axes

For table VVIII, we have:

- We consider 12 factorial axes,
- The first tree values together account for more than 43% of the total inertia of the point cloud. Beyond third factor, the difference between values becomes insignificant, so we limit ourselves to F3.
- The items we will consider for our study are: *Solution support (Specific software, Other software), Operational ability (Accessibility and Flexibility) and Decisional ability*

(Managements indicators, Performance indicators, Performance reports).

#### The CRM HR determinant (CRMHR)

From Table 14, we remark that the determinant of human resources is the latest one with a total inertia ratio of 1,286. It means that practitioners disagree with a wide dispersion about the key components of HR namely staff skills, training on CRM and sensitization and assessment systems developed around CRM. The analysis of asymmetric graph of variables and observations showed a big gap between the profiles of practitioners and high data dispersion.

The first three eigenvalues of the CRM are  $\mu = 0.707$ ,  $\mu = 0.327$ ,  $\mu = 0.252$ . They are not at all close, which explains that there is a weak association between concepts that represent the HR as a determinant of CRM.

**Table n° 14:** Semantic recurrences related to CRM HR according to practitioners

Concepts	Number of occurrences
Staff Skills	12
CRM training	30
Sensitization System around CRM	10
Assessment and control System	16

#### Determinant CRM Human Resources

Own values, inertia percentage and percentage of accumulated inertia:

Total inertia ratio: 1,286

	F1	F2	F3
Own value	0,707	0,327	0,252
Inertia (%)	54,957	25,442	19,601
% accumulated	54,957	80,399	100,000

Table 15. The 3 factorial axes

For table 15, we have :

- The first line represents the rank of the considered factorial axis,  $p = 3$  factorial axes,
- The first three values together account for 100% of the total inertia practitioners opinions according to HR CRM determinant. We can limit our analysis to the first factor with 54% of inertia and for more significations connections we can also consider the second axis with more than 80% of the total inertia of the point clouds.
- The items we will consider for our study are *Staff skills, CRM training and Control system for human resources*.

#### Discussion of CRM Items

To conclude, CRM is a strategic choice for enterprises and mainly for mobile phone service providers. They have to

guide the overall strategy toward the customer. In other words, it is essential to rethink the organization and business structure around customer service, train and develop management and IT skills related to CRM, implement an effective process and support it with technology. The objective is to offer consequently a quality customer experience in the use of services across CRM practices. Furthermore, we understand with evidence that interactive links between the determinants of CRM and the determinants of the quality of the customer experience (QoE) exist. On one hand, the semantic analysis of CRM determinants brings up the determinants that we found in the literature review of the quality of customer experience, like quality of service, quality of interaction with customer, claims management and customer knowledge. And on the other hand, it turns out that practitioners are aware that we should look beyond the relationship to manage the customer experience to satisfy and retain thereafter.

#### B. Exploration of QoE by qualitative method: focus group

The research objective of this paper is to look for determinants that contribute to build up the customer experience. Therefore, we began with a documentary study based on the review of reports and studies carried out by the National Telecommunications Regulatory Agency which is the authority in charge of regulating the telecommunications sector in Morocco. This primary exploratory study is the foundation of our theoretical framework.

In order to complete and compare the concepts extracted from the literature review, we choose to lead a qualitative exploratory study consisting of focus group. This latter is an efficient way to collect the maximum of felt, thought, perceptions that Moroccan young users experience when using a mobile telecoms service.

The focus group is an informal discussion among a group of selected individuals about a particular topic [77]. Methodologically, focus group interviews involve a group of 6–8 people who come from similar social and cultural backgrounds or who have similar experiences or concerns. They meet together to discuss issues with the help of a moderator and where participants feel comfortable enough to engage in a dynamic discussion for one or two hours [77].

Our research choice consisted on a group of seven members selected following a call of participation that we launched to the group of telecommunications and IT students. The discussion with the group lasted an hour and a half and was focused on the use of the mobile telecoms services, namely voice, Data, Internet and complementary services.

For data analysis, we collected recorded and transcribed data by the Transcriber Application. To that end, we mobilized the content analysis method [75]. Then, we treated and coded all the answers and we analyzed the verbatim following the method of parsing (syntactic unit) and semantic [75]. According to this analysis, we have got answers segments that we have grouped around recurring key ideas which revolve around the following factors: loyalty, churn, boycott, positive and negative opinions, feeling, perceived



value, perceived quality, QoS, bad or good lived-experiences in the past.

#### Results and interpretations

For our study, we collected and classified in general 311 ideas cited during the focus group. The most important items are related to QoS, interaction with operator, loyalty, choice assessment and negative opinion with the following percentages 15%, 10%, 9.32%, 7.71% and 7.07% respectively. We also identified other factors in relationship with the usability of services, positive perceived value, bad previous experiences, perceived quality, feeling, churn, positive opinion, user's preference, great previous experiences, negative perceived value and boycott with the following percentage 6%, 6%, 5.78%, 5.46%, 5.46%, 5.14%, 5.14%, 4.5%, 3.21%, 2.57% and 0.32% respectively.

In order to give an insight to all this data, we use the clustering approach for determinants in line with theoretical framework (See Table.II).

Moreover, we drew from a German study in the mobile cellular telecommunications market, to cluster loyalty, boycott and churn in a single determinant "Attrition & Retention". This study showed empirical evidence of causal linkages from customer satisfaction to customer loyalty and to customer retention [78].

Furthermore, we grouped quality perceived and value perceived into "Perception" determinant referring to Andreani and Conchon (2005) who argue that perceived value can be regarded as a consumer's overall assessment of the utility of a product or service based on perceptions of what is received and what is given [76]. The author referred to this assessment as a comparison of a product or services "get and give" component [76].

We also used the definition of Zeithaml, V.A (1988) who argues that perceived quality has global perceptible, sensorial and sensible dimensions: both services (benefits) and features that express the quality promise [71].

The data collected by this study provided evidence that user's positive opinion, negative opinion, feeling and preference must be grouped on "Affect" determinant in accordance with the framework for experiential marketing model based on Sense, Feel, Think, Act and Relate [50].

On the basis on the quality of daily experience studies conducted by Hektner, J. M. et al., it seems fair to suggest that great or bad previous experience lived and choice assessment should be gathered on "Affect" determinant [52].

Referring to International Telecommunication Union (ITU) recommendation [62], [49] and other authors, there is overwhelming evidence corroborating the fact that "QoS" determinant encompasses services usability, technical offer and operator interaction.

TABLE I6. THE CUSTOMER EXPERIENCE DETERMINANTS

Determinant	Items	occurrence	%	Cumulated %
Attrition & Retention 46	Loyalty	29	9,32	14,79
	Churn	16	5,14	
	Boycott	1	0,32	

Perception 44	Perceived quality	17	5,46	14,14
	Negative perceived value	8	2,57	
	Positive perceived value	19	6,10	
Affect 121	Positive Opinion	16	5,14	38,9
	Negative Opinion	22	7,07	
	Feeling	17	5,46	
	User's preference	14	4,50	
	Previous great experience	10	3,21	
	Previous Bad experience	18	5,78	
	Choice assessment	24	7,71	
QoS 100	Services usability	19	6,10	32,15
	Technical Offer	47	15,11	
	Operator interaction	34	10,93	
Total		311	100	

#### Discussion of QoE Items

We aimed to understand the determinants of the customer experience. In this regards, the analysis of data allowed us to distinguish between three kinds of variables. Objective Variables which means effects like QoS, Perception and Affect and others subjective variables that involve the cause of these effects like "Attrition and retention" and others which intermediate the causal relationship like "attitude" and "previous experience".

While summing up all the subjective determinants, we got a cumulative rate of 67.18%. Hence, it seems that the subjective and human dimensions are the most the important.

Moreover, starting from a set of QoE models derived from the literature review, we analyzed the content of the focus group verbatim and construct the following determinants: Attrition & Retention, Perception, Affect, and satisfaction. Those latter will be confronted in our future research with the empirical reality through the following items:

- Attrition & retention: Loyalty, Churn, Boycott
- Perception: Perceived Value, Perceived Quality
- Affect: Customer feeling, Preferences, Opinions, Previous Experiences , Choice assessment, Satisfaction
- QoS : Interaction with the operator, Usability of Services , Quality of the technical offer

#### C. Regulation documentary study

ANRT was created in February 1998 under Law n° 24-96 on postal and telecommunications services which dictated the general outlines of the sector's reorganization. The Agency is responsible for:

- The power of legal regulation;

Using its legal regulatory authority, ANRT supports the dynamism of a competitive market to help stakeholders better achieve their goals. It does so by raising barriers to sector growth or even imposing provisions for the common good.

▪ The power of technical regulation

The power of technical regulation has made ANRT responsible for developing standards and the enforcement thereof. In particular, ANRT is responsible for determining technical specifications and administrative approval of terminal equipment radio installations intended to be connected to a public telecommunications network, managing scarce resources, Quality control and monitoring operator commitments in terms of coverage.

▪ The power of economic regulation

To ensure conditions for fair competition and to support sustainable development in the telecommunications sector, the Agency has the authority to intervene in the market in case of suspicion of abuse. To ensure the economic regulation of the sector, ANRT is authorized to approve operators' technical offers and interconnection pricing; to ensure compliance of fair competition in the sector; to resolve any disputes between operators and to Monitor the development of the Information Technologies sector on behalf of the Government.

### Discussion of Regulation Items

The mobile market is strategic for the Moroccan economy, regulated by the State and highly sensitive to technological developments and qualitative standards. Over the past few years, the sector has experienced strong growth, characterized by lower prices and intensive competition between the three operators. This growth was supported by the strong demand from users and the maintenance of regulatory and control measures and levers governing the sector. In this ecosystem, the three players in the sector, namely the customer, the regulator and the operator, must converge according to a management model aiming to more performance and balance. This model would value the most influential determinants and minimize risk factors that may affect the triangular relationship between them.

### IV. ESTIMATION OF THE TRIANGULAR RELATIONSHIP BY SEM

To test simultaneously the existence of causal relationships between several explanatory latent variables and more variables to explain we select the second-generation methods called methods of structural equation. In our future research, we will address the causal relationship between latent variables by an emerging technology used in structural equation approaches. It is based on the analysis of variances, known under the name of the PLS approach (Partial Least Square) which is adapted to certain structural models for which conventional estimation procedures can be tricky to use [79].

The latent variables are unknown, they can be estimated from the manifest variables. Thus, the latent variables are estimated by combining the information obtained from using a set of manifest variables and isolating their common variances

portions. This approach allows control measurement errors. The theory related to latent variables is complex and has been developed by many researchers as Bollen (2002) or Borsboom et al. (2003) [80],[81]. As part of this communication, we call latent variables: CRM, QoE and Regulation and we call manifest variables all items related to each latent variable. Those determinants have been explored in the literature review and from the exploratory qualitative research.

In this section, we present details of our finding on three latent variables LV estimated from the manifest variables MV.

### Indirectly measurable variables:

- QoE as latent variable to explain (dependent our outcome variable),
- CRM as explanatory latent variable (independent variable),
- Regulation (ANRT) as a moderating latent variable.

### Directly measurable variables called items or manifest variables that form the latent variables.

#### A. CRM items

	MV		Objective Of Item	Authors
<b>CRM Strategy CRMST RAT</b>	Moroccan mobile telephony operators have a strategic vision oriented customer. they perceive the CRM as an information technology tool with the objective of the customer satisfaction			
	<b>Vision CRM VISCRM</b>		Your company has a strategic vision oriented towards its customers	Alard and al., (2000) Parvitiyar and Sheth (2001), Buttle (2001), Howlett and Rodger (2002), Thieriez (2002), Zablah, Beuenger, and Johnston (2003), Singh and Agrawal (2003), Peppers and Rogers (2004), Peelen (2009), Alard and Guggemos (2005), Swift (2000), Peppers, Rogers and Dorf (1999), Rita Urbanskiene and al (2008), Hobby (1999), Nurdilek Dalziel and Fiona Harris (2011), Aihie Osarenkhoe and Az-Eddine Benmani (2007), Douglas M. Lambert(2010) Heskett and al. (1994), Lefranc, (2013), Shaw, R. and Reed, D. (1999), Pine, B.J. and J.H. Glimore. (1999),
	<b>IT Tool</b>	<b>ITT CRM</b>	Your company considers CRM as an information technology tool for achieving performance objectives	
	<b>Satisfaction</b>	<b>SAT CRM</b>	Your company uses CRM to satisfy customers	
<b>CRM process CRMPR OC</b>	Moroccan mobile operators have an effective CRM process			
	<b>Step of customer interaction</b>	<b>SCI CRM</b>	The steps of customer interaction are well defined within your company	Lambert, D. M, (2010), Payne, A. and Frow, P. (2006), Zablah, A.R., Bellenger, D.N., and Johnston, W.J. (2005)



	<b>Multi-Channel Integration</b>	<b>MI CRM</b>	In its customers interaction, your company integrates multiple channels of communication in customer touch points,	Xu (2002), Missi and al (2002), Ryals and Payne (2006), Khanna (2001), Stone and Woodcock (2001)
	<b>Qualification and data processing</b>	<b>QDP CRM</b>	Your company regularly updates and processes customer data	Ramano and Fjermestad (2003), Frock (2000), Kutner and Cripps (1997), Ja-Shen Chena, and al (2009)
	<b>Customer Data Collection / Customer Journey</b>	<b>CDC CRM</b>	The steps of collecting customer data and the customer journey map are well defined within your company	Nguyen, T.H and al. (2007), Park, C.H and Kim, (2003), Mckim, R. (2002), Zikmund, W.G., McLeod, R. Jr and Faye. G.W. (2003), Dillon, A., Morris, M.G. (1996)
<b>CRM organization CRMORG</b>	The operators of the Moroccan mobile telephony have an appropriate organizational structure in CRM.			
	<b>Organizational Structure</b>	<b>OS CRM</b>	The CRM is a matter of direct top management	J.L. Giordano, (2006), Ajzen, I. (1991), Heskett and al, (1994), Buttle, (2001), Kaplan and Norton, (1996)
		Sale function	The sales function is the structure most concerned by the CRM	
		Management services and customers	Management services and customers is the structure most concerned by the CRM	
	<b>Cellule responsible</b>	<b>CRC RM</b>	The operators of the Moroccan mobile telephony have a unit dedicated to CRM.	
<b>CRM Technology CRMTECH</b>	Mobile operators support their CRM strategy with CRM solutions that have operational and decision-making abilities.			
	<b>Solution support</b>	<b>SSCRM</b>	Your company uses software solution to collect and processing customer data	Lamparello (2000), Mckim (2002), Crosby Johnson (2001), Gosney and Boehm (2000), Dionne (2001), Glazer (1997), B.Ramaseshan and al (2006), Alard and Guggémos (2005)
	<b>Operational ability</b>	<b>OACRM</b>	These software are easy to use (Accessible, flexible, compatible ...)	
	<b>Decisional ability CDCRM</b>	<b>DA CRM</b>	CRM software allows your company to forward out management and performance indicators	

<b>CRM Human CRMHUM</b>	Training, skills and the evaluation system are the main criteria that the operator must pay attention to in order to ensure the effectiveness of the CRM staff			
	<b>Training</b>	<b>TRACRM</b>	Your company trains its staff in CRM	Kaplan and Norton, (1996), Buttle, (2001), Heskett and al, (1994), Ramaseshan and al, (2006)
	<b>Control system for human resources</b>	<b>CS CRM</b>	Your company has a CRM system that evaluates the CRM staff	
	<b>Staff Skills</b>	<b>SSCRM</b>	The CRM staff is qualified for this job	

### B. QoE items

	MV		Objective Of Item / Questions	
Attrition & retention ATR ET	Customers operators are not willing to change their operators.			
	Loyalty	LOYQoE	Your customers are loyal	Gerpott, Rams and Schindler, (2001), Chen and Russell, (2007), Meyer and Perey, (2009)
	Churn	CHUQoE	Some of your customers are predisposed to leave the operator to go to your competitor	
	Boycott	BOYQoE	Your customers boycott some mobile services	
Perception PER C	In your business, the design of mobile services take into account the customers perception of quality and value of services.			
	Perceived Value	PVQoE	the collected customer data enable your business to know the gap between the supply of the operator and its real value as perceived by the customer	Giordano, (2006), Laghari, K.R. and al. (2013), ITU, (2007), Parasurama, Zeithaml and Berry (1985)
	Perceived Quality	PQQoE	The collected customer data allow your company to know the difference between the quality of service offered by the operator and the actual quality of service as perceived by the customer	
Affect AFEF	Operators establish a close relationship with their customers by knowing more their preferences, opinions, feelings and perceptions within the use of mobile services.			

	<b>Customer feeling</b>	<b>CFQoE</b>	Your company knows the feelings of its customers (love, insecurity, discrimination, fear, ...)	Garg and al, (2012), Hektner and al, (2007), Schmitt, (1999), Mitra, and al. (2011), ANRT Report (2015)
	<b>Preferences</b>	<b>PREQoE</b>	Your company knows the mobile services use preferences of its customers	
	<b>Opinions</b>	<b>OPIQoE</b>	Your company knows what customers think of mobile services	
	<b>Choice assessment</b>	<b>CAQoE</b>	Your company's customers are satisfied with their choices and recommend their operator to their entourage	
	<b>Previous Experiences</b>	<b>PEQoE</b>	Your company knows the (good and bad) previous experiences of its customers	
<b>QoE SAT</b>	The Operators are aware of the level of customer satisfaction			Hektner and al, (2007), Moller and al, (2009), Laghari and al, (2012), Dillon and Morris, M.G. (1996),
	<b>Interaction with the operator</b>	<b>INTQoE</b>	The interaction with the customer is regularly monitored and evaluated through the various points of contact and communication with the customer	
	<b>Usability of Services</b>	<b>USQoE</b>	The services most used by clients are known	
	<b>Quality of the technical offer</b>	<b>QTOQoE</b>	The quality of the technical offer is regularly measured and evaluated	

### C. Regulation items

		MV	Objective Of Item / Questions	
Tech nical pow er  POU VTE CH	The regulator control of the operator technical offer and its quality can positively impact the perception, the feelings and the opinions of the customers			
	Technical quality (QoS) control	TQCREG	The QoS control by the regulator helps to improve your company's services.	Genoud (2004), Wellenius, and Rossotto, (2000),
	Auditing and monitoring of commitme nts	AMCREG	The audit of operators by the regulator contributes to the fulfillment of operators' commitments to cover the territory network.	
	The legal authority can supervise CRM practices and impact customer satisfaction			

Legal Power POU VJUR	Respect of specifications	RSREG	The Respecting of specifications by the operator may adversely affect the design of mobile services	ANRT Report (2015), Williamson (1985), Kahn (1988), Boyer(200) , Chavance (2012)
	Regulatory framework	RFREG	The laws, decrees and regulatory decisions can restrict customer access to mobile services and their usability	
economic Power POU VECO	The regulator acts on the competitive position of operators and customer attrition			
	competition	COMREG	The regulation of competition encourages the customer to remain faithful to his operator.	ANRT Report (2015), Arentsen and Künneke (1996), Kahn (1988),
	Tariff regulation	TRREG	The Tariff regulation homogenizes market prices and give more flexibility to the customers in choosing the operator.	
Social Power POU VSO C	Relation entre les clients et le régulateur			
	Customer complaints management	CCMREG	Customers can interact with the regulator to make a claim or complain antis competitive practices.	ANRT Report (2015)

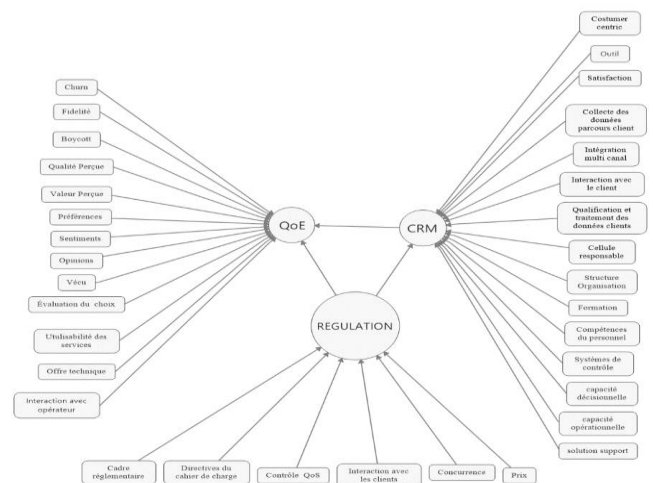


Fig. 1. Preliminary model – PLS Approach

### VI. Conclusion

The strategic way to increase revenue growth in the mobile phone industry is customer relationships. It is well-known that CRM enables services providers to improve their relationships with their customers by creating a single

relationship and a single view of the customer across the entire organization, allowing the customer to do business any time, any place and anywhere they choose through whatever channel they choose. The customer can be touched towards different touchpoint and the challenge for every organization is to identify the customer immediately and personalize its service based on that customer's previous interactions. For telecommunications mobiles operator, CRM should be able to integrate those channels, allowing the organization to build on each interaction to improve the quality of the customer experience and increase their chance and intention to buy.

CRM is not just about software; it is a strategy, a process, with an adaptable organizational structure.

From the exploratory studies, within the Moroccan mobile sector, we will be able to measure the impact of the CRM on the QoE by following the preliminary model as estimated by the PLS approach as seen in the figure 1. Also, we will observe how regulation moderate this impact. Especially through The items of regulation as well the regulation of competition, the prices regulation and the technical and Legal control.

In The telecommunications mobile services, customer experience is improving only ever so slightly, or even decreasing. That makes the results we can achieve even more remarkable. But the competitive advantage that these operators have achieved has not come about because of a piece of software, but because of the initiative they have taken to become customer-focused. To become customer-focused operators need to have a people with competencies, efficace process and a vision of strategy CRM.

To conclude, we can say that the causal relationship between MRC and QoE can be influenced by the moderating power of regulation. However, the weight of structural coefficients associated to the relationship between latent variables of the internal model will determine thereafter the quality of model estimation by PLS approach.

The exploratory studies allowed us to highlight a variety of items. This latter explains both the importance of causal relationship for users and providers that the complexity of the regulator's role in the moderation of this relationship.

There are two mains drawbacks of this paper. Our research has been limited by the problem to interview CRM professionals; the second shortage is relatively related with a small sample of focus group. The next stage of our research is the data collection, in order to confirm the causality of latent variables. The survey will be through a population of 300 executive manager of mobile industry. By the way, questions will correspond to objective of items and Interviewees must assign a response related to their level of agreement according to a graduated Likert scale of 1 to 7.

In our research, we found that there are some limitations such as the size of the survey. The first study was about CRM practitioners and the second one was about users but the third one was from documentary nature related too the mission of the national agency of telecommunications reglumenteries

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# A Theoretical Framework for Measuring the Customer Experience (May 2017)

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**Abstract**— In the last few years there has been increasing interest from scholars and practitioners in the customer experience and its measurement. It's widely considered the next competitive battleground. The purpose of this paper is to highlight the importance of assessing the customer experience. In this paper we present an overview of the theoretical and conceptual framework of the customer experience and its evolution. We also point out its main determinants and focus on the most popular methods of its measurement and finally we shed some light on the scale development approach.

**Index Terms**— Customer Experience, Experience Economy, Experiential Marketing, Items Scales, Measurement, Scale development, Services Marketing, Quality of experience.

## I. INTRODUCTION

AROUND the world, companies have come to recognize the importance of managing and measuring the customer experience (CX) as a new compromising challenge to the ultimate success of their business [1].

Many researchers, authors and practitioners consider the concept of experience as an extremely promising model, an approach that relies on consumer's behavior, needs and desires as well as on high quality standards.

Consumers are no longer simply seeking utilitarian and functional aspects of the product but they are also looking for the hedonistic and subjective side of consumption: the experiential consumption, a new marketing vision [2].

The relational approach or CRM as well as the model of the total quality, two approaches adopted and used in the 90s, almost disappear from marketing practices.

According to a study led by the consulting firm Bain & Co within 362 companies operating in several sectors and their customers, 80% of Chief Executive Officers (CEOs) claim they deliver great customer experiences while only 8 percent of their customers agreed with this judgment [3].

The impact of customer experience on the company has been introduced and discussed in the marketing literature in the last decade [4]. Creating superior customer experiences is considered a key objective for the organization success [5].

The service marketing literature concerned with the theoretical concept of the customer experience is based on the notion that this latter is a sum of clues and indices that the consumer receives through all direct and indirect interactions with the company and its offerings as a part of a total experience [6].

The Customer Experience remains a complex and multidimensional concept that spreads as a competitive advantage and a new source of differentiation for the company [7] [8].

Several measurement methods have been proposed in the literature in order to assess the customer experience. The development of a reliable and valid scale has attracted the interest of practitioners and academics in the 1980s and has been the focus of a many research in the field of operational management [9].

In the following sections, we will present the theoretical foundations of the customer experience such as the definition of the concepts and highlight its main dimensions. We will also track the key variables for developing a suitable measure building on existing methods in the literature. Finally, we will give insight to the scale development process.

## II. THE CUSTOMER EXPERIENCE: CONCEPTS AND DIMENSIONS

The importance of the customer experience as a consumption driver was cited in the old economic literature that described it as the extent to which consumers decide what goods and what experiences to purchase [10] [11].

At the end of the 20<sup>th</sup> century, Pine and Gilmore wrote about how economies change by introducing the new paradigm of the "Experience Economy" [7]. They are the first authors to have studied the concept of customer experience as a new type of offer. Until then, we distinguished three types of offers: commodities (primary sector), manufacturing (secondary sector) and services (tertiary sector). The experience appears as a fourth option.

In today's economy, offering goods and services of high quality is not sufficient for the firm to get a competitive advantage. Companies need to compete on a more complex level by creating and offering a total satisfactory experience through all the purchase stages, managing customer's expectations and response before, during and after the buying process [5] [6].

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### A. *The Concept of Customer Experience*

Experience is an interdisciplinary concept that has attracted the interest of many researchers in the field of economics, psychology and management [12].

Psychologists, consumer behaviorists, philosophers, economists, marketing and management researchers, managers and consultants try to approach and define the customer experience from their unique viewpoints.

The term "experience" can refer to both an internal assessment of consumers [12] [13], but also a strategic marketing discipline [14] [15] [16].

The experience truly entered into the marketing field in 1982, with Holbrook and Hirschman who were the pioneer authors to point out the necessary integration of the consumer experience into the consumer behavior patterns [17]. Their paper "The Experiential Aspects of Consumption: Consumer Fantasies, Feelings, and Fun" is the base for other research founding the experiential marketing paradigm [18].

Since then, this concept is viewed as a key factor for understanding consumers' behavior and even as the foundation of an economy [7] [12].

Academics have paid increasing attention to how the customer experience could go beyond service. A research paradigm used the customer journey metaphor to explore experience, defining experience as perceptions of service through each point of contact with the company [19]. Other researchers have used the same metaphor to assert that this journey can both precede contact with the company and continue after it and integrate what Payne et al. (2008) call the "encounter of communication" and the "encounter of the use" as well as the "encounter of service" [20].

The concept of "customer journey" is described as the sequence of the customer's contact points with the company during the purchase and the service provision. It is a widespread notion in the design of the service that reinforces the statement that the customer perception may vary according to the journey [21] [22].

To provide the desired experience, service firms must capture and assemble a consistent set of elements or indices during the customer journey [23].

Rawson et al. (2013) also discuss the management of the overall customer journey, starting from the initial request to the final invoicing of the service [24].

The definitions of the customer experience concept are very wide. Several definitions are proposed in the literature. They range from the current and predicted customer's buying and consumption experience, a distinctive economic offer or the result of the interactions with the firm to the concept of consumer search for a new experience as a co-creator of value.

Carbone and Haeckel (1994) were among the first authors to give a definition to the customer experience: "By 'Experience', we mean the 'takeaway' impression formed by people's encounters with products, services, and businesses. We constantly filter a barrage of clues, organizing them into a set of impressions-some of them rational, some emotional... collectively, they become an experience." [25].

Gilmore and Pine (2002) added the idea of a "memorable" experience and thus the storage aspect of the experience.

Experience is a series of events staged by a company with the objective to involve the customer. The experiences are personal, distinctive and memorable [26].

The customer experience definition by Sundbo and Hagedorn-Rasmussen (2008) postulates that the customer is actively involved and takes into account memory's aspects. According to the researchers, a customer experience is "a mental journey that leaves the customer with memories of having accomplished something special, having learned something or just having had fun" [26].

Meyer and Schwager (2007) define customer experience as : "the internal and subjective response customers have to any direct or indirect contact with a company." [12].

Maklan and Klaus (2011) add that this internal response results from a cognitive and emotional evaluation of all the encounters related to the purchase behavior [28].

Building on the work of other researchers, Gentile et al. (2007) point out that: "The customer experience originates from a set of interactions between a customer and a product, a company, or part of its organization, which provoke a reaction" [13]. This experience is strictly personal and implies the customer's involvement at different levels (rational, emotional, sensorial, physical and spiritual) [15]. The authors state that the evaluation of the experience depends on the comparison between the customer's expectations and the stimuli coming from the interaction with the company and its offering at the different moments of contact or touch-points.

Berry et al. (2006) define the customer experience as a set of indices ("clues") which includes features that are both functional and emotional. The combination of all indices is the "total customer experience" [23].

In their research within companies, Lemke et al. (2006) state that there are five key elements that characterize the experience: the emotional aspect, the social impact, the relationships with the company, the interpersonal relationships with other customers and the atmosphere [29].

According to the conceptual model of Lemke et al. (2011), the quality of experience includes the service quality, the quality of the product, the social impact, the communication with the company and the experience context [30].

For consumer behavior researchers, the experience can be defined as a continuous learning generator for individual behavior [31].

Schmitt (1999) proposes a new definition of the experience: "Experiences occur as a result of encountering, undergoing or living through things. They provide sensory, emotional, cognitive, behavioral, and relational values that replace functional values." [15].

There is a broad consensus that the customer experience is different and more complex than the quality of service, the customer satisfaction, the loyalty and recommendation [32].

Offering an optimal and positive customer experience influences customer satisfaction, creates an emotional connection with the brand and enhances customer loyalty. Therefore, it helps to increase market growth and foster the organization's profitability and competitiveness [33] [34].

According to Pine and Gilmore (1999), the concept of experience involves a theatricalization of some components: the employees personify the actors; the customers are the spectators; the site becomes the scene [35].

Arnould et al. (2002) classify the experience into four main steps following the purchasing process: the anticipation of the consumer experience, the purchase experience, the consumption experience and the memory of experience [36].

According to Schmitt (2003), the value of experience strengthens the purchase intent. A series of studies conducted by his consulting firm in the field of experience has shown a strong correlation between the value of the experience, the overall impression and the consumer purchase intent [37].

Voss (2003) illustrates the profitability of the concept of experience through his model called "The Experience Profit Cycle", which states that memorable visits and the desire to repeat the experience induce an increase in the attendance, the duration of the visit and the expenses, which in turn generates a growth in the company profits and value [38].

### *B. The Customer Experience Dimensions*

The multi-dimensionality of the customer experience is widely recognized in the literature of experiential marketing. The customer experience literature lacks empirical support and the standardized dimensions of the customer experience are to be established. However, Schmitt (1999) and Haeckel et al. (2003) attempted to explore its dimensions, supported by other researchers [15] [39].

Schmitt (1999) says that consumers of yesteryear interested in functional and utilitarian aspects should be now seen as "rational and emotional human wanting to perform and live fun experiences through five types of experiments: sensory, cognitive, emotional, social and behavioral" [15]. The author considers that each experience shows the three dimensions of the mind: sensations, feelings and thoughts that he completes with two other dimensions, which are the individual's behavior and the relationship with others [15].

Schmitt (2003) noted that the ultimate goal of experiential marketing is to create a holistic experience that integrates all individual types of experiences into the total customer experience. The author was among the first researchers who discussed the experience management. According to him, the company has five actions levers or Strategic Experiential Modules and should stimulate the customers' senses ("sense") and feelings ("feel"), encourage them to think ("think"), to act ("act") and to feel connected to the product ("relate") [37].

The sensory dimension refers to the five senses that are taste, touch, smell, vision and hearing. Regarding the cognitive dimension, it refers to the development of thoughts within the individual that may cause an experiment. Schmitt (1999) also mentions the importance of the role of emotions. He points out that emotions must be manifested positively, for example, by empathy, joy and pride. The social dimension refers to interactions, perceptions and sense of belonging that consumers could have with certain groups. The behavioral dimension, meanwhile, is targeting experienced physical responses of consumers [15].

From another point of view, Haeckel et al. (2003) distinguish three types of indices - functional, human and mechanical - that lead to the customer experience. Functional indices refer to the actual functioning of the good or service. Mechanical clues stimulate the brain's emotional circuit and evoke emotional responses, while human clues such as words, tone and body language are expressed by sales staff. These indices can be considered as three dimensions of the customer experience [39].

Berry et al. (2006) linked the functional indices to the technical quality of the service. The mechanical indices refer to the service encounter, the service environment, the service scape, the atmospheric and the physical environment. It includes the location where the service is offered, the interactions of customers with the service provider, combined with tangible property that facilitates the communication of the service. The employees' behavior and performance are the third category of indices that is human. Human clues are related to the action and appearance of employees and service providers such as the tone of voice, the body language, the appearance, the level of enthusiasm, and others [23].

Backstrom and Johansson (2006) argue that positive experiences are created when employees make extra efforts and go beyond the level of the required service [40].

Gentile et al. (2007) have conducted an empirical study concerning the role of experiential characteristics of some well-known brands and products [13]. Their research suggests that sensory, emotional, cognitive, pragmatic, lifestyle and relational components allow understanding the customer experience. By investigating the role of different experiential features in the success achieved by some products, their study suggests that value proposition should include both experiential characteristics (hedonic experiential value) and functional characteristics (utilitarian value).

Verhoef et al. (2009) state that the customer experience is of cognitive, social, emotional and physical nature [5]. Their models of creating customer experience suggests that its determinants and the corresponding management strategy should include the social environment, the service interface, the atmosphere of sale, the assortment, the price, the customer experiences in alternative distribution channels and the past customer experience. The authors developed four other major determinants that are the social environment, the service interface, the store atmosphere and the past experience and derived three dimensions: the quality of service outcome, the quality of interaction and the peer-to-peer quality [5].

Lemke et al. (2011) also postulate that the customer experience consists of three dimensions: the encounter of communication, the encounter of service, and the encounter of usage [30].

The dimensions provided by Schmitt (1999) was adopted and subsequently amended by several authors [13] [14] [16].

#### *1) The Cognitive Dimension*

Cognitive engagement within the individual lies on the way the experience causes some illuminating thoughts. The cognitive approach suggests that consumers are rational and oriented towards problem solving [36]. The cognitive dimension can be defined as the thoughts that are generated individually during the activity, regardless of the source [41].

## 2) *The Emotional Dimension*

Bagozzi et al. (1999) define an emotion as a state or a mental process involving physical expressions. At the moment of consumption, an emotion is defined as "the set of moods aroused particularly when using the product or during the consumption experience and is categorized by an expression (happiness, anger and fear) or by some underlying dimensions such as the approval or the inconvenience, the relaxation or the action, the calm or the excitement" [42].

According to Holbrook and Hirschman (1982), the experiential vision impacts the affects which consist of attitudes, preferences, feelings and emotions [18].

## 3) *The Sensorial Dimension*

The use of the senses is important in creating engaging and memorable experiences. Several authors mentioned the importance of experiences surrounding the consumption [15]. Monitoring touch, sound, gustatory, olfactory and visual senses helps to create a good atmosphere for customers [43].

## 4) *The Social Dimension*

The social dimension can be defined as "the interaction or the communion with others" [13]. Experience is lived individually, but it fits into a social context that permits to be in relationship with others and with the image that the consumer would like to make of himself.

## 5) *The Behavioral Dimension*

The consumption experience is created in the action by the customers' physical behavior. Several studies have examined the impact of an experience, by assessing satisfaction, loyalty, word-of-mouth and recommendation [44] [45] [46].

# III. MEASURING CUSTOMER EXPERIENCE

Peter Drucker said: "Only what gets measured, gets managed". This applies in particular to the challenges firms face in measuring their customers' experience and its impact on their performance.

The customer experience measurement is seen as the key challenge for the success of customer experience strategies. Klaus (2015) states that "If done properly, the customer experience measurement is the key of success and profitability". [1].

In his research papers published in the International Journal of Marketing, Klaus (2011, 2013) described the complexity of finding the right measures for customer experience [47] [48].

Klaus and Maklan (2007) established that customer experience is conceptually different from the quality of service and hence requires a new corresponding measure [49].

Although many operational research has focused on the service's design and development, the experience design has received limited attention [50]. However, several "operational" tools have been developed to assist in the design and the assessment of the customer experience. These tools include the creation of experience indices [23], the design of "servicescape" or physical environment [50], the customer journey and the service mapping [51] [52] [53], the service transaction analysis [54], the customer experience analysis [55] [56], the integrated audit [57], the service incidents analysis [58] and the sequential incident technique [59].

The Scales development method is an alternative method for measuring the customer experience in specific contexts [1].

## A. *Methods of Measuring the Customer Experience*

Several methods have been developed in different areas which range from the management of quality of service, the service marketing, the experiential marketing to psychology.

### 1) *The Quality of Service Management Measuring Methods*

According to Maklan and Klaus (2011), SERVQUAL is the most common measure of the quality of service that was designed by Parasuraman et al. in 1988 [28]. This method aimed at measuring customers' perceptions with respect to their expectations regarding five dimensions: tangibility, empathy, assurance, responsiveness, and reliability.

Furthermore, many authors emphasized the link between service quality and customer satisfaction [46]. Anderson et al. (1994) demonstrated that the quality management helps to increase customer satisfaction and the company results [60]. Customer satisfaction induces greater purchase intent, the willingness to pay more and the recommendation to others [61].

Reichheld (1996) added that increasing customer loyalty fosters profitability [62]. Believing that conventional satisfaction surveys cannot alone measure the experience that customers have, the author designed a single indicator, the Net Promoter Score (NPS). This index permits to identify, among customers, who will be the prescribers within their relatives, and those who will be the detractors. On a scale of 0 to 10, only 9 and 10 scores refer to prescribers. Those who respond 7 and 8 are passive customers. Less than 6 are considered as detractors.

Jones and Sasser (1995) suggested going beyond traditional customer satisfaction surveys to find out what customer really feels through frontline or in-depth interviews with current and lost customers and records of customer complaints [63].

### 2) *The Service Marketing Experience Measurement Methods*

Garg et al. (2010) identified six methods of measuring the customer experience from services marketing: blueprinting, service mapping, service incident analysis, walk-through audit, service transaction analysis and experience audit [64].

#### 2-1 *Blueprinting*

In his fundamental paper, Shostack (1984) proposes a tool to represent in writing the process of the service before its implementation. The goal is to anticipate problems and to specify the criteria of performance and quality [65].

#### 2-2 *Service Mapping*

According to Kingman-Brundage (1991), a "service map" is a management tool that describes the sequence of tasks and activities undertaken by the customer, the frontline and the support team contributing to the success of the service [53].

#### 2-3 *Service Incident Analysis*

According to Stauss (1993), to ensure customer satisfaction in the long-term, the company should establish a list of all the problems that the customer faces in the service experience in order to solve them [57]. He identifies three main methods: the Complaint Analysis, the Critical Incident Technique and the Sequential Incident Technique methods.

## 2-4 The Experience Audit

The audit of experience is a recommended method implemented by Haeckel, et al (2003) and Berry et al. (2006) that aims to study systematically the customers' experiences and explain their emotional responses to each index at every point of contact or touchpoint with the company [39] [23].

## 2-5 Walk-Through-Audit (WTA)

The Walk-Through-Audit (WTA) is an audit used to assess the customers' experience from the beginning to the end of their interaction with the company [65].

## 2-6 Service Transaction Analysis (STA)

Johnston (1999) recommends the service transaction analysis (STA) method that includes four key elements: the concept of service, the service delivery process, the quality of the transaction evaluation, the messages which correspond to the interpretation of the service by the customer [55]. The author suggests using the STA method as the basis for a walk-through-audit by a mystery customer or by an independent consultant purporting to be a real customer of the firm.

## 3) The Experiential Marketing Measuring Methods

Holbrook and Hirschman (1982) were among the first authors who focused on the customers' emotional aspect in the analysis of the consumption experience in an assumption that consumer choices are based on the feelings of pleasure and fantasy. They stressed the need to develop specific measures to assess the customers' deep feelings [18].

Experiential survey techniques are based on qualitative methods: information collection through spontaneous, less structured and directive interviews and field observations.

## 3-1 Experiential Survey by Interview

The experiential survey is based on an indirect method of interviewing customers. Andréani and Conchon (2002) explain that the interview takes the form of a free conversation without a guide or a formal frame of response [66]. The indirect questioning methods include visual expression techniques, roleplay, word associations, purchase tale, etc.

## 3-2 Experiential Survey by Observation

Observation permits to collect on the lived customers' experience and to access hidden or unsaid information. This is the case with the customer journey [66].

## 4) Measuring Methods from Psychology

Three main measures of emotions are used in the customers' experience analysis in psychology: the Mehrabian and Russel (1974), Izard (1977) and Plutchik (1980) models.

## 4-1 The Model of Mehrabian and Russel (1974)

The model of Mehrabian and Russell (1974) is part of the theories originated from psychology [67]. According to the authors, the individual's perceptions and behaviors in a given environment are the result of emotional states created by this environment. Environmental stimuli influence the emotional states of pleasure, arousal and dominance (PAD) which in turn drive the approach or avoidance behaviors. The PAD scale developed by the researchers consists of six items per dimension or eighteen items in total. Each participant is exposed to a situation and is asked to respond to the eighteen items on a scale from 1 to 7 or 9 points.

## 4-2 The Model of Izard (1977)

According to Izard (1977), emotion is a subjective experience with an experiential affective dimension. To assess emotions, he provides a differential emotion scale (DES) [68]. DES I can measure the intensity of the emotional experience felt by individuals at a specific time on an intensity scale in 5 points. DES II assesses emotions over extended periods of time and determines how many times the individual feels each of the basic emotions in a given context or during a specific time interval using a 5 points frequency scale. Izard (1977) identifies ten fundamental emotions: interest, anger, disgust, contempt, shame, guilt, joy, sadness, fear and surprise. Both measures are based on a list of 30 points (3 adjectives associated with each fundamental emotion).

## 4-3 The Model of Plutchik (1980)

Plutchik (1980) retains eight basic emotions: fear, anger, joy, sadness, acceptance, disgust, anticipation and surprise. According to the author, these basic emotions are opposed in pairs and combine to form new emotions. His scale assesses every emotion with respect to its degree of intensity [79].

## 5) The Lived Experience Measuring Methods

Dixon et al. (2010) question the usefulness of measuring customer satisfaction and offer a new measure: the Customer Effort Score (CES) [70]. To meet customer expectations, he recommended to the company to focus on reducing customers' efforts, to be more interested in the emotional aspect of interactions, to listen and to learn from disgruntled customers, and finally to focus on solving customers' problems and anticipating their coming needs. The CES is based on a scale from 1 (very little effort) to 5 (a lot of effort).

## B. Scales for Measuring the Customer Experience

The development of scales is an iterative, complex and rigorous process which aims at measuring the dimensions of a construct by using items in a scientific approach of robust conceptual and psychometric analysis.

Likert (1969) identified three main steps in the scale development process namely the initial design of the survey, the questionnaire development and the data analysis [71].

Churchill (1979) recommended a scale development procedure based on empirical methods with a great focus on factor analysis and reliability of internal consistency (alpha coefficient and structural equation modeling) [72].

Schwab (1980) identified three stages in the development of measures: item generation, scale development and scale assessment [73].

Spector (1992) subdivided Likert three steps into five stages: the construct definition, the scale design, the pilot test, the scale dissemination and item analysis and finally the validation and standardization of the measures [74].

The model of Schwab has been adopted by Hinkin (1995) who considered the scales development techniques used in organizational behavior research [75].

Rossiter (2002) brought a new procedure, called C-OAR-SE for the development of measurement scales specific to marketing constructs [76].

classification, Attribute classification, Rater identification - Scale formation, Enumeration and reporting. This procedure challenged the paradigm of Churchill which has dominated the scales development field in Marketing for nearly 25 years.

The theory of multivariate generalization combines the two antagonistic perspectives of Churchill and Rossiter with a balanced focus between the conceptual rigor and the empirical validation of constructs [77].

#### IV. THE SCALES DEVELOPMENT METHOD

##### A. The Process of Scales Development

The procedure of Churchill for scales development is "a widely accepted approach" in the methodological framework [78]. According to this procedure, the process of creating a scale consists of five main steps (see Figure.1).

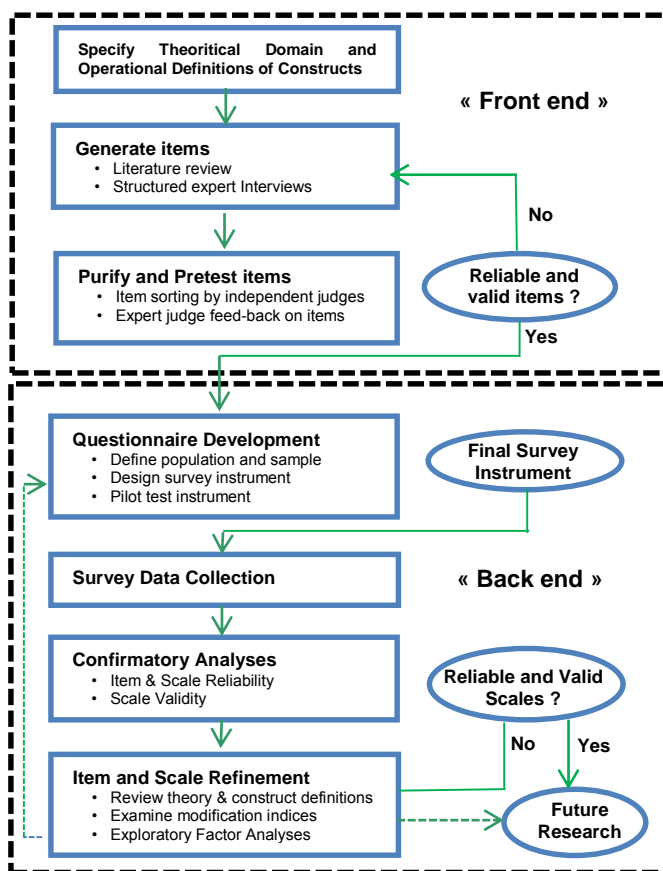


Fig. 1. The scales development process

**Stage 1- Construct definition:** This stage starts with a literature review and a comprehensive qualitative study in order to articulate the meaning and domain of the construct.

**Stage 2- Items or statement generation:** This step consists of formulating and elaborating the items from the literature review and the assessment by experts through interviews. The scale generation explores what customers perceive from their experience's components, based on comprehensive qualitative studies. This step leads to a preliminary scale representing the dimensions of the construct.

**Stage 3- Pretest (purification):** This stage focuses on administering the questionnaire, performing statistical analysis and consultation within experts.

The initial purification permits to assess the scale, through a representative sample of the customers, the context, the company or the offer. Using Exploratory Factor Analysis (EFA), the scale is purified to the items that represent the dimensions of the construct.

**Stage 4- Main data collection (validation):** A refinement using Confirmatory Factor Analysis (CFA) allows the validation of the purified scale based on a representative sample and the confirmation of the reliability and the validity of the scale of the construct.

**Stage 5- Reliability and validity of the model (validation):** The validation is achieved by evaluating the construct and its dimensions.

The literature review, the expert consultation, the peer review and the exploratory discussions with members of target groups represent information sources that researchers use to generate and evaluate the items contained in the scale.

As part of our research, we will adopt the Churchill procedure. After defining the customer experience, an exploratory study will be carried out in order to conceptualize the research model, creating customer experience dimensions and generating corresponding items and statements in the context of the information technology (IT) industry. Then, the selected items will be tested empirically through a field data collection to determine the main items for IT companies' customers in the perception and evaluation of their experience.

##### B. Customer Experience Scales Models

Several researchers have studied the concept of experience and others have tried to assess the customers' experiences in different contexts by developing multi-items scales.

Schmitt (2003) developed a measurement scale for the touristic industry by gathering experience dissemination tools into three major areas: the branding, the interface with the consumers and the innovation [37]. For each of these areas, an evaluation has been performed. Based on its experiential grid linking the strategic experiential modules (SEM's) with the experience providers (EXPros), he has created an experience rating model which consists of a 7 points graduated scale.

An index for the quality of banking experience (EXQ) was developed by Klaus (2015) and aimed to cover the cognitive and affective aspects of direct and indirect consumer encounters with the company [1]. The evaluated factors in this scale are peace of mind, the expected result, the moment of truth and the experience of the product. This scale addressed new dimensions in the banking industry and tried to explain main customers' behavior like re-purchase, recommendation or word of mouth, satisfaction and loyalty. The scale consists of three dimensions: the brand experience, the service experience and the consumption (post-purchase) experience.

Ting-Yueh and Shun-ching (2010) also gives importance, in their scale, to the emotional experience measurement [79].

The concept of economy of experience brought by Pine and Gilmore (1998) which advocates the personal involvement of the individual was also measured in the context of tourism.

Four dimensions stand out: education, aesthetics, entertainment and escape. The items emerging from this scale are very similar to the construct of Schmitt as Pine and Gilmore (1998) define the experience as a personal experience existing in the mind of individuals who were engaged in an emotional, physical, intellectual or even spiritual level [7].

Regarding the experiential marketing dimensions, Brakus et al. (2009) measured the experience based on the cognitive, emotional, behavioral and sensory dimensions of experiential marketing. However, this scale was limited to the context of a brand experience and does not measure if the experience is positive or negative [34].

Fornerino et al. (2006) and Chou (2010) also considered the five experiential dimensions developed by Schmitt in order to create their measure of experience [41] [46]. The first authors measure the immersion in a consumption experience while the second one measures the link between the relational marketing and the experiential marketing.

Bagdare and Jain (2013) measured the experience in the context of experiential retail focusing on the emotional side of the construct including joy, mood, entertainment and distinction of experience [80].

## V. CONCLUSION

The concept of experience is still a subject for numerous researches and projects attracting interest of organizations and scholars in a variety of fields.

The components of the experience are so diverse and variable according to the customer and the context that its assessment constitutes a big challenge.

Focusing on the theoretical and the conceptual framework of the customer experience and its measurement, this paper represents a preliminary study attempt to develop a multiple-item scale for measuring the customer experience in the context of the information and communication technologies (ICT) industry in Morocco.

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# Using a GIR tool in a Business Intelligence Context: the case of EGC conferences

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**Abstract**—In this paper, we present the results from an experimentation using a geographical information retrieval (GIR) tool for scholarly publications analysis in a Business Intelligence (BI) context. The approach is based on a multi-dimensional analysis which combines the thematic, temporal and spatial features of the publications. Results given in the paper are twofold: (i) a detailed description of the GIR tool and (ii) a validation of the method on a scholarly corpus made of the EGC (Extraction et Gestion des Connaissances) conferences from 2004 to 2015.

**Index Terms**— Geographical information retrieval, GIR tool, Scientometrics, Document analysis, Text Mining, Business Intelligence.

## I. INTRODUCTION

THE widespread adoption of e-journals and digital repositories, as well as the changes in electronic communication practices provide students and scientists with access to more information than at any other time in history. Methods have been created to access, filter, extract and organize this huge amount of information. Metrics have been developed to measure the flow of information among countries, disciplines, organizations and to identify collaborations between individuals, research units and research fronts, which are usually based on citation analysis (bibliometrics), number of publications or patents (scientometrics), hyperlinks, usage data and statistics (webometrics) in order to identify correlations between more or less structured data.

The goal of this paper is twofold. It first presents a new semi-automatic method based on a geographical approach and implemented in a Geographical Information Retrieval (GIR) tool and secondly illustrates the use of the GIR tool for scholarly publications analysis in order to identify correlations between thematics (what?), location of scientific events such as congresses or location of authors labs (where?) and time of the event (when?).

The main interest of this method is to highlight the evolution of thematics addressed by scholarly publications

over time and in relation with the location (city name) where take place the events. Although much scientometrics studies identify correlations between events and period such as author cocitation analysis for domain mapping [1] or research fronts identification [2], very few studies, if any, are based both on time and space in relation with topics extraction. Leydesdorff and Milojevi [3] provide a general overview of Scientometrics and conclude their paper arguing that the modeling of knowledge exchanges in scientific discourses cannot be reduced to the exchanges of information in co-authorship, cword, or citation relations. Following this idea, we propose a method based on a multidimensional analysis of a collection of publications which combines spatial, temporal and thematic dimensions. We postulate that this approach may be of great interest in a BI context.

In section two, we introduce the context and the rationale of our work. The next section presents the general process of the method. Section four first describes in more details the architecture of the tool and its components dedicated to a specific corpus made of 1103 publications presented to the Extraction et Gestion des Connaissances (EGC) workshops from 2004 to 2015. Section five describes some examples which validate the use of a GIR system for a scientometrics purpose in a BI context. Finally, section six gives some concluding remarks and perspectives for future work.

## II. CONTEXT AND RATIONALE

Coined in 1969 by Nalimov and Mulchenko, scientometrics includes all quantitative aspects of the science of science as indicated in the subtitle of the journal *Scientometrics* [4]. The largest subfield of Scientometrics is probably citation performance (named impact factor by Garfield from the Institute for Scientific Information (ISI)) which takes the frequency with which a document is cited as a measure of the impact or influence of that document on the citing literature. Another subfield is the co-citation analysis which aggregates indicators that can be interpreted as a measure of the exchange of information between journals, institutions or countries. Word related analyses also play a major role in Scientometrics. Documents title and abstract, authors name, keywords (from thesauri or not) and classification schemes give relevant information that can display measures to identify topics changes in a collection of publications, evolutions of the research front or conceptual migration in an interdisciplinary perspective.

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The growing importance of open access e-journals, open archives (arXiv, HAL), scientific search engines such as Google Scholar, bibliographic databases (Scopus, Web of Science, etc.) give new opportunities to understand the evolution of scholarly communication practices and for mapping science in a Business Intelligence Context. For example, in the biomedical sciences, PubMed comprises 2 millions citations and, in computer science, CiteSeer has over 1.4 million articles and the Association for Computing Machinery (ACM) digital library has 1.5 million pages. Using the DBLP database [5], different studies have been conducted to determine the changing practices of scientific communication or to assess the collaborations of researchers through their publications [6].

In France, works are initiated as part of the national ISTEEX project<sup>1</sup> whose goal is to acquire and to index scientific publications in order to create a digital library. The ISTEEX project aims to create innovative information retrieval services to access, filter and browse the content of the digital resources and not only through the name of journals or the scientific classification. Several platforms exist to analyse this amount of documents. Among them, the web platform Gargantext<sup>2</sup> is designed to produce living maps that evolve as you work with them. They can be used for dressing a state-of-the-art, mapping a bunch of documents, setting up a collective representation of a problem, etc. This kind of platform is very helpful but it does not give the possibility to carry out detailed geographical analysis.

Initially named and defined by Ray Larson [7], Geographic Information Retrieval (GIR) aims at retrieving documents which satisfy geographic characteristics. Those characteristics explicitly address a three-level dimension: spatial, temporal and thematic dimensions ([8]; [9]) which are used to represent the documents archived in the corresponding database. A GIR tool partially or entirely matches the query with the metadata describing the documents and can be used in a scientometrics perspective to identify links between events (thematic dimension), city name of events (spatial dimension) and date of events (temporal dimension). As mentioned before, scientometrics approaches usually link topics and periods but, to our best knowledge, don't take into account the spatial dimension.

A recent experimental work, entitled Anthology of the Inforsid Conferences<sup>3</sup> and based on a lexico-scientometrics approach presents an analysis of the 30 first Inforsid conferences from 1983 to 2013. The results display a scientific mapping of the topics addressed by the conference over the years according to the locations of the authors labs or the conferences locations (city name). A similar work by the same researcher [10] has been conducted on the EGC conferences.

Beyond these experiments held on the Inforsid and the EGC conferences, we propose a generic approach that can be used on data corresponding to any new series of conferences. Our approach supports IR operations in a dynamic way and

analysis combining spatial, temporal and thematic dimensions. This approach is based on a data model described in the following section.

### III. GENERAL PROCESS

The main objective of the method is to analyze a collection of scholarly documents from a multi-dimensional perspective.

The general approach is described in figure 1. The process is made up of three steps: (1) the preparation and the validation of the metadata describing the documents, (2) the indexation of the documents content and linked metadata in the GIR tool, (3) the multidimensional information analysis and/or retrieval phase which allows the exploration of the collection.

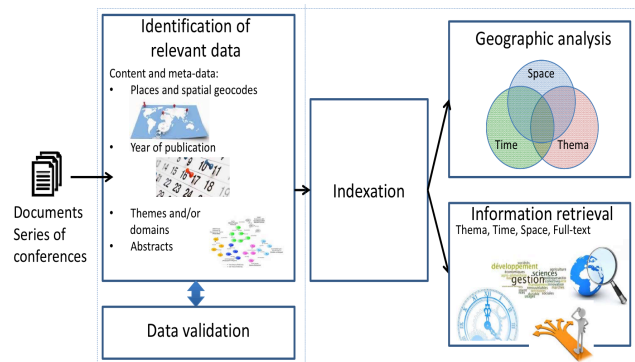


Fig. 1. Generic processing chain supporting scientific publication corpora analysis.

Regardless of any type of publication, the process computes spatial, temporal and thematic metadata. If these metadata are not available, we first need to enrich the articles in order to get for each one:

- the name of the authors and co-authors;
- the title;
- the name, latitude and longitude of the cities where the co-authors labs and the conference are located (for the spatial perspective);
- the year of the publication (for the temporal perspective);
- the domain and corresponding session name, (for the thematic perspective).

Spatial, thematic and temporal metadata validation process is respectively based on geocoding, text mining tools and a calendar database.

In the second step, the metadata are indexed by a search engine in order to improve and support the mining process and the information retrieval processes. Table I gives an overview of the indexed data. It should be noted that the words of the title and the abstract of an article are added to the index in the full-text information category for the IR purpose.

The third step is the querying process of the documents. The process is mainly supported by the Elasticsearch<sup>4</sup> platform and

<sup>1</sup> <http://www.istex.fr/le-projet/>

<sup>2</sup> <https://iscpif.fr/gargantext/your-first-map/>

<sup>3</sup> [http://dbrech.irit.fr/rechpub/cabanac\\_inforsid\\_accueil/](http://dbrech.irit.fr/rechpub/cabanac_inforsid_accueil/)

<sup>4</sup> <https://www.elastic.co/fr/>

TABLE I  
 SYNTHETIC MODEL OF INDEXED DATA.

Thematic information	Conference place
	Authors city names
	Authors names
	Title
	Abstract
Spatial information	Session
	Domain
Temporal information	Authors city geocodes
	Conference place geocode
Full-text information	Year of publication
	Title words
	Abstract words

visualization tools such as MapInfo<sup>5</sup>, Google Earth and Kibana<sup>6</sup>. Elasticsearch is a search engine based on the Lucene library which supports full-text IR as well as IR combining spatial and temporal criteria. The platform also offers a variety of data analysis and display tools.

The querying process gives the user the opportunity to explore the index according to the different features of the metadata model. With the searching interface, a user may filter the co-authors localizations related to conferences places and years or ask for the evolution of the conference topics over the years. The user may also navigate into the document collection according to the topics of the conferences. Terminology extraction from the abstracts of the articles is possible for information clustering or categorization.

Based on the geographical model of the metadata, more complex queries can be addressed such as: Is there any modification of the average distance between co-authors cities and conference places? Is there a significant proportion of articles published by co-authors whose labs are far away each other? What is the temporal and spatial distribution of the authors dealing with those thematics? Are there thematic characteristics according to the location of the conferences or the authors labs, or according to the dates of the conferences?

These examples show that the geographical model of the document representation gives new opportunities in a scientometrics perspective for mapping scientific practices.

#### IV. AN INNOVATIVE GEOGRAPHICAL INFORMATION INDEXING AND RETRIEVAL APPROACH

In this section, we detail the implementation of the geographical processing tool dedicated to the EGC publications.

##### A. Data preparation and validation

For the experiment, we used the data provided by the EGC challenge in 2015, available as a file (« RNTI articles export.txt » file provided by the Challenge<sup>7</sup>) made of articles published in the EGC conferences from 2004 to 2015. For each article, the following metadata are provided:

- Series: journal name;
- Year: year of publication;

- Title: title of the article;
- Abstract: Abstract of the article;
- Author: author names separated by commas;
- Booktitle: Conference name;
- pdfpage: pdf file hyperlink for the first page;
- pdfarticle: pdf file hyperlink to the article.

The next step consisted in preparing the spatial and thematic data as the temporal data were already mentioned in the initial version of the file under the year label.

##### 1) Spatial and temporal dimensions

A first step is to complete the information for each article, automatically adding the conference venue and doing it manually for author names and author cities (laboratory affiliation). The second step complete these data by the spatial coordinates related to the cities. We have used two Geocoding Web Services<sup>89</sup> to automatically determine latitudes and longitudes for author cities and conferences venue.

##### 2) Thematic Dimension

The thematic dimension refers to the subjects of interest addressed by the EGC conferences and given by the name of the sessions. Two problems were pointed out: first, as the names of the sessions were not included in the metadata provided in the original file, we had to manually enrich the datasets with these names. Secondly, as the sessions themselves have been differently labeled over the years, we had to create some higher-level categories, called meta-sessions, in order to group sessions referring to the same thematic but with different names. This grouping provided a set of 8 meta-sessions (see Table II). For example, the knowledge management session of the 2004 edition, the Building and Ontology session of 2011 or the Semantics and Ontologies session of 2015 were assigned to the meta-session #1, named Knowledge Organization. All the sessions of the 2004-2015 EGC conferences have been classified into the 8 meta-sessions, and we then allocated the articles to the relevant corresponding meta-session. From the 1103 articles of the corpus, we retained 812 articles (about 73% of the initial corpus), excluding the posters and the invited lectures

 TABLE II  
 DEFINED META-SESSIONS FOR EGC CONFERENCE PUBLICATIONS BETWEEN 2004 AND 2015.

Meta-session	Id	Number of articles
Knowledge organisation	1	129
Machine learning	2	69
Sequences, patterns and association rules	3	120
Classification	4	82
Software and applications	5	122
Visualisation and IR	6	62
Web and social networks	7	26
Big data	8	152

<sup>5</sup> <http://www.pitneybowes.fr/software/geo-decisionnel-sig/mapinfosuite/mapinfo-professional.shtml>

<sup>6</sup> <https://www.elastic.co/fr/products/kibana/>

<sup>7</sup> <https://egc2017.imag.fr/defi>

<sup>8</sup> <https://adresse.data.gouv.fr/tools/>

<sup>9</sup> <http://www.batchgeocodeur.mapjz.com/>

as they were not related to a specific session.

#### a) Meta-sessions validation step

In order to validate the categorization of the articles in the 8 meta-sessions, we propose an incremental text mining method based on the abstracts of each article (see the abstract field) to automatically classify all articles in the relevant meta-session. We assume that the terminology used in the abstracts is fairly discriminating to identify the relevant meta-session for each article. In the state-of-the-art, text categorization techniques break down into three main groups: a first one refers to ad hoc algorithms [11] [12], a second one is based on lexical resources [13], and a third one encompasses learning methods such as Naive Bayes [14]. The supervised learning methods may be more or less complex: (i) all the words of the text (bag of words, unigrams or n-grams) [15]; (ii) the presence or absence of a set of specified words; (iii) the location of certain words [16]. As the annotated corpus integrates information on the sessions and the meta-sessions, we propose an incremental supervised classification approach for (un-)validate meta-sessions that we have manually defined. Results have been scored with the F-measure performance metrics. Moreover, in order to estimate the effectiveness of the various steps, we apply a cross-validation process which a method of reliability estimation of a model based on a sampling technique. Table 3 presents the results in terms of accuracy.

#### b) Implementation method

The text-mining method used for the abstracts analysis encompasses 3 steps (see Table III):

1. A classic bag-of-words approach using the data mining algorithm Naives Bayes called DMNBtext [14]: for each article, all words of the abstracts are first bundled into a vector which is then used to identify any meta-session that fits with the analyzed article (1 vector for 1 article);
2. The cleaning of the corpus content which consists of the lemmatization using TreeTagger<sup>10</sup>, and the removal of empty words;
3. The terms weighting: for each meta-session, creation of a list of words constituting the name of the attached sessions. For each vector (article), we attribute the weight of 1 to lemmatized words non present into these lists and 10 to those present (the most relevant value given by all the experiments carried out).

The experiments were first carried out on the entire corpus. The classic bag-of-words approach gave mixed results (see Table III, steps 1 and 2). These results are due to the fact that the vocabulary changed from 2004 to 2015. Furthermore, the vocabulary as a whole is not discriminating.

Using terms weighting on the sessions names improves the results with reach a score of 84.8% of correct classification and a cross-validation of 15 folds (see Table III, Step 3). Also, the number of publications differs over time for each metasession. In addition, over the period, the same meta-sessions are not addressed each year by the EGC conferences

as it is illustrates by the Web and social networks meta-session. To improve the results, the whole corpus has been split of in subsets corresponding to smaller periods of time: a first subset consisting of articles published between 2004 and 2007, a second one between 2008 and 2011 and a third one between 2012 and 2015. We processed the three subsets and we had much better results, with a valid classification rate from 81.9% to 95.7% (see Table III, step 4). We may point out that the best results are obtained with a cross-validation of 10 folds.

These results allow us to validate the classification of the articles into the 8 meta-sessions. The next step is to analyze

TABLE III  
RESULTS FOR META-SESSION VALIDATION.

Step	Description	F-measure score (Cross-validation process with N folds)			
		N=3	N=5	N=10	N=15
1	Classic bag-of-words approach	0.197	0.277	0.301	0.321
2	a. Lemmatisation	0.38	0.396	0.394	0.394
	b. Removal of empty words	0.244	0.393	0.387	0.387
3	Weighting of words	0.741	0.776	0.822	<b>0.848</b>
4	Weighting of words for time period 1	0.649	0.756	<b>0.819</b>	0.814
	Weighting of words for time period 2	0.812	0.891	0.914	<b>0.920</b>
	Weighting of words for time period 3	0.793	0.862	<b>0.957</b>	0.951

the evolution of publications with the spatial, temporal and thematic dimensions.

#### B. Indexation and Geographical Information Retrieval

At the end of the data preparation and validation stage, we obtain a cleaned corpus made of the prepared articles. A json<sup>11</sup> document, compliant with the data model described in table I, is produced for each article described in this file. This document is then indexed with the ElasticSearch platform.

We have defined a retrieval method combining full-text retrieval with geographic information retrieval. We have tried out several scenarii (table IV). Only papers with an abstract have been taken into account. First column of the table displays the different scenarii for the full-text retrieval (is the word "classification" present or not present in the title and/or the summary?). For each scenario, the number of papers can be found in the second column. The following columns describe more selection criteria combined with full-text search:

- thematic criterion: papers in the "Classification" metasession;
- temporal criterion: papers written since 2007;
- spatial criterion: papers whose at least one author works in a city unless 200 km from Paris.

We observe (table IV) that (i) 79 papers are in the Classification meta-session, (ii) 196 papers have the word classification in their title or in their abstract and (iii) 49 papers are in common with (i) and (ii). We may conclude that the full-text research and the thematic research (based on

<sup>10</sup> <http://www.cis.uni-muenchen.de/~schmid/tools/TreeTagger/>

<sup>11</sup> JavaScript Object Notation

meta-session) are complementary in this case (like in other observed cases). We also notice that spatial and temporal criteria provide a better precision to observe data.

In this experiment, we use the same weight for each criterion and the returned papers are sort by relevance. Let us note however that it is possible to weight criteria to give

TABLE IV  
NUMBER OF PAPERS FOR EACH SEARCH SCENARIO.

Search of "classification"		Criteria			
		Thematic	Thematic	Thematic	Thematic
		Temporal	Spatial	Spatial	Temporal
title $\wedge$ $\neg$ summary	17	5	5	0	0
$\neg$ title $\wedge$ summary	100	21	17	9	6
title $\wedge$ summary	79	23	19	11	6
title $\vee$ summary	196	49	41	20	15
$\neg$ title $\wedge$ $\neg$ summary	752	30	25	12	11
No full-text search	948	79	66	32	26

priority at one or more research areas. In next section, we present some scientometrics illustrations of the GIR tool.

## V. A SCIENTOMETRICS ILLUSTRATION OF THE GIR TOOL

To illustrate the interest of using a geographical search engine in a scientometrics context, we carried out some focused analyses<sup>12</sup> we present hereafter. The findings we present are not innovative per se but they show that querying the GIR tool may offer opportunities to create new correlations that can be served for an in-depth analysis of the publications.

### A. Spatial and temporal dimensions

The first illustration is concerned with the spatial and temporal features found in the texts. Geocoding services and distance computing functions may be used to analyze the spatial dimension expressed in the metadata, for example the calculation of the average distances between the cities of the authors of an article and the city of the corresponding conference, or the average distances between the cities of all the authors of a given article.

One possibility is to analyze the authors lab locations when compared with the conference locations according to the year of the conference. Figure 2 displays a radar chart which visualize the example.

The figure shows that the series  $200 < \text{Distance} < 400$  km points out an important decrease of the articles percentage from 2010 and later. The same trend may be noted when examining the  $400 < \text{Distance} < 800$  km series. On the other hand, the Hammamet conference shows an unusually large percentage of articles for which the average distance between the co-authors labs locations and the conference place is higher than 800 km (which is not very surprising!). Finally, the Paris conference shows an important percentage of articles for which the average distance between the co-authors labs locations and conference place is lower than 200 km. We mostly observe the same finding when considering the average

distance between 400 and 800 km.

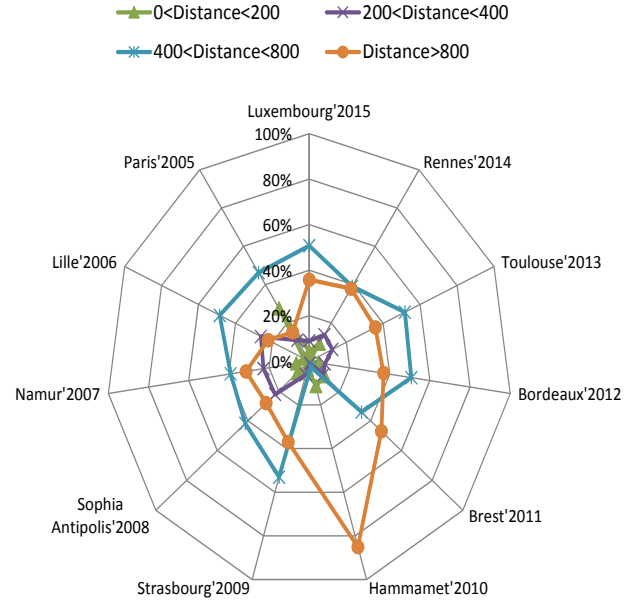


Fig. 2. Articles (percentage) according to average distances (km) from the place of the conference to the affiliation places of the co-authors.

Another possibility is to consider distances between the different labs locations (cities) of a co-authors network of a particular article. The radar chart (figure 3) displays the proportion of articles according to the geographical distance between co-authors labs locations. The Distance = 0 km series shows that the co-authors are mostly of the same place whatever is the place or the year the conference. However, this trend is particularly true when considering the Paris, Clermont-Ferrand and Luxembourg conferences.

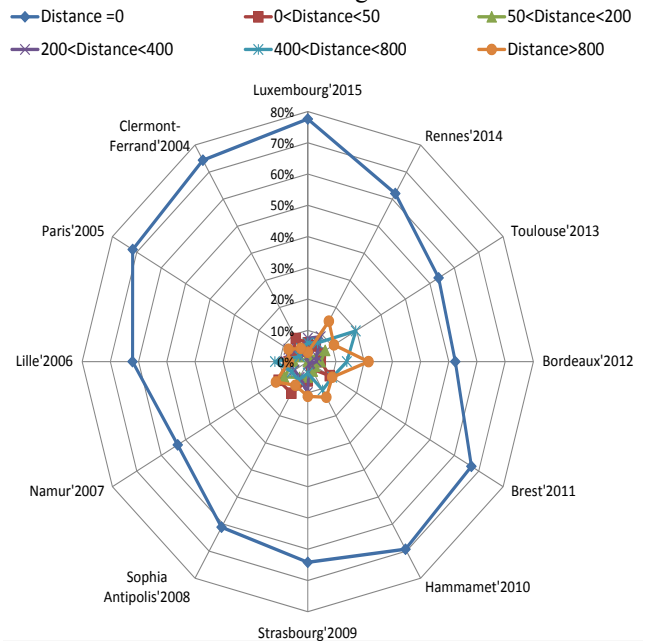


Fig. 3. Articles (percentage) according to average distances (km) between the affiliation places of the co-authors.

<sup>12</sup> The reference will be given later to make the paper anonymous



### B. Thematic dimension

A second illustration of using a GIR tool in a scholarly analysis context is given by figure 4 which shows the evolution of the classification of articles by meta-session over the 12 years of the EGC conferences. As displayed in the figure, no more than two meta-sessions lasted over the years: #1 (Knowledge organization) and #3 (Sequences, Patterns and association rules). The #8 meta-session (Data and Big data) has been held from 2004 to 2014 and disappeared in 2015. Most of the articles have been published within these three meta-sessions. The #6 meta-session (Visualization and IR) is

missing in 2009. Moreover, in 2009, only 5 meta-sessions have been held. The #7 meta-session (Web and social networks) has been held in 2004 and reappears in 2010. Scarce articles have been published in this meta-session (only 26 papers from 2004 to 2015). Others meta-sessions, #2 (Learning) and #4 (Classification), are not proposed each year: 8 years for the first one and 10 years for the second one. The #5 meta-session (Software and applications) has been provided all over the years except in 2008 and the significant number of authors show it is a well-appreciated challenge.

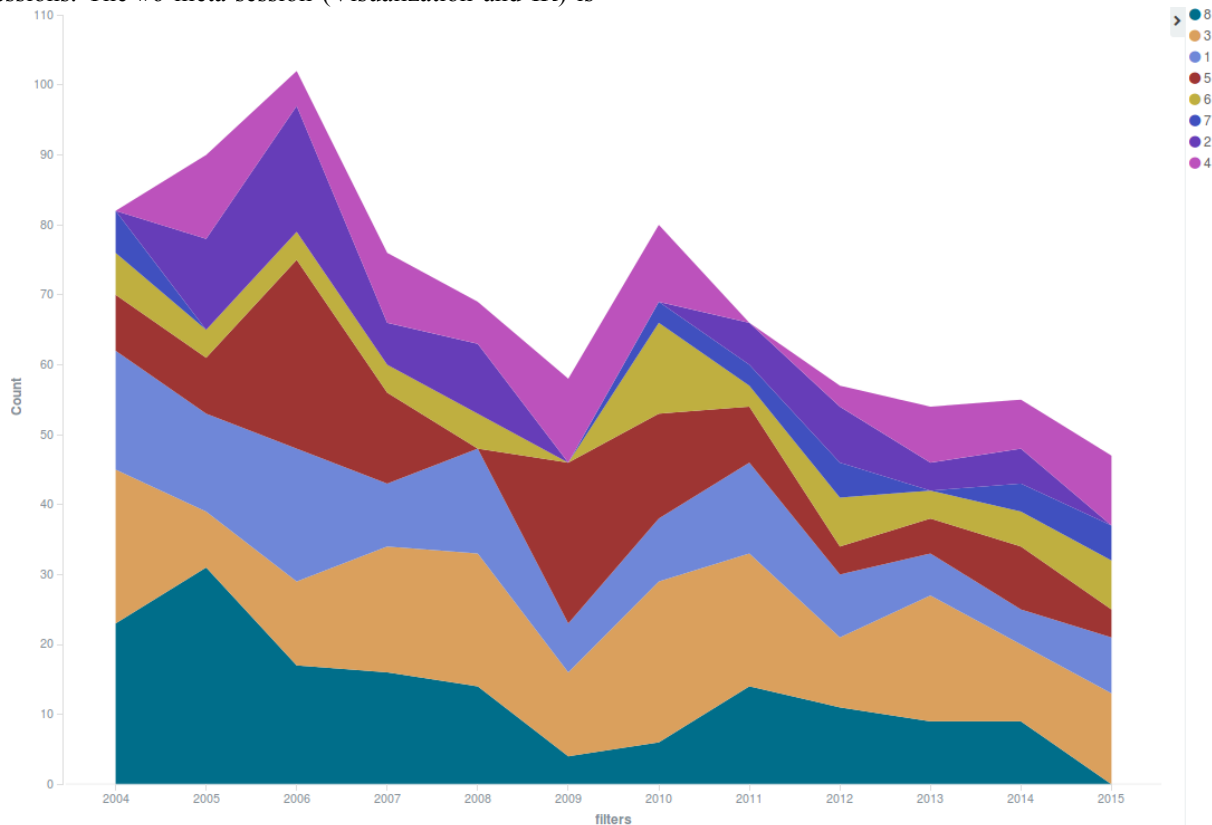


Fig. 4. Evolution of the number of publications by meta-sessions on the temporal dimension.

### C. Combining the three dimensions

A third illustration is obtained when combining the three dimensions. For each of the 8 meta-sessions, the whole 12 years period has been first split off in 3 slices of time: 2004-2007, 2008-2011 and 2012-2015. For each city of the conference venue, 3 pie charts show the evolution of the number of articles classified in the meta-sessions. Based on the temporal, spatial and thematic dimensions of the EGC corpus, figure 5 gives an overview of the evolution of the domains of interest over time and the authors and conferences cities.

For example, we may note that:

- Paris area, Lyon, Rennes and Montpellier provide the largest number of authors on the three periods;
- some areas (Lille, Grenoble) have no authors over a period;
- some areas (Lille, Lyon, Nancy, Nice) have no authors for one or more meta-sessions;
- many areas (for example, Toulouse, Nice, Grenoble, Nancy, Nantes) are declining between the first and the last period.

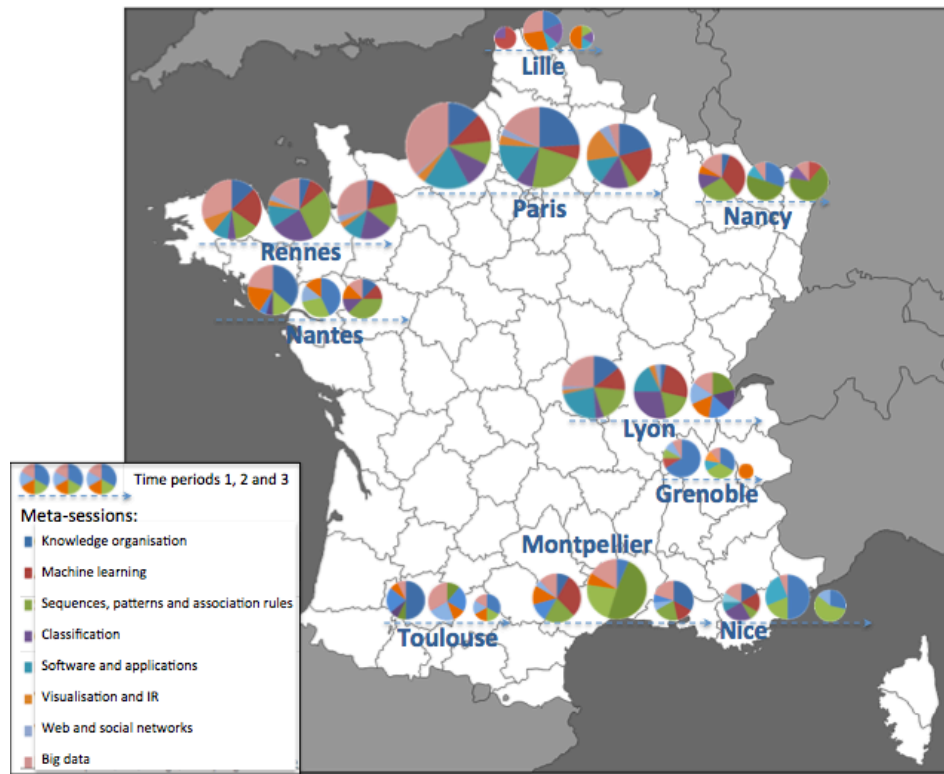


Fig. 5. Geographical analysis (time - space - thematic) of the publications.

#### D. Further analysis

For another experiment, we use Kibana tool in order to analyse our collection of scientific publications. Kibana is a data visualization and analytics tool for Elasticsearch. Focused on the authors and co-authors, the analysis takes

into account the thematic classification of the articles, their geographic origin and the period of publication as well as the gender of the authors and co-authors. Figure 6 shows the evolution of the classification of authors by number of articles over the 12 years of the EGC conferences.

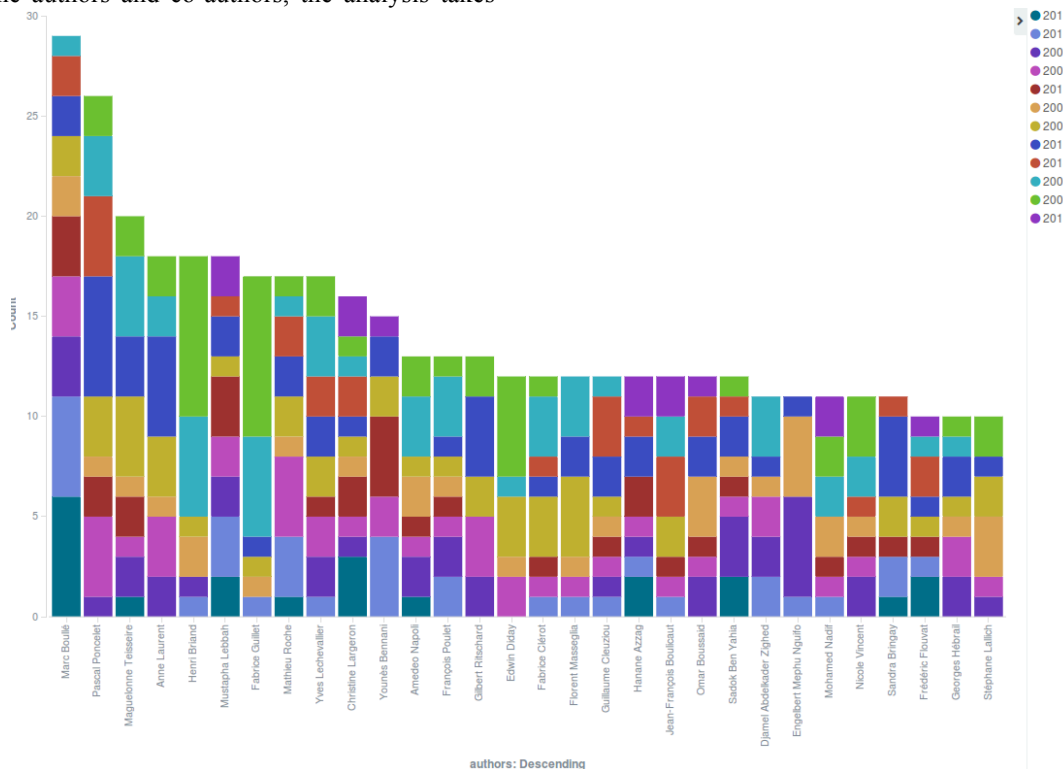


Fig. 6. Top 27 Authors

27 authors are the most prolific ones with more than 10 articles over the whole period. According to [17], these authors are named as the “Ambassador group”. Two-thirds of the authors published their first publication the first year of the conference (2004). None of them published each year of the whole period but 50% published at least once in each of the 3 slices of time. It seems that ambassadors are faithful to the EGC conferences. The author with the highest number of publications published during 10 years in 7 meta-sessions. He

doesn't publish in #6 meta-session. The second highest author published during 9 years in 6 meta-sessions and the third one also published during 9 years in 6 meta-sessions. The fourth one published during 7 years in 4 meta-sessions.

Furthermore, we observe that some ambassador authors are highly specialized in a topic whereas others are more generalists. The gender criterion shows that 18% of women are part of the Ambassador group. Among these ambassador authors, only 8 have had an accepted article in 2015.

For the ambassador group, figure 7 shows the distribution of number of articles per meta-session and period (4 years each). This figure highlights the ambassadors who publish in the 3 periods, those who don't publish in the third period and those who begin to publish only from the second period.

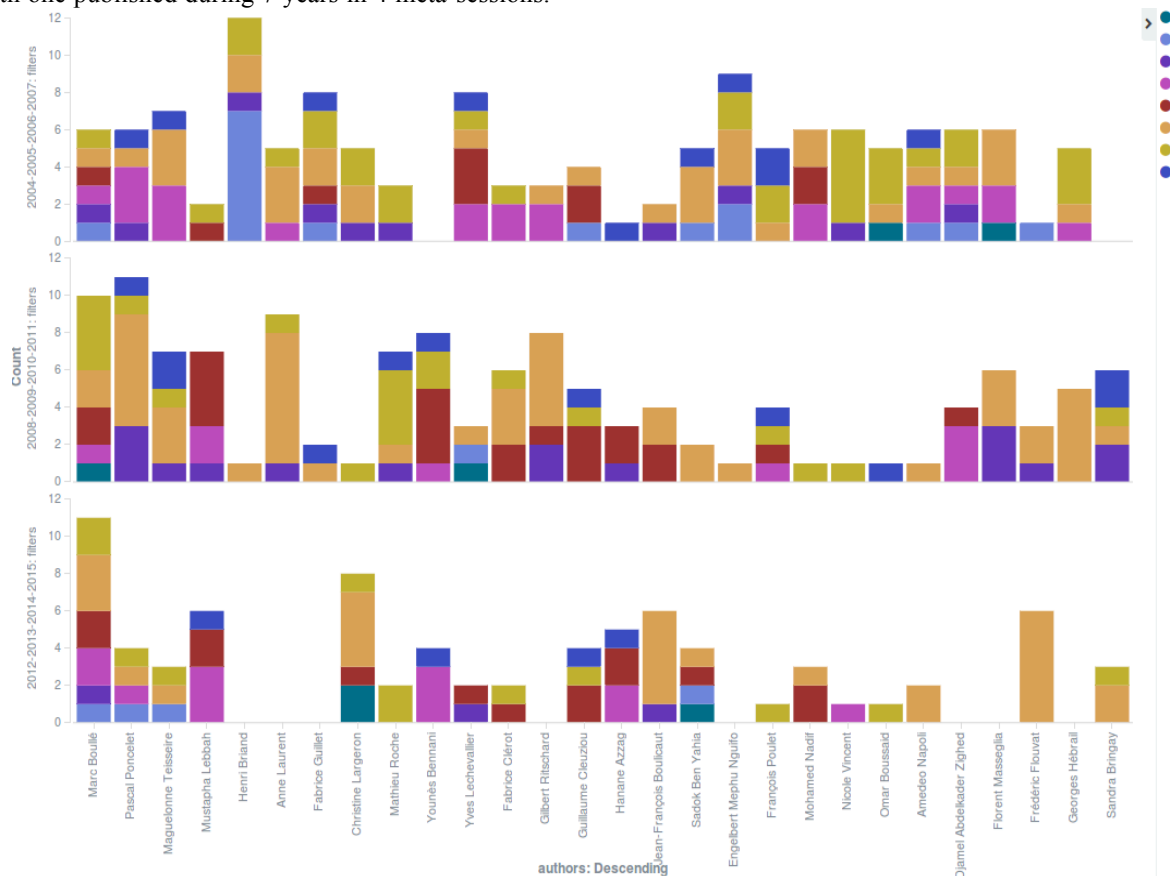


Fig. 7. Ambassadors & meta-session on 3 periods

Figure 8 displays a dashboard which gives more information about a particular author combining two criteria on each diagram: year and co-author, co-author and id-article, co-author and meta-session. We can study the profile of ambassador authors: do they have the same co-authors through time? Do they have many co-authors? Do they produce in several metasection? Do they write sometimes alone? The charts reveal the authors publication strategy, the changing nature of the co-authoring, the

evolution of their domain interests, etc. For example, figure 8 (section A) shows the links between an author and his most frequent co-authors, fig. 8 (section B) shows the spatial location of the co-authors, fig. 8 (section C) shows the links between an author and the article he/she published, and fig. 8 (section D) in which meta-session he/she published the most.

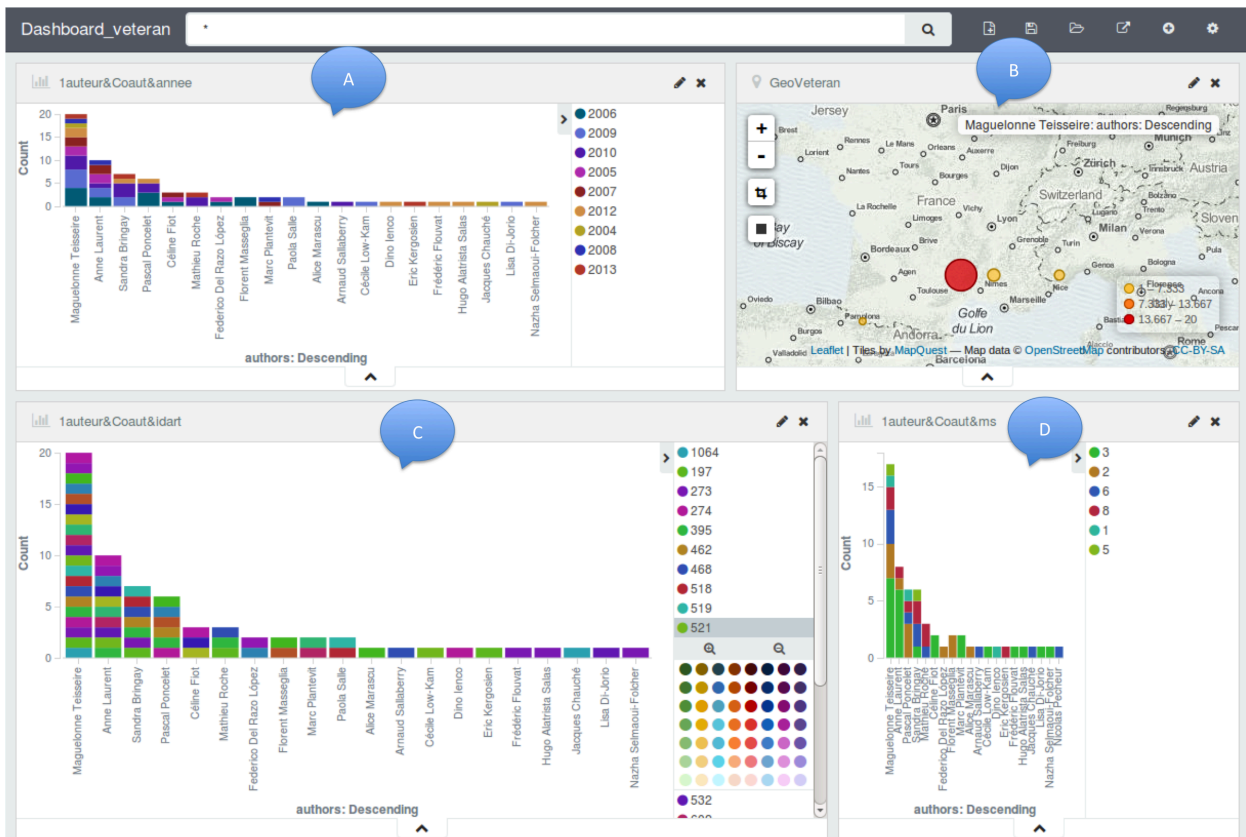


Fig. 8. Dashboard of one ambassador

Built interactively with queries addressed to the GIR tool, a dashboard is an easy tool to deal with complex parameters: for example to get a mapping focused on a specific author and its related links with co-authors network, conferences venues, labs location (city) or the evolution of the domain interests over the years (figure 9).

These first elements show that our GIR tool can help experts to conduct qualitative analysis on scientific publications.

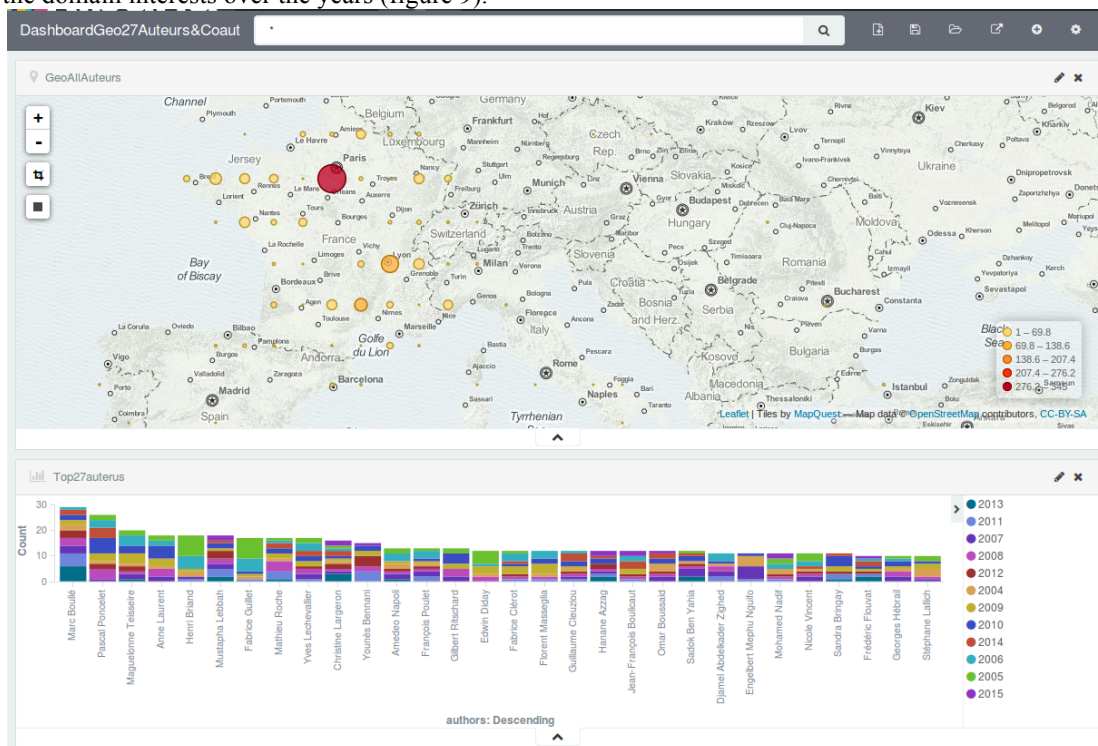


Fig. 9. Playing with a Dashboard.

## VI. CONCLUSION AND PERSPECTIVES

In this paper, we presented a semi-automatic and multidimensional analysis method to investigate scholarly publications. Exploiting the spatial, the temporal and the thematic features of articles (through the corresponding metadata), the method has been implemented in a geographic search engine to allow users bringing out relevant correlations in order to better understand the mapping of science. Illustrated on the EGC conferences from 2004 to 2015, the method shows that the combination of the three dimensions gives new opportunities for scientometrics analyses. Regarding the thematic dimension, we first classified the different articles of the EGC corpus within meta-sessions and then validated the classification using a text-mining approach which has been proceeded on the articles abstracts. Spatial and temporal dimensions may be considered as filters for querying the geographic search engine. A geographical view of the corpus is obtained by combining the different dimensions on the corpus. The methodology presented in the paper is a generic one and can be adapted on different kinds of scholarly corpora. The different steps - data preparation, indexation, analysis and information retrieval constitute an integrated process that can be used whatever the conferences and linked data.

Future works will consist in (i) substituting the manual work in the preparation step by automated processes, especially the identification of the cities for the authors laboratories, (ii) testing the methodology on new corpora (for example the ISTEEX corpora in Library and Information Science) and (iii) integrating English in the processing chain in order to deal both with French and English written articles.

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# Result Prediction using k-Nearest Neighbor Algorithm for Student Performance Improvement

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**Abstract**—The examination results have become an integral part of every student's life. The educational institution's ranking is greatly influenced by the university results. This paper mainly focuses on the prediction of a student's university result by making use of different attributes. These attributes might be of quantitative and qualitative type. The quantitative attributes used are Internal Assessments, Attendance percentage, Number of On-Duties taken and Overall Assignments completed. The qualitative attributes include Subject feedback, Faculty feedback, and whether the student is a Day Scholar/Hosteller. Here, we make use of k-Nearest Neighbor algorithm (or k-NN for short) against the historical data of students for more accurate prediction of results. In this method all the attributes considered are converted to the same scale. This algorithm makes use of the Euclidean distance formula which is used to find the nearest record. This algorithm predicts better results which help students maximize their academic output.

**Keywords**—University Results, Prediction, Attributes, k-Nearest Neighbor, Euclidean distance formula.

## I. INTRODUCTION

Educational institutions impart knowledge to students and test the imbibed knowledge through exams. These educational institutions are run by both government as well as by private entities teaching engineering, arts, medicine etc.... Examination is an integral part of every educational institution. It also plays a vital role in a student's career.

The exam results form a pivot to judge a student's capacity. The exam results affects the student's future and also influences the ranking of the educational institutions. The ranking of an educational institution solely depends on the results they produce. The result obtained by a student reveals his/her interest and knowledge towards the particular branch of study.

Over the years educational systems have been improving drastically. Result prediction has become a common practice for the improvement of the institution and for the betterment of students. Predicting results by the institutions provides sufficient time to students for improving

themselves. This helps in improving the student's academic performance and also the ranking of the educational institution.

Currently the student's academic performance is predicted by considering their assessments and behavioral pattern during class hours. This method of prediction being followed is crude and does not give accurate results. In today's context result prediction plays a major role in not only for ranking of educational institutions but can also be used for much wider applications.

## II. RELATED WORKS

Many people have proposed various systems that analyze and predict the behavioral and academic pattern of students. In the year 2014, Naren J [1] proposed a system that specifies the classification techniques for predicting the career options and to predict the violent behavior prevalent among students. A response sheet was used to gather details regarding the background information, reaction of a student when irritated and the interests of a particular student. These parameters were mined to find the corresponding behavioral pattern of a student. However, additional research on student attitudes and learning is needed to predict the patterns efficiently. The response sheet must be created in such a way that it avoids false values and other possible problems. Minimal number of attributes is used which in turn does not give accurate values. Only limited amount of information is suggested for prediction of career options for students.

Authors Nitya Upadhyay, Vinodini Katiyar [2] have proposed a system for predicting the academic performance and the behavior of a student. Various techniques such as Naïve Bayesian Classification, Multilayer Perceptron, J48 and ID3 were used to analyze the attributes. However only a comparative analysis on which technique would give accurate results was specified but not on how they need to be implemented.



### III. PROPOSED MODEL

In this section, we are going to present a conceptual model of our system and explain the various aspects of it in a systematic manner.

#### A. Data Gathering

In order to predict the student results we need to gather large amount of data. Larger amount of data results in more accurate prediction. Hence data gathering plays a vital role. The educational institutions are responsible for collecting and providing these data. Students of the respective institutions have to fill in the necessary details in an excel sheet or fill in a form provided by the institution. These forms include general information such as name and register number of a student and the necessary information required for prediction.

There are two types of important data required

- Data of past students
- Current student data

The data of past students refers to the collective records of previous batches which are stored in order to predict current student results. Current student data refers to the group of students for whom the prediction process has to be carried out. It is the responsibility of the institution to periodically update and verify the data of the students. This ensures that prediction process yields accurate results.

#### B. Attribute Selection

There are large amount of student data available which is not being utilized efficiently. Attribute selection is one of the most important step. It is important to extract meaningful attributes from the gathered data. Only with sufficient and required attributes can the prediction process be implemented and improved. The attributes are classified into:

- Quantitative attributes
- Qualitative attributes

Quantitative data are those which have a specific measure. These are present in the form of numbers. These data are filled in by the faculty based on the student's performance. The attributes used here are Internal Assessments, Attendance percentage, Number of On-Duties taken and Overall Assignments completed. Qualitative data are those which are not present in the form of numbers. It normally defines certain qualities/characteristics. The qualitative data are converted into numerical form by using questionnaires. The questionnaires contains a text box where each student will have to enter a value. The average value is calculated for the questionnaire based on the value entered by the individual students. These averages are the corresponding numerical value for the respective qualitative attribute of a student. The value given for each option is just a number used for converting qualitative data into quantitative data. The qualitative attributes used are Subject feedback, Faculty

feedback, and whether the student is a Day Scholar/Hosteller. The last attribute has a predefined value i.e. Day Scholar is given a value 3, Hosteller as 2, Room staying student as 1. All the attributes selected need to be scaled to a common range. This is to ensure that they can be used in k-Nearest Neighbor algorithm.

**Faculty Name : Mr.M.Mariappan.**

- 1) Subject matter organized in logical sequence:-  
Your Rating  out of 10.
- 2) Teacher comes to the class on time and engages regularly:-  
Your Rating  out of 10.
- 3) Teacher comes well prepared in the Subject:-  
Your Rating  out of 10.
- 4) Teacher keeps himself / herself updated:-  
Your Rating  out of 10.
- 5) Teacher maintains discipline in the Class:-  
Your Rating  out of 10.
- 6) Teacher offers assistance and counselling to the needy students:-  
Your Rating  out of 10.
- 7) Teacher provides good feedback on the performance of the students:-  
Your Rating  out of 10.
- 8) Teacher speaks clearly and audibly:-  
Your Rating  out of 10.

Fig. 1. Sample Questionnaire for Faculty Feedback.

Fig 1 shows a sample form for faculty feedback. The values entered by individual students are taken into consideration while calculating the average. The average for the above sample is calculated to be 9.4. Similarly a questionnaire for subject feedback is used and its average is calculated for each student individually.

#### C. Implementation

There are numerous number of algorithm which are used for prediction process. Some of these algorithms are neural networks, naïve Bayes, k-Nearest Neighbor, decision tree. In this paper we have used k-Nearest Neighbor algorithm for the purpose of prediction.

The main step before prediction process is to check if all the past data of students are available. Only with the help of present and past data of students the prediction process is possible. Once the data is available the required attributes for result prediction are taken into consideration. These attributes are stored in two separate tables. One for the past students data and the next is the current students data for whom the prediction is to be done. The attributes present in the two

tables are scaled down to a common range which does not exceed 10. Then with the help of k-Nearest Neighbor algorithm the prediction process is carried out.

The first step for prediction is to randomly set a value for k. This value of k should neither be too large nor too small. This is because k represents the number of nearest neighbor. The value of k cannot be zero or below zero.

The next most important step is the construction of the distance table. This table has to be constructed for each and every student for whom the prediction process is carried out. The construction of this table is based on the Euclidean's distance formula. The formula is as follows:

$$D = \sqrt{(x_1 - y_1)^2 + (x_2 - y_2)^2 + (x_3 - y_3)^2 + \dots + (x_n - y_n)^2}$$

Where,

D is the distance

$x_1, x_2, \dots, x_n$  = the records of current students

$y_1, y_2, \dots, y_n$  = the records of past students

Once the distances are calculated using the Euclidean's distance formula they are sorted into ascending order. Now the distance table of each current student consists of distances calculated through their records vs. all the past students records. Since they are sorted it is easier to find the k-nearest neighbor with the help of k value.

All the records other than the k-nearest neighbors are removed from the table. Only the records equal to the value of k are left in the distance table. This shows that the range of the result prediction lies somewhere within the range of these records.

After the construction of distance table with only the required records, the past students records are fetched from the past students table. The exam results of these students are checked and the average result of these students are calculated. Once the average has been computed the value is subtracted and added with 0.25. This gives us a range in which the result lies.

#### IV. SIMULATION

The simulation is carried out using excel for easier representation and understanding. The application of k-Nearest Neighbor algorithm along with Euclidian's distance formula is carried out on a sample data.

Student Register No.	Test 1	Test 2	Test 3	Attendance	OD Taken	Faculty Review	Subject Review	Student Type	GPA
310613205059	5	5.4	6.9	7.8	3.4	7.9	6.7	3	7.2
310613205060	4	8.9	5.8	6.7	5.5	6.9	8.7	2	8.1
310613205061	6	4.6	9.5	8	7.4	8.7	9.1	2	8.5
310613205062	7.8	7.3	6.6	7.4	8.2	6.7	5.6	2	6.4
310613205063	4.4	8.8	7.4	4.5	9	7.7	6.3	3	5.5
310613205064	5.6	9.2	8.5	6	6.6	9.2	3.4	3	7.7
310613205065	9.2	7.8	9.2	5	7.4	6.7	8.2	1	6.5
310613205066	8.8	9.3	5.5	7.6	8.5	8.5	6.7	1	7

Fig. 2. Past Students Table

Student Register No	Test 1	Test 2	Test 3	Attendance	OD Taken	Faculty Review	Subject Review	Student Type	GPA
310614205065	7.3	6.5	5.5	8.7	5.6	9.4	6.6	3	?
310614205066	6.7	7.7	6.3	7.2	8.3	6.7	8.3	2	?
310614205067	6.4	8.6	6.5	5.5	7.7	9.6	7.5	3	?
310614205068	7.4	9.2	8.6	9.2	5.6	8.7	9.2	2	?
310614205069	7.8	7.8	7.4	6.9	5.6	9.4	8.2	2	?
310614205070	9.3	6.5	6.8	9.3	6.7	8.4	8	2	?
310614205071	6.8	7.5	8.7	5.6	7.8	6.2	6.9	3	?
310614205072	9.4	7.3	6.4	8.5	9.1	6.7	5.9	1	?

Fig. 3. New Students Table

Fig 2 consists of sample data for past students record which consists of all the required data along with the final result with which new results are going to be predicted. Similarly Fig 3 consists of sample data of new students. It contains all the attributes required to predict its final result. The student type in both the tables indicates if the student is a day scholar/hosteller.

Past Student Register No.	Distance	Order
310613205059	4.05	1
310613205060	5.69	4
310613205061	5.72	5
310613205062	4.45	2
310613205063	7.03	7
310613205064	6.14	6
310613205065	7.05	8
310613205066	4.95	3

Fig. 4. Distance Table

Let  $k=3$ , this tells us that the first three records have to be extracted after the distance has been computed.

The distance is computed using the Euclidean's distance formula. The calculation for student register number 310613205065 against one record is shown:

$$D = \sqrt{(7.3-5)^2 + (6.5-5.4)^2 + (5.5-6.9)^2 + (8.7-7.8)^2 + (5.6-3.4)^2 + (9.4-7.9)^2 + (6.6-6.7)^2 + (3-3)^2}$$

$$D=4.05$$

Similarly all the distances can be calculated for all the students. The distance table for the above student is generated as in Fig 4.

Fig 5 shows the distance table for the student 310613205065 in ascending order.

Now we extract the first three records as the specified value of k is 3. Taking the average of the results of these three records we get 6.87. Therefore we can compute the range to be 6.62 to

7.12. This is done by subtracting and adding the average value with 0.25.

Past Student Register No.	Distance	Order
310613205059	4.05	1
310613205062	4.45	2
310613205066	4.95	3
310613205060	5.69	4
310613205061	5.72	5
310613205064	6.14	6
310613205063	7.03	7
310613205065	7.05	8

Fig. 5. Sorted Distance Table

Register No.	Prediction Result	Result Range From	Result Range To	Original Result	Within Range
310614205065	6.87	6.62	7.12	6.60	YES
310614205066	7.17	6.92	7.42	6.95	YES
310614205067	6.30	6.05	6.55	7.00	NO
310614205068	7.87	7.62	8.12	8.10	YES
310614205069	6.30	6.05	6.55	6.80	NO
310614205070	7.53	7.28	7.78	7.50	YES

Fig. 6. Final Predicted Table

Similarly all the results for all the students were predicted. Fig 6 shows the final table of predicted results of students and was verified after their results were published.

## V. CONCLUSION

The proposed system provides insights of how the student results can be predicted. It showcases the efficient result prediction strategies used under k-Nearest Neighbor algorithm. This when implemented on a large scale by various institutions will yield fruitful results which in turn will maximize the prediction rate and improve the individual academic results of an educational institution, thereby increasing their ranking. The proposed system gives the institution the time to progress the students in their areas of improvement. Though there have been different classification algorithms predicting the results of students and yet no algorithm has been applied on real time educational datasets. In this work we have computed the results of some students belonging to an educational institution and showed results.

## VI. FUTURE SCOPE

In this paper we consider some of the most common attributes from the student's data. A lot of other factors can be taken into consideration for better prediction purposes is left as future scope of this paper. This system can be implemented in a wider scale if a common database is used by all colleges. With larger amount of data big data analysis can be used for faster prediction of results. It can also be applied for predicting the results of individual subjects which in turn yields more accurate results.

This system can also be implemented in other domains such as health sectors. In health sectors symptoms of a patient when considered as attributes can be used for disease predictions.

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# Empirical research on the application of SW-Tools for Web and Social-Media Monitoring (April 2017)

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**Abstract—** The research question in this paper was:

**Is the utilisation of software tools for web and social-media monitoring for B2B companies beneficial?**

**We used the following sub-questions:**

- 1. How will new information concerning a start-up company diffuse in the web?**
- 2. Is it possible to improve competitor information in an established B2B business with web monitoring?**
- 3. Is it possible to detect the potential of ingredient branding in the automotive market?**

**For the same three tasks we used commercial web monitoring tools for this analysis of Big Data and compared the results.**

**Our research results showed that in B2B markets the importance of the web and social media is growing. It is possible to observe this across different countries and languages. The companies gain current information and can receive alerts concerning important changes.**

**But there are still limits to reliability and completeness. The research set-up seems to be the most crucial activity.**

**Index Terms—** B2B

**Big Data, Competitor, Established Business, Ingredient Branding, Monitoring, Social Media, Start-up, SW-Tools, Web**

## I. INTRODUCTION

THE B2B BUSINESS IS CHARACTERISED BY DIRECT COMMUNICATION BETWEEN SUPPLIER AND BUYER. THE MARKETS ARE OFTEN VERY SMALL AND SPECIFIC. HOWEVER, THEY ARE ALMOST ALWAYS INTERNATIONAL. IN THIS ARTICLE, THE RESULTS OF AN EMPIRICAL STUDY ARE PRESENTED. IT EXAMINES WHETHER WEB MONITORING IS RELEVANT IN THE

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B2B BUSINESS AND WHAT BENEFITS A COMPANY CAN ATTAIN THROUGH WEB MONITORING.

The benefits depend on the subject under investigation and on the company's situation and objectives. Therefore, this study was based on different research subjects typically occurring in companies. One object of investigation is the observation of the communication activities of a start-up company and its competitors. The company faces the market launch of an electric personal multicopter. The topic is of great public interest and the company wants to keep track of how newly published information is received and disseminated on the internet. There are prototypes of other concepts that can be considered competitors. Their communication activities and effects are also to be observed.

Another object of investigation involves observing opinions on autonomous driving. On the basis of these findings, an automotive supplier can analyse the opportunities for ingredient branding in this future market.

Finally, the third subject of investigation involves the monitoring of competitors for industrial drive systems in an established market.

In terms of these three subjects, web and social media queries were formulated and conducted over a period of eight weeks. Depending on the software tool, it was expected that different results could be achieved. In order to receive suggestions on the influence of tools on the results, three different software tools were used, with which the identical monitoring questions were formulated.

## II. WEB AND SOCIAL MEDIA MONITORING

This section discusses important terms related to the results of the empirical study.

Web or social media monitoring denotes the systematic and continuous determination and monitoring of published conversations, posts and mentions of specific topics or keywords on social media and other online media such as websites [1]. It is the targeted search for contributions concerning one's own company, products or competitors and therefore comparable to a funnel that collects, monitors and tracks relevant conversations and moods on the Web [2]. Web monitoring is used to find out which topics the users and also the competitors are dealing with and which trends are developing in the industry [3]. Web monitoring, depending on

the setting, filters relevant contributions in the entire Internet and evaluates their contents. It is possible to capture and analyse generated content from all users. In the past, however, only information from mass media and companies was available. This allows the comparison between the results of the web monitoring and the results of market research.

The following list shows some application targets for web monitoring.

- Analysis of target groups and the brand position.
- Identifying channels on which potential customers talk about products and solutions [4].
- Opinion on the company and current topics [5].
- Early warning system for critical discussions.
- Identification of trends and topics that may affect the company [6].
- Identification of influencers and multipliers.

### III. WEB MONITORING TOOLS

Search engines consist of crawlers, indexers, and searchers. Crawlers take known documents as a starting point and go to new documents, which are connected via links. Indexers generate structured information on documents, which are evaluated in subsequent analyses. The index is stored with the document address and evaluations in the database. Using the searcher, users formulate questions in the search engines. [7]

Search engines represent the whole web. As a result, they provide an address list of the documents found, which are arranged according to their relevance. Monitoring tools work like search engines and in addition, search continuously. They search in defined sources and try to find all documents.

Web monitoring tools provide the following analysis features.

#### A. Frequency

You can find answers to questions for a specific period, such as: How often is a product or company mentioned? In which media is the term used, and how frequently? In which countries?

#### B. Performance

Are there reactions to the contributions which include the searched term? How big is the commitment of the readers? How many readers have been reached (followers, members, hits)?

#### C. Sentiments

What opinions and associations are expressed in connection with the term?

#### D. Topic exploration

Which terms are frequently used in connection with the search term? Are there certain competing products, applications, problem groups, target groups?

#### E. Opinion leader

Which pages, forums, groups, people are opinion leaders?

#### F. Profiling

What is the profile of the people who contribute to the term: gender, country, age ...?

The methods of the software tools are based on heuristics, assessments, entry points and historical data. For this reason, complete and 100% correct results cannot be expected. Therefore, in this empirical study, the gain by use of web monitoring was assessed on the basis of the specific cases mentioned in section I.

### IV. EVALUATION OF THE EFFECTIVENESS

When analysing the search results, two types of errors are to be distinguished. Table 1 shows the types of errors.

	Relevant	Not relevant
Selected	Right decision	Error type 2
Not selected	Error type 1	Right decision

Table 1. Types of errors

There is no way to determine how many items are available with the expressions you are looking for. Therefore, the number of errors of type 1 cannot be determined. On the other hand, it is possible to determine how many of the items found do not meet the search criteria. [8]

### V. RESEARCH RESULTS

#### A. Frequency of items

We wanted to know whether we would find differences, for the same queries when using different software tools. Fig. 1 shows that the course and number of hits is very similar for the three tools used. On occasion, it can be noticed that with different tools there is a time offset at peak values. However, the level of the course of the hits develops similarly. Since the time offset occurred occasionally with all tested tools, we suggest that it is due to the tools' crawlers that perform the indexing of the web pages in a specific way.

Nevertheless, we found large differences in the peaks on individual days. We subjected this to a specific investigation. It turned out that one tool suppressed identical content. The tool that showed all content found displayed especially high peaks in Twitter messages that resulted from re-tweets.



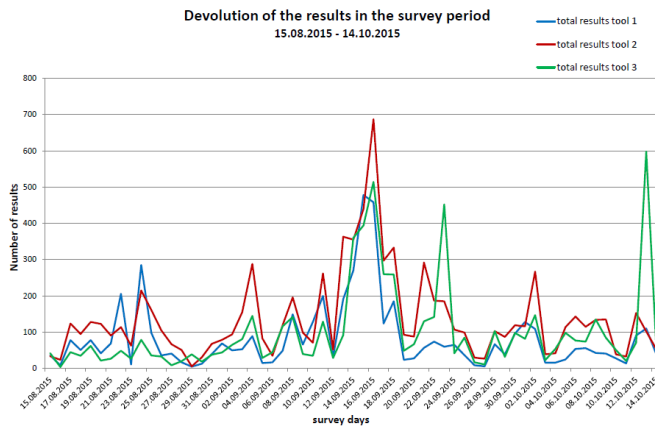


Fig. 1. Number of results found with the same query using different tools

### B. Frequency of Competitors

The frequency of publications concerning competitors is a typical question. This is illustrated by the example of the start-up e-volo. We see in Fig. 2 that reporting on the provider Terrafugia is done continuously and at times very often. When the analyst finds irregularities, he is then able to analyse the articles in order to find the content of and the reason for the publication.

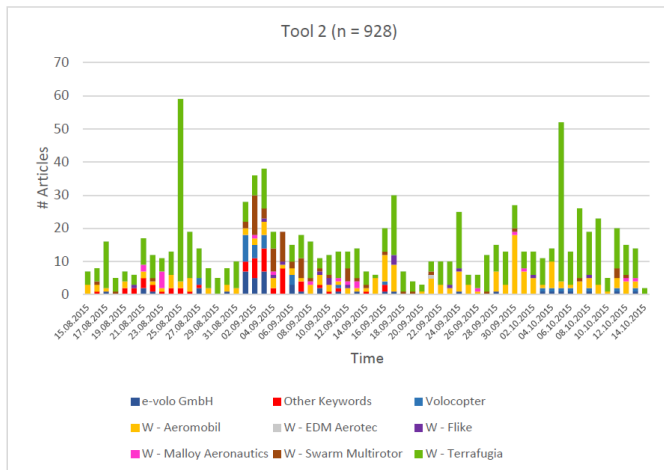


Fig 2. Number of articles found concerning competitors

### C. Frequency of Channels

The observation of media that publish on important topics enables companies to choose the right media and to react quickly. Fig. 3 shows the results to the question in which internet domains strong activity on "autonomous driving" is to be found in German language. The discussion on this topic takes place in domains with technical, financial and general content.

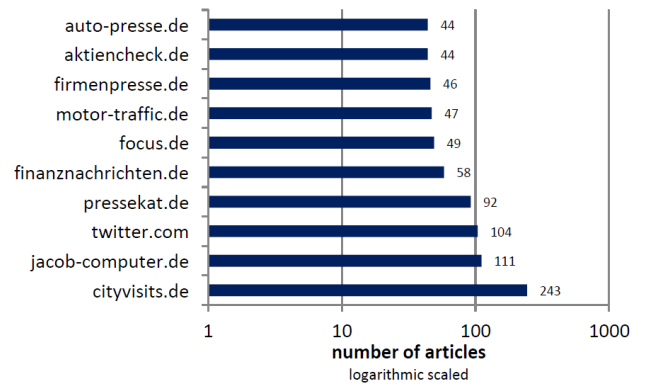


Fig. 3. Top 10 domains with German-language articles on autonomous driving

### D. Frequency of Authors

In the Internet, and especially in social media, both professional and private authors publish. It is important for companies to identify key opinion leaders. This is also possible via the web monitoring tools used in this study. Thus, companies can provide important authors with targeted information.

### E. Effectiveness of search

The quality of the search results is an important criterion for assessing how useful web monitoring is for companies. For that purpose, we have examined the contents of the articles in a sample of the results. The example in Table 2 shows the search for the company name "e-volo GmbH", its competitors and other keywords. All keywords were searched using the three monitoring software tools. A total of 4,159 articles were found. We cannot make a statement about how many articles exist on the Web, but have not been found. Further statements relate only to the articles found.

	All Data		Test scope		Relevant items		Relevant content	
	Σ	n	Σ testable articles	Proportion [%]	relevant	Precision 1	relevant	Precision 2
<b>Identified articles</b>								
<b>Total</b>	<b>4159</b>	<b>463</b>	<b>403</b>	<b>87%</b>	<b>403</b>	<b>100%</b>	<b>80</b>	<b>20%</b>
Tool 2	928	122	111	91%	111	100%	26	23%
Tool 1	2176	216	200	92%	200	100%	36	18%
Tool 3	1055	125	92	74%	92	100%	18	20%
<b>e-volo GmbH</b>	<b>351</b>	<b>23</b>	<b>22</b>	<b>100%</b>	<b>22</b>	<b>100%</b>	<b>11</b>	<b>50%</b>
Tool 2	75	6	6	100%	6	100%	4	67%
Tool 1	168	8	8	100%	8	100%	4	50%
Tool 3	113	9	8	89%	8	100%	3	38%
<b>Competitors</b>	<b>3640</b>	<b>433</b>	<b>375</b>	<b>87%</b>	<b>375</b>	<b>100%</b>	<b>69</b>	<b>18%</b>
Tool 2	801	116	105	91%	105	100%	22	21%
Tool 1	1930	206	190	92%	190	100%	32	17%
Tool 3	909	111	80	72%	80	100%	15	19%
<b>Other Keywords</b>	<b>268</b>	<b>7</b>	<b>6</b>	<b>100%</b>	<b>6</b>	<b>100%</b>	<b>0</b>	<b>0%</b>
Tool 2	52	0	0	-	0	0%	0	0%
Tool 1	183	2	2	100%	2	100%	0	0%
Tool 3	33	5	4	80%	4	100%	0	0%

Table 2. Effectiveness of search with different tools

In the next step, a random sample of the items found was drawn. This sample was then further examined manually. 13% of the articles in the sample were not examinable.

In this search the searched keywords were actually found in all examined articles. This means that key figure precision 1 is 100%. In other search queries, small percentages of articles were found that did not contain the keywords.

In the following analysis step, the contents of the articles were examined by the authors as to whether they were relevant to the search query. Relevance in this case refers to,



whether these are articles concern the companies searched. The key figure precision 2 is used to determine the proportion of the relevant articles. This share of only 20% is low. The different tools show clear differences in precision 2. In order to improve this result when defining the search, the searcher has to conduct tests and content checks to find exclusive terms or combinations of terms that lead to an improvement in precision 2. This process is time-consuming.

### F. Sentiments

The sentiment analysis function is intended to show the analyst whether the found articles have a neutral, positive or negative relationship to a specific keyword. Thus, attitudes, opinions and evaluations of the authors of the articles could be interpreted. Table 3 shows the found sentiment for a query example. The articles were manually analysed and sent by one of the authors. There were clear deviations.

	All data		Test scope		Sentiment Tool			Human sentiment review			Difference	Q. quality
	Σ	n	testable	negative	neutral	positive	negative	neutral	positive	Σ	[%]	
Tool												
Tool 2	928	122	111	2	101	8	1	80	30	44	60%	
Tool 1	2176	216	200	2	134	64	1	151	48	34	83%	

Table 3. Example of sentiment analysis

Tool 2 showed a neutral assessment in all cases under consideration. In the example, Tool 1 reached a good result with a match of 83%. However, in other cases the results were much poorer. As a result of sentiment analysis with regard to the cases investigated, it can be seen that the quality varies greatly depending on the case. Results of the sentiment analysis must be subjected to further reviews before they are used as findings in decision-making processes. However, there are probably fields of application in which sentiment analysis is very useful. This could include monitoring the launch of new products.

## VI. CONCLUSION

On the basis of empirical web and social media monitoring studies, the results of the investigations were examined and analysed. It was found that in the B2B business relevant information is also found by means of web monitoring.

No exact results can be obtained when determining the frequency of the occurrence of articles that are related to defined search terms. The use of different software tools leads to different results. Nevertheless, comparative statements can be made on the investigated objects. For example, the importance of competitors, communication channels or authors of the articles can be determined comparatively. Also the temporal development of the occurrence of topics can be observed.

There is no way to ensure all published articles are found. On the other hand, the proportion of non-relevant found articles is very high. In order to master this problem and

ultimately arrive at meaningful results, the set-up of the query must be prepared carefully and with great effort and tested several times. The implementation of the monitoring only makes sense in this case. The analyst needs to have good knowledge of search technologies, online media and the subject matter of the subject to be monitored.

A great advantage of web and social media monitoring is that publications can be observed in the relevant languages and countries.

This makes it very suitable for use as an early warning system. Due to the problems of web monitoring, we recommend a dedicated approach by collecting initial experiences with a defined topic. With this experience, the monitoring can then be extended to other topics.

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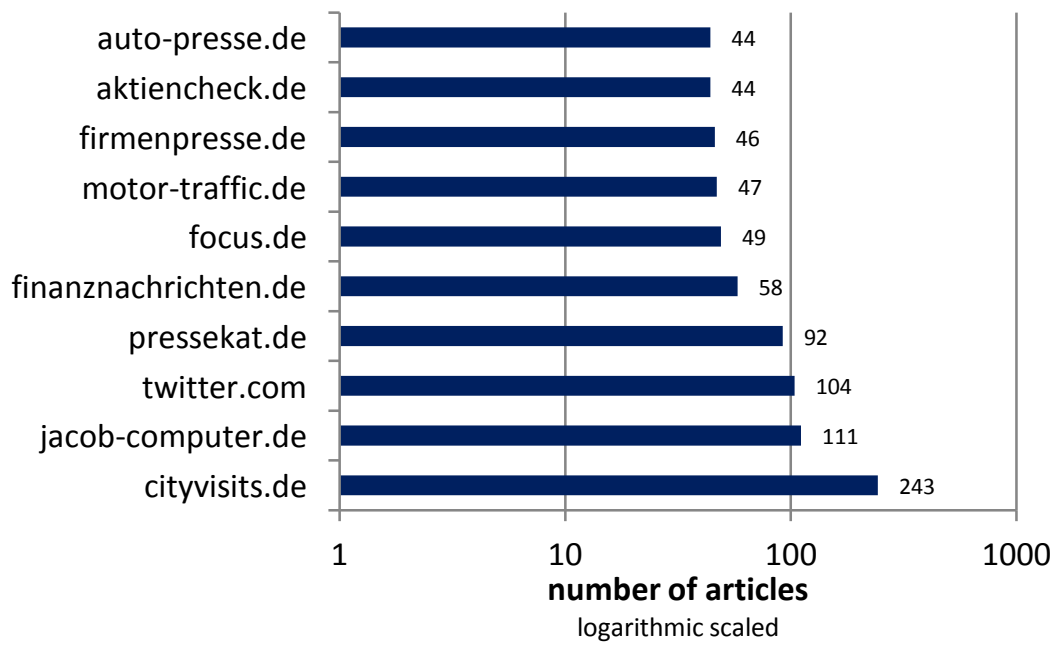
She received the B. Sc. degree from Karlsruhe University of Applied Sciences in International Management in 2015 and graduated from Karlsruhe University of Applied Sciences with a Master's degree in International Management in 2016.

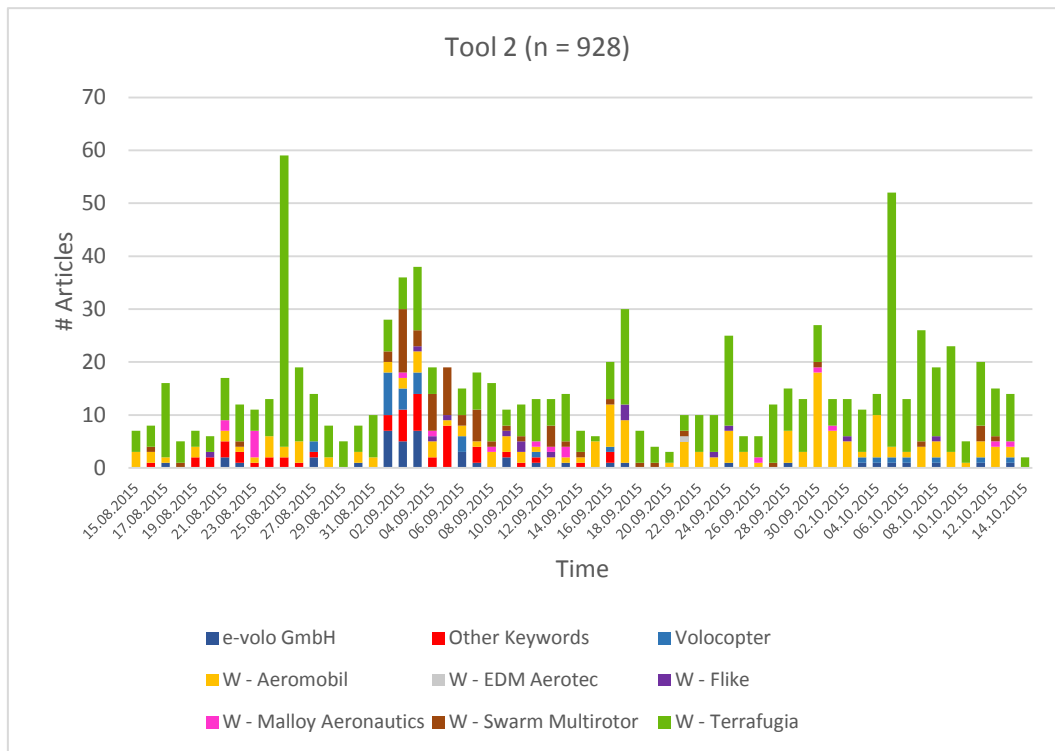
From 2012 to 2016 she gained practical and international experience in various companies besides her studies. For instance, at EnBW Baden-Württemberg AG, Germany, in the field of social media and web controlling. Since 2016, she has been working as an international controller at Carl Zeiss Vision International GmbH, Germany.

Her research interests are focused on web analysis and controlling: to find out which online activities can have an impact on firm business results, and in which way they can be influenced.

	All data	Test scope		Sentiment Tool			Human sentiment review			Difference	Q uality
	$\Sigma$	n	testable	negative	neutral	positive	negative	neutral	positive	$\Sigma$	[%]
<b>Tool</b>											
<i>Tool 2</i>	928	122	111	2	101	8	1	80	30	44	60%
<i>Tool 1</i>	2176	216	200	2	134	64	1	151	48	34	83%

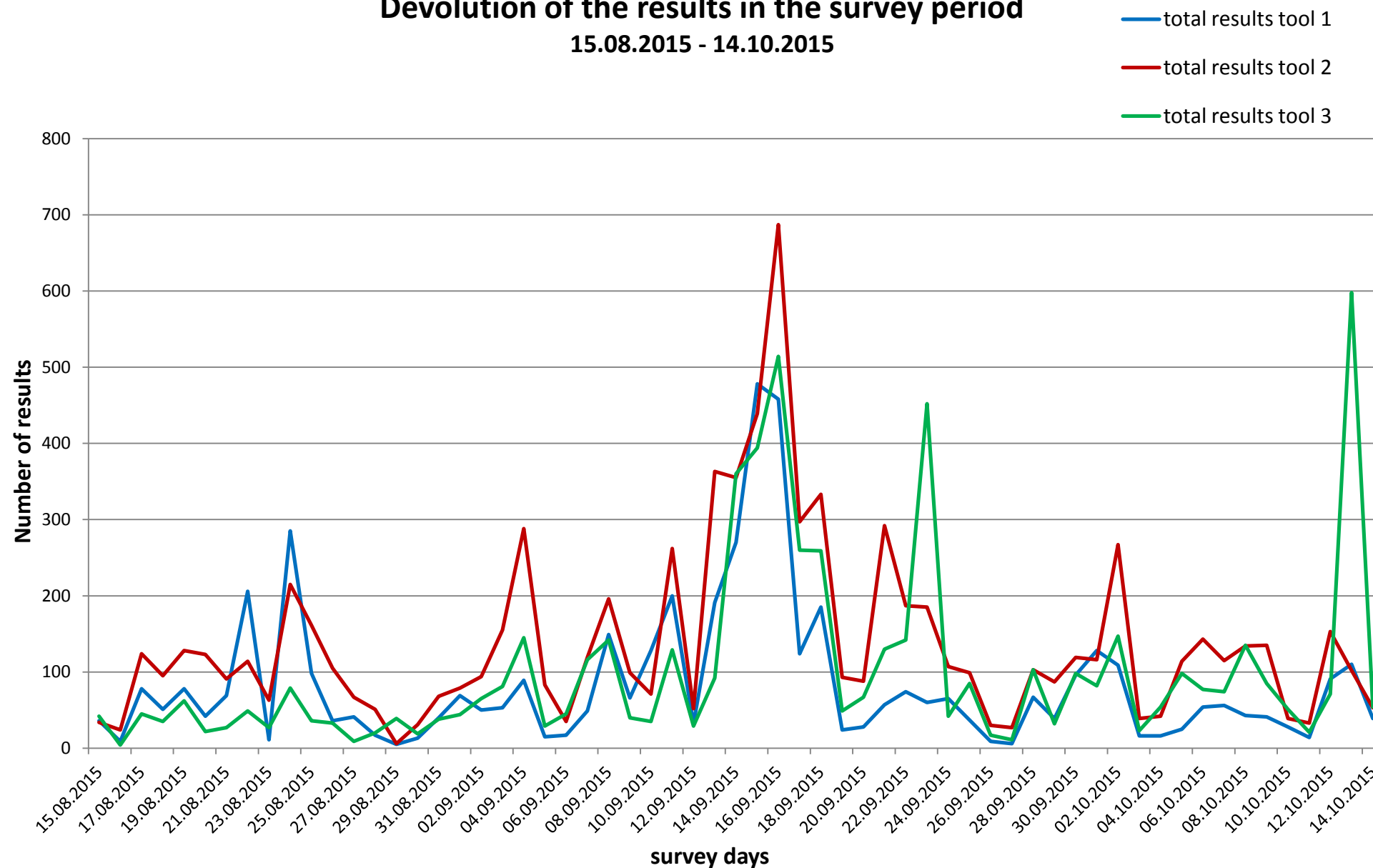
Identified articles	All Data	Test scope			Relevant items		Relevant content			
	$\Sigma$	n	$\Sigma$ Reviewed articles	Proportion [%]	Relevant	Precision 1	Relevant	Precision 2	Not relevant	Proportion [%]
<b>Total</b>	<b>4159</b>	<b>463</b>	<b>403</b>	<b>87%</b>	<b>403</b>	<b>100%</b>	<b>80</b>	<b>20%</b>	<b>323</b>	<b>80%</b>
<i>Tool 2</i>	928	122	111	91%	111	100%	26	23%	85	77%
<i>Tool 1</i>	2176	216	200	93%	200	100%	36	18%	164	82%
<i>Tool 3</i>	1055	125	92	74%	92	100%	18	20%	74	80%
<b>e-volo GmbH</b>	<b>351</b>	<b>23</b>	<b>22</b>		<b>22</b>	<b>100%</b>	<b>11</b>	<b>50%</b>	<b>11</b>	<b>50%</b>
<i>Tool 2</i>	75	6	6	100%	6	100%	4	67%	2	33%
<i>Tool 1</i>	163	8	8	100%	8	100%	4	50%	4	50%
<i>Tool 3</i>	113	9	8	89%	8	100%	3	38%	5	63%
<b>Competitors</b>	<b>3640</b>	<b>433</b>	<b>375</b>		<b>375</b>	<b>100%</b>	<b>69</b>	<b>18%</b>	<b>306</b>	<b>82%</b>
<i>Tool 2</i>	801	116	105	91%	105	100%	22	21%	83	79%
<i>Tool 1</i>	1930	206	190	92%	190	100%	32	17%	158	83%
<i>Tool 3</i>	909	111	80	72%	80	100%	15	19%	65	81%
<b>Other keywords</b>	<b>268</b>	<b>7</b>	<b>6</b>		<b>6</b>	<b>100%</b>	<b>0</b>	<b>0%</b>	<b>6</b>	<b>100%</b>
<i>Tool 2</i>	52	0	0	-	0	-	0	-	0	-
<i>Tool 1</i>	183	2	2	100%	2	100%	0	0%	2	100%
<i>Tool 3</i>	33	5	4	80%	4	100%	0	0%	4	100%







## Devolution of the results in the survey period 15.08.2015 - 14.10.2015



# *Study on the openness, market scale and growth in regional economies*

## *A research based on instrument of geographical distance in China*

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**Abstract**—This paper revisits the relationship between growth, trade openness and market scale. Empirical studies have provided that area develops lopsided problem in China is increasingly serious, while large trade openness and market scale bring about more economic growth. So far there is very little empirical evidence on the impact of the integrated economy on regional economic growth. This paper use a number of data set from province-level GDP and socio-economic, as well as statistical methods panel OLS and instrumental variables (IV) estimation techniques to explore the effects of trade openness and regional market scale on the three major economic regions.

The results indicates that the impact of market scale and trade openness on economic growth is found to be positive. Foreign market could substitute for regional market; Moreover, the overall regional disparity was owing to the trade openness, market scale and macroeconomic policies between three regions.

**Keywords**—trade openness; market scale; growth; instrumental variables; regional economies

### I. INTRODUCTION

After years of development, foreign trade has become the most active part in the Chinese economy. China has become ranked in the forefront of the world trade power. In 1978, import and export goods of China amounted to \$20 billion 500 million, which in the world trade only ranked thirty-second, accounting for less than 1%. In 2013, Chinese total import and export of goods amounted to \$4 trillion and 160 billion, of which exports amounted to \$2 trillion and 210 billion, imports amounted to \$1 trillion and 950 billion. According to the World Trade Organization Secretariat preliminary statistics, China has surpassed the United States to become the world's largest trade country.

At the meantime, unbalanced growth of regional economy has been one of the key development characteristics considered across China. The economic disparities is even more discernable between eastern coastal areas and western regions. For example, per capita GDP in Yunnan province in 1999 was 4,478 yuan, while per capita GDP in Shanghai was 27,561 yuan, there is a difference of 23,083 yuan. However, in 2013 per capita GDP of Yunnan province increased to 27,264 yuan, per capita GDP of Shanghai at this time already increased to 97,343 yuan, the gap between them is 72,731 yuan, which is 3.04 times in 1999. It

means per capita GDP in China has increased year by year, inequality among individuals is growing within most regions. This trend would not conducive to China's economic and social sustainable development.

Theoretically, the influence of trade openness on economic fluctuation is uncertain. Openness will increase the external impact of economic shocks. Meanwhile, the degree of specialization of the industry makes it more vulnerable in the face of shocks from specific trade sectors. In addition, the higher trade openness degree, the bigger export market scale. And the efficiency of resource allocation will be improved, which can effectively alleviate the impact of domestic instability on the economy.

To reflect the social and economic development of different regions and providing the basis regional development policy for the national development, Chinese Seventh Five-Year Plan divided country into three economic regions, respectively they are east region, central and the western region. Therefore, we contributes to the literature by using province-level information to study and try to solve (1) the relationship between trade openness and regional market scale ; (2) the effects of trade openness and regional market scale on the three major economic regions; (3) the main factors behind unbalanced growth in China. The answer to these questions will help government to introduce effective policies mitigating the economic fluctuation based on the existing export market concentration, hence to reduce the negative impact of economic fluctuations, making contribution to promote the healthy development of Chinese regional economic.

### II. LITERATURE REVIEW

In order to explore the relative contributions of market scale and openness to explain the growing economic inequality between different regions, many experts at home and abroad have done lots of researches. According to the thoughts of early scholars, openness and trade scale these potential determinants of growth might be interlinked (see Magdalene, 2016).

However, due to the different situation in regions and different research methods that adopted by scholars, there are several arguments of interaction effect between trade openness and market scale in explaining economic growth. On the one hand, most studies support the positive effect of trade openness

on economic growth. and open economies grow faster than closed economies. (see Geoffrey J.D. Hewings, 2014). Kim (2016) point out that on average, greater international trade, promotes economic growth and amplifies growth volatility in the long-run, in the short-run, causes a negative short-run correlation between growth and growth volatility. Ma (2012) use simultaneous equations model and VAR model to analyze interrelationship between trade openness and structure of labor-intensive industries, they find trade openness has a positive effect on economic growth and in the meanwhile baffles the development of labor-intensive industries. On the other hand, as emphasized in Kojo Menyah (2014), trade liberalization and financial development may not have made a significant impact on growth.

Recent empirical work on Chinese research also focuses on relationship of openness, growth and other influencing factors. Xu and Meng (2015) use a panel threshold model, find there is negative association between openness and growth with a lower level of human capital and significant positive association between them if with a higher level of human capital. Xu and Guo (2014) the energy consumption plays an important role in promoting each area's economic growth, but the effect of trade liberalization on economic growth is not important in China's central and western area. Wang (2015) and Li (2011) based on the different model settings, static and dynamic panel model, come to unanimous conclusion, their empirical results show that carbon dioxide emissions is increasing due to trade openness in China, international trade has a negative impact on China's environment.

Previous cross-country studies on the openness-growth connection are subject to fundamental methodological and econometric problems, as pointed out by Mohammad et al.(2016). However the endogenous problem of trade openness may exist in various aspects of country: the more affluent provinces and autonomous regions, the greater the regional advantage to expand exports. Thus researchers use the geographical distance from the provincial capital to the nearest coastline to measure the index of trade openness (Huang Jiuli, Li Kunwang, 2006), although in a certain extent this method can reflect the transportation cost, there still has a certain deviation between geographical distance and the actual transport distance.

So far there remains a lack of satisfactory measure of openness, and very little empirical evidence on the impact of the integrated economy on regional economic growth. Motivated by this idea, we investigate the research methods of Huang Jiuli and Li Kunwang (2006), using road distance from the provincial capital city to the nearest port which can more appropriately represent the transportation cost. Moreover, the geographical distance of the city at the prefecture level or above is taken as the tool variable, which can effectively solve the endogenous problem of the empirical study.

### III. MODEL AND DATA

Based on the model of Huang and Li (2006), we use the following empirical framework to investigate long-run growth. Accordingly, the author puts forward the corresponding with China's actual situation of countermeasures, to narrow the regional economic disparities exist among regions. With a

number of data set from province-level GDP and socio-economic, this paper introduce fixed effects into regressions to control the endogenous problem of trade openness and market scale. In general form, this model can be characterized as

$$g_{it} = \beta_0 + \beta_1 FMA_{it} + \beta_2 RMS_{it} + \beta_3 FMA_{it} \times RMS_{it} + \beta_4 \log y_{i,t-\tau} + \beta_5' Z_{it} + \varepsilon_{it} \quad (1)$$

The data consists of  $i=1, \dots, 28$  provinces, and  $t=1, 2, \dots, 4$  period. Where  $\beta_0$  and  $\varepsilon_{it}$  respectively for constant and error term. Explained variables  $g_{it}$  is the logarithm of the average growth rate of per provinces capita income in period  $t$ ,  $g_{it} \equiv \log(y_{it}/y_{i,t-\tau})/\tau$ .  $\log y_{i,t}$  is the logarithm of the initial capita income per province in period  $t$ .  $FMA_{it}$  is the trade openness of province  $i$  in period  $t$ .  $RMS_{it}$  is a calculated measure of regional market scale

$$RMS_{it} = \sum_{j \neq i} (Y_{ij} / D_{ij} + Y_{it} / D_{ii}) \quad (2)$$

Where  $D_{ij}$  is the shortest road distance between provinces  $i$  and  $j$ ,  $D_{ii}$  is the provincial internal distance:

$$D_{ii} = \frac{2}{3} \sqrt{s_i \pi} \quad (3)$$

Where  $s_i$  is the land area of province  $i$ ;  $Y_{it}$  is the per capita GDP,  $Y_{ij}$  is the gross regional domestic product.  $FMA_{it} \times RMS_{it}$  is the multiplicative interaction between trade openness and regional market scale, parameter  $\beta_3$  is expected to be negative if the foreign and regional markets exhibit substitutes for each other. The variable  $Z_{it}$  represents a vector of control and environmental variables that are primarily determined by investment rate ( $INV_{it}$ ), literacy rate ( $LR_{it}$ ), as well as the proportion of the total area of the government consumption ( $GOV_{it}$ ).

Data on literacy rate, used to measure the level of literacy in a country, currently we use the proportion of people who over school age (15 years old) could read and write in the corresponding population, also come from the National Bureau of Statistics of China. Data for geographical factors, distance inside and between provinces, are taken from electronic map. Considering the topography (such as the mountain plateau and desert, etc.), we use road distance from the provincial capital to the nearest port instead of crow flies.

The annual data for the period 1970-2010 is calculated using in this paper comes from the National Bureau of Statistics of China. We divide this period into four sections, and in the regression we take the arithmetic mean of variables in each time period. The cross-sectional data totals 28 provinces (not include Xizang, Chongqing and Hainan), hence the total data consist of 112 provincial-level observations of province GDP for four periods, every ten years as a time period. Notice that there are only 84 observations for literacy rate because of incomplete information in 1970s.

#### IV. EMPIRICIAL ANALYSIS

Following the definition of the variables and the methodology, we now turn to the empirical analysis. Table 1 reports the summary statistics for both complexity and the actual volatility. According to the regression Equation (1), the author uses the geographical distance of China provincial capital city from the nearest port (variable  $fma$ ) as the instrumental variable instead actual trade openness, obtained by two stage least squares results as shown in Table 2. The return of the three major economic zones of the east region, midland, and west region, the estimated results of different regions are obtained as shown in Table 3.

Table 1 Summary statistics

Variable	Obs	Mean	Std.	Min	Max
$g_{it}$	112	0.088	0.038	0.019	0.198
$rms$	112	0.297	0.394	0.008	1.847
$fma$	112	1.993	3.310	0.050	23.877
$fma*rms$	112	0.934	2.540	0.000	16.401
$lny$	112	5.712	1.417	1.977	9.134
$gov$	112	0.114	0.044	0.035	0.248
$inv$	112	0.442	0.160	0.172	1.008
$lr$	84	0.804	0.151	0.443	0.984

In Table 2 as a benchmark in column (1), we use the augmented model that explains differences in average growth rate of per provinces capita income across China by the geographical level in the previous period to mitigate the endogeneity problem, including the regional market scale ( $RMS_{it}$ ), trade openness ( $FMA_{it}$ ) and interaction  $FMA_{it} \times RMS_{it}$ , we observe that the effect of  $RMS_{it}$  and  $FMA_{it}$  are both positive and highly significant, and the interaction between trade openness and regional market scale  $FMA_{it} \times RMS_{it}$  is negative across all formulas, and in column (3) and (5) significant at the five percent level. In column (2) (3) (4) we introduce a range of other possible control variables. Finally in column (5) we consider all of the variables, we can see that the results are still stable.

Table 2 Panel two-stage least squares estimation results

	(1)	(2)	(3)	(4)	(5)
<b>fma*rms</b>	-0.007** (-2.387)	-0.005* (-1.757)	0.005*** (-3.095)	-0.004** (-2.196)	0.005*** -0.956
<b>rms</b>	0.070*** (6.109)	0.050*** (3.528)	0.039*** (3.419)	0.024* (1.894)	-0.009 (-0.559)
<b>fma</b>	0.007*** (3.224)	0.006** (2.621)	0.004** (2.496)	0.003* (1.894)	0.001 -0.981
<b>lny</b>	0.010*** (-3.994)	0.012*** (-4.692)	-0.005* (-2.019)	-0.007** (-2.673)	0.013*** (-5.491)
<b>gov</b>		0.286*** (3.579)		0.239*** (3.455)	0.042 -0.508
<b>inv</b>			0.135*** (5.582)	0.126*** (5.531)	0.088*** (3.563)
<b>lr</b>					0.039

					(1.282)
<b>_cons</b>	0.118*** (7.926)	0.106*** (6.169)	0.043** (2.061)	0.037* (1.884)	0.098*** (4.241)
<b>N</b>	112	112	112	112	84
<b>R-sq</b>	0.653	0.695	0.741	0.769	0.847
<b>r2_w</b>	0.653	0.695	0.741	0.769	0.847

t statistics in parentheses, \* p<0.1, \*\* p<0.05, \*\*\* p<0.01

And we consider to what extent do these variables matter for understanding differences in growth across different regions? Table 3 provides an analysis of economic growth focusing on the three economic regions of China for selected years.

Table 3 District data

	eastern area	midland	western area	all
<b>fma*rms</b>	-0.005*** (-4.329)	-0.034 (-1.066)	0.037* -1.88	-0.004** (-2.196)
<b>rms</b>	0.042* -2.177	0.074 -1.798	0.092*** -5.182	0.024* -1.894
<b>fma</b>	0.002 -1.763	0.025 -1.891	0.007* -1.872	0.003* -1.894
<b>lny</b>	0.010** -2.692	-0.002 (-0.514)	-0.014*** (-4.385)	-0.007** (-2.673)
<b>gov</b>	-0.145 (-0.875)	0.08 -0.655	0.229** -2.309	0.239*** -3.455
<b>inv</b>	0.107** -2.257	0.123** -3.489	-0.018 (-0.465)	0.126*** -5.531
<b>_cons</b>	-0.019 (-0.967)	0.009 -0.392	0.115*** -3.6	0.037* -1.884
<b>N</b>	44	28	40	112
<b>R-sq</b>	0.775	0.87	0.894	0.769
<b>r2_w</b>	0.775	0.87	0.894	0.769

t statistics in parentheses, \* p<0.1, \*\* p<0.05, \*\*\* p<0.01

#### V. RESULTS

The empirical result confirms the existence of research that market scale and trade openness often have a positive impact on regional economic growth, and it has a substitution effect between foreign market and domestic market.

Table 2 shows that investment rate and government consumption are significant at the 1% level across column (1)-(4). Since these variables are government controlled this result suggests that investment rate and government consumption is also important in understanding differences across regions. It can be seen however that literacy rate is not significant, one possibility is maybe there is migration across district borders, while most internal trade in China is in agricultural products and processed products, this result is not unexpected.

In Table 3 the association of multiplicative interaction between trade openness and market scale is particularly significant in eastern area. On average, eastern area enjoy lower transport costs and experienced a high influx of foreign capital, hence it has a large substitution effect of domestic and foreign market.

Also we can see that the regional market scale, government consumption and trade openness of western region are significant, one way to interpret this is that western area are rich in natural resources, lack of preferential policies, infrastructure construction and investment, hence a strong support from government has remarkable influence on its economic growth.

As a matter of fact, inequalities in economic development is very common no matter with or between countries; and the positive associations of openness and market scale those determinants begin to disappear when they interact with different regions, reflecting the reinforcing effect on spatial inequalities. In the circumstances that economy and trade have gradually expand, how to reduce the negative impact of trade openness on Chinese economic, and ensure the sustainable and balanced growth of China economy, become an important problem at the present stage.

## VI. POLICY SUGGESTIONS

The evidence for China suggests that the trade openness and market scale estimation analysis reveals a positive relationship for income growth. Regions with a better-developed market system, such as eastern cities Shang Hai and Shen Zhen, with preferential policies and geographical advantage, tend to grow faster, in contrast, western region with small trade openness and market scale tend to grow slower. Therefore, although geographical location cannot directly affect the economic development, it can indirectly affect the per capita GDP through circulation of commodities and production factors. According to the above conclusions, this paper puts forward following policy suggestions:

(1) High-quality market environments should be established, backed by an improved legal system, with surveillance by social networks, the media, and individuals. For instance, our results suggest that border areas like Yunnan, a relatively closed economy by the measure of ratio of trade to GDP, would probably improve its overall market competitiveness if it moved from its current fixed regime to a more flexible one, such as be endowed with greater administrative and financial autonomy, etc. Only by achieving the transformation of primary processing products exports to high value-added exports, can these backward area expend its market scale.

(2) In upgrading the industrial structure, policy need to adopt different strategies for each region. For eastern area, is necessary to vigorously promote the transformation and upgrading of industrial manufactured goods and the upgrading of processing trade is necessary, to achieve the independent product export led trade pattern. For the central and western provinces, government should focus on the development of processing trade, through undertaking processing trade of coastal areas, to achieve the structure changes of export commodities from low value-added products to products with high added value, so as to shorten the development gap between western provinces and eastern coastal provinces, improve the export trade structure of China.

(3) The central and western provinces borders West Asia, South Asia, Russia and other countries, with excellent geographical advantages, these areas should actively participate

in international cooperation, such as signing regional strategic agreements to enjoy the land, taxation, finance, cooperation, environmental protection and other related preferential policies, promoting commerce not only through expanding domestic market but also with neighboring countries to increase regional income per capita. Also, government could increase the intensity of economic support and improve the local infrastructure construction, to be tilted to a certain extent in the tax system, which will accelerate the development of central and western provinces.

(4) Meanwhile the worldwide new change in science and technology gives China a great historical opportunity to realize the striding-over development. Therefore every district should emphasize the role of trade openness and market scale, as countries are more easily to be impacted by the rest of the world. With the trade liberalization deepens, it has become the main channel to spread the world economic fluctuations, and plays a very important role in the formation of the world economic synchronization

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# Competitive intelligence and corporate governance: Towards a strategic alignment

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**Abstract—** Why do organizations seek for information? The answer most often given in both practical and theoretical researches, is that information is recognized as a potential that should be exploited to contribute to make forward-looking decisions and then to strengthen the firm's competitiveness. One of the most challenging things for companies is to scan and monitor their environment in order to maintain a sustainable competitive advantage. Furthermore, the ability of a company to remain competitive in such an ever-changing context depends on its ability to take advantage of the information flowing in the environment.

This article attempts to provide a theoretical basis that seem relevant in examining the links between, on the one hand, competitive intelligence that is considered as a way or mechanism of environment scanning by providing strategic information on its stakeholders and on the other hand, corporate governance. To that end, a wide range of published literature related to competitive intelligence and corporate governance is examined and reviewed.

This paper demonstrates that the concepts of corporate governance and competitive intelligence are usually treated separately, however competitive intelligence as a managerial approach can be seen and regarded as governance tool that integrates all stakeholders who provide relevant information for decision makers. Thus, competitive intelligence can be included into a corporate governance system with the aim of mastering strategic information and improving significantly firm's overall competitiveness.

**Index Terms—** competitive intelligence, corporate governance, decision-making, information, stakeholders

## I. INTRODUCTION

Current society is characterized by high amount of information. Given this, having relevant, accurate and strategic information depends significantly on an effective system of environmental scanning. This environment is for the company the main source of uncertainty and risk. Thus, environment scanning should be a regular task for any organization looking for sustainable performance and requires from decisions-makers some efforts to formalize it. The company should exploit changes in the environment to its advantage, therefore competitive intelligence is considered as a practice that manages and takes under control these changes, provides a competitive advantage to companies and help decision-makers to predict their actions.

Competitive intelligence is a significant research area and it is recognized by many organizations as a valuable tool to shape strategic decisions, improve and increase competitiveness. The role of competitive intelligence - beyond mere adaptation to changes in the environment - is to pre-empt threats in the external environment, in other words, thanks to this managerial practice; the company becomes proactive in its relationship with its environment specially with its stakeholders and thus develops high level of vigilance that allows her to be more competitive.

Furthermore, competitive intelligence is also regarded as an organizational device and a managerial practice that leads to a better corporate governance and contribute to a better reading of the business environment by providing strategic and accurate information that will support decisions makers to prevent threats and exploit the opportunities that offer their business environment.

The central purpose of this research paper -mainly theoretical and descriptive in nature- is to review the current literature on competitive intelligence and to highlight the interaction between competitive intelligence and corporate governance and to understand the major features of that synergy. To better understand this connection, this paper has been divided into two parts: Firstly, this paper highlights the importance of competitive intelligence as a concept and as a managerial tool, also it presents a brief overview of the literature on corporate governance. Then, it details key aspects of alignment between corporate governance and competitive intelligence. Our concluding remarks recapitulate and examine our contributions, limitations and suggestions for future research.

## II. RESEARCH METHODOLOGY

In this article, the basic sources of information were books, journal including on-line journal. To identify pertinent literature, academic databases and search engines were examined. A review of references in related studies led to more important sources, the references of which were further reviewed and assessed. Keywords such as "competitive intelligence" and "corporate governance" were used in search engines to find more relevant articles. The documents analysis was focused on relationship between competitive intelligence and corporate governance. Methods such as analysis, synthesis



and comparison were used to process information gathered from different sources.

### III. LITERATURE REVIEW

The environment become increasingly competitive day by day due to the advent of technology and some vital innovations, so as a result, competitive intelligence has become one of the important management concepts and has been highly incorporated into the culture of companies.

The search for information was and is still the most important concern of decision-makers in various fields such as: military, economic, political, etc. The analysis of the literature allows stating that the term of "competitive Intelligence" has a rich history dating back to many years ago. In present study, a theoretical framework was adopted to explain the concept of competitive intelligence. It is based basically on an overview of its fundamentals functions.

In order to gain a better understanding of all these issues, we firstly try to shed some light on the typology of organizational information flow, then we define competitive intelligence and corporate governance, next we examine the nexus between these two concepts.

#### A. Information and knowledge flow within the organization: some conceptualization

Basically, information and knowledge are regarded as the corner-stone of both competitive intelligence and corporate governance.

Even if both terms of knowledge and information are used indifferently, there are some elements that should be nuanced between these two concepts. In this sense, information is recognized as a flow of messages [1], while knowledge is perceived as a set of rules and a process of simultaneously knowing and acting [2].

Information and knowledge flows are viewed as a valuable source of sustainable competitive advantage. "Knowledge flow comprises the set of processes, events, and activities through which data, information, and knowledge are transferred from one entity to another" [3].

One of the main theoretical stream of knowledge flow within the organization stems from Nonaka's researches [1]. This author emphasizes two major dimensions for knowledge. On the one hand, the epistemological dimension which focuses on two forms of knowledge: explicit knowledge communicated in symbolic forms such as: diagrams, or procedural manuals etc. and tacit knowledge that is acquired through experiences and comprised of both cognitive and technical elements that couldn't be codified. On the other hand, the ontological dimension which underscore knowledge sharing with stakeholders such as, formal departments, divisions, firms and business networks.

As shown in Figure 1, there is an interaction between these two dimensions that aims to describe organizational knowledge flow:

- First, Nonaka 1994 affirms that knowledge is created mainly by individuals in the organization and is predominantly tacit in nature. It is flowing from the

individual to the group level through a process of socialization (vector 1).

- The second flow of knowledge (vector 2) is arisen by externalization, which transform tacit knowledge into explicit knowledge permitting it to be shared by others.
- The third flow of knowledge (vector 3) result from a process called combination which involves coordination between different groups in the organization. It converts explicit knowledge into more complex explicit knowledge.
- The fourth flow of knowledge (vector 4) arises through a process of internalization which implies different actors in the organization allowing the conversion of explicit knowledge into tacit knowledge at the organization level.

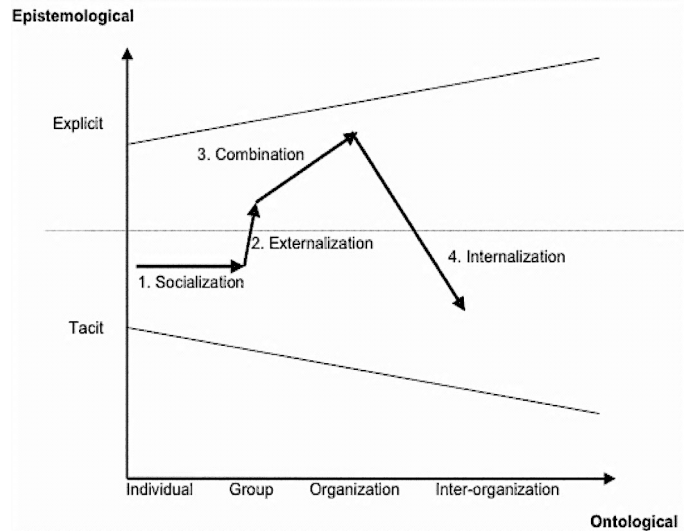


Fig. 1: Nonaka Knowledge Flow Theory, adapted by [4] from [1]

As mentioned earlier, if information and knowledge are viewed as valuable and strategic resource, the practices and tools to set up a knowledge based system within the organization are highly required. Thus, competitive intelligence and corporate governance are widely regarded as processes which integrates information and knowledge in the everyday life of companies.

#### B. Defining competitive intelligence

Due to the advent of new information and communication technologies, competitive intelligence took a crucial concern among researchers specially in management science and nowadays it involves several disciplines. It generates a considerable interest to scholars and as often in this type of general concepts; there is no commonly accepted definition. Nowadays, competitive intelligence has become a distinct field.

The historical developments in the economic level that marked the world have long been the source of strategic trends of firms, countries and even territories in economic policies. Given this, the concept of information has been notoriously developed from the two world wars. It has evolved in the context of military operations as it has been noted by some researchers stating in this regard that "the offensive and defensive management of the open information [...] was born from the confrontation of power interests that marks the

milestones of globalization and trade"[5]. The concepts underlying competitive intelligence are related to the emergence of economic power between the states and the development of trade in which strategic information was crucial, determining and sought by all countries to defend their interests and ensure their territorial and economic growth.

There are several definitions for competitive intelligence in contemporary practice and scholarship, the review of the literature on competitive intelligence highlighted a variety of terminologies showing the evolution of concepts identifying its contours. Hereafter, we will try to highlight the diversity of some definitions that have been given to better comprehend competitive intelligence. In recent years, competitive intelligence has become a noteworthy and a significant management discipline that helps to improve decision making and business planning [6].

As cited above, several definitions have been suggested to better understand the concept of competitive intelligence. In this sense, "the competitive intelligence encompasses the entire competitive environment monitoring operations: scanning, protection, manipulation of information, influence".[5]

Competitive intelligence has been also defined as the "combined, coordinated research actions of research, treatment and dissemination for strategic and operational exploitation, useful information to economic actors. These actions are conducted legally with all the guarantees of protection necessary to preserve the heritage of the company, with the best quality, time and cost" [7]. In other words, competitive intelligence is regarded as the ability of the organization to comprehend its business context and, benefit from the opportunities and neutralize risks.

In a wide range of organizations, competitive intelligence is viewed as a "systematic process initiated by organizations in order to gather and analyze information about competitors and the general sociopolitical and economic environment of the firm" [8]. It engages a "systematic and planned process to ethically collect, analyze, synthesize and disseminate accurate, relevant, timely and actionable intelligence about customers, competitors, partners, markets and other environmental factors in order to assess and monitor external environment, provide early warning signals and support decision-makers in strategic and tactical decision-making" [9].

Additionally, competitive intelligence requires a "set of procedures and data sources used by marketing managers to sift information from the environment that they can use in their decision making" [10].

Considered as both a product and a process [11], competitive intelligence "enables executives to make smarter, more successful decisions, thereby minimizing risk, avoiding being blind-sighted, and getting it right the first time" [12].

According to these definitions, the major output from competitive intelligence is the ability to make forward-looking and well-informed decisions. As a result, the most common benefit of competitive intelligence is its capacity to create information profiles that support an organization to detect its competitor's strengths, weaknesses, strategies and objectives, [13].

Drawing on the researches of some authors [14] and [15], we present in what follows a theoretical approach of informational functions of competitive intelligence the most the most considered in the literature. In order to better comprehend this concept. More specifically, we need to shed light on three main functions:

- Strategic monitoring: usually confused with "industrial espionage", strategic monitoring aims at scanning the environment in which they operate to ensure that they are ahead of the changes that are occurring in their industry, and they are aware of what their competitors are doing in order to prepare their reaction patterns if and when necessary, [16].
- This function involves the research, gathering, storage, analysis, dissemination and the use of this actionable information in strategic decision-making process.
- Protection: Depicted as information risk management, this function aims to preserve intangibles assets of the organization [14]. In other terms, "competitive intelligence consists of the mastery and protection of strategic information to every economic actor"[17]. Its fundamental objectives are: enhancing industrial competitiveness, preserving the business security and strengthening an influencing strategy. This definition underscores an essential point: "information protection and security". Furthermore, competitive intelligence is aimed at protecting information held or issued by organization to preserve the informational asymmetry in its favor [18].
- Influence: in a fast-moving context and in an open global market, information is considered as a strategic value driver and is viewed as a lever of influence. For this reason, competitive intelligence has the purpose to generate an "influencing strategy" in order to realize better results and to have much control on the business environment. This third dimension has become increasingly important in the competitive intelligence field of action and aimed to exert an informational pressure by optimistically altering the interaction between the organization with its business environment.

Competitive intelligence, in turn, requires the design of an accurate information processing process. Thus, competitive intelligence is an informational process consisting of linked phases [19]. The whole output of the competitive intelligence process is considered as an input to the decision-making process [20]. There are many competitive intelligence process models designated in the literature. According to [19], competitive intelligence process aims to identify the information's needs of the decision-makers and determine what information is required to generate the intelligence; then the intelligence is disseminated to the decision-makers. This process aims to provide actionable intelligence during the analysis phase that will, consequently, build and maintain a competitive edge to the organization.

### C. *A Stakeholder approach of competitive Intelligence*

The stakeholder theory is well conceived and apprehended in the literature related to corporate governance. A broader examination of the literature shows that good corporate governance depends strongly on its relationships with its stakeholders. Based on this, how competitive intelligence could benefit from the stakeholder theory framework?

Utilizing competitive intelligence successfully in the organization shouldn't depend only on a developed process. The required framework conditions such as organizational culture and awareness, a formal infrastructure and stakeholders' involvement should exist in order to ensure successful implementation. Given this, the importance of stakeholder relationships has and continues to get more attention in the organizational researches. Moreover, stakeholder theory provides a solid basis for corporate governance. Furthermore, Stakeholder theory conceptualizes the firm as a chain of internal and external key members with interconnecting relationships. It thus requires simultaneous attention to interests of all stakeholders in day-to-day decision-making [21]. Based on stakeholders approach, competitive intelligence practice is aimed at gathering, analyzing, and disseminating information and knowledge on and to these stakeholders to minimize threats and maximize potential benefits [22].

As a result, the main premise of the stakeholder approach to competitive intelligence is the following: competitive intelligence requires that organizations pay attention to a particular stakeholder and each stakeholder could be considered as a source of information for the organization. Thus, competitive intelligence could take advantage from information emerging from a network of stakeholders both internally and external to the organization.

### D. *Defining corporate governance*

Corporate governance is a multifaceted concept that is extremely difficult to define in one sentence. This concept can be defined as making diverse choices that shape objectives and allocate people with sufficient resources to carry out the tasks and safeguard the outcomes. In other words, it is about making decisions to achieve corporate objectives and align behavior and strategy with business goals through empowerment and monitoring [23].

Corporate governance helps companies to improve their corporate performance by reducing the organizational exposure to risks. It is a structural system which encapsulates institutional policies, rules and business controls that create a suitable framework for managing and operating inside the company [24].

The most common conceptualizations of corporate governance identify two general models of this concept: the shareholder model, which focuses on shareholder value maximization, and the stakeholder model, which emphasize value creation of any element who can affect or is affected by the firm strategy and orientations. Beyond this polarization, corporate governance aims at obtaining accurate information concerning the expectations of both shareholders and stakeholders

Much of the previous writing has researched and examined competitive intelligence and corporate governance independently as being unrelated. However, we try to demonstrate in this paper that these two concepts are somehow linked.

Based on the stakeholder's theory, we describe in what follow, the nexus between corporate governance and competitive intelligence.

## IV. COMPETITIVE INTELLIGENCE AND CORPORATE GOVERNANCE: TOWARDS AN ALIGNMENT TO ACHIEVE CORPORATE OBJECTIVES

After identifying the stakeholder theory and defining corporate governance, it is time to understand why the stakeholder's relations are significant for the best practice of competitive intelligence. For this reason, this section defines the place of competitive intelligence in corporate governance and discusses some issues of its use in the management of business processes in company. We suppose that the stakeholder model of corporate governance may help firms to reinforce their competitive intelligence process.

As defined above, good corporate governance can help to improve corporate performance levels and reduce the organizational exposure to risks. For this purpose, competitive intelligence tools could be considered as an important component of a corporate governance strategy helping and enforcing policy and measuring performance and adherence to governance directives.

### A. *Corporate governance and Competitive intelligence nexus*

In today's competitive companies - described as "smart companies" – their competitiveness depends on their capacity to mobilize the knowledge of their stakeholders by co-building information. Certainly, information creates value, but this value is based on the quality of the interaction and the involvement of different stakeholders around this information [25].

Indeed, the concept of corporate governance often refers to the concepts of decision, power, sharing and coordination. These concepts that covers corporate governance are often based on an approach through information to ensure understanding by all stakeholders of the decision problem issues. Hence, synergy between competitive Intelligence and corporate governance seems natural since both concepts are based on the research of the best decisions that leads to shape strategic decisions and achieve a sustainable competitive advantage, however, it is necessary to highlight the different dimensions and aspects of this synergy.

Thus, based on the transaction cost theory using the market to coordinate activities generates various types of costs including costs of research and information processing [26]. For this end, governance is defined as a set of internal and external mechanisms that lead executives to manage the company by making decisions that maximize the value of the firm and contributes through its mechanisms to reduce costs related to information research by eliciting a deeper understanding of its stakeholders who are considered as an important source of information [27]. In other words, corporate governance depends

greatly on a good level of disclosure and suitability of the information disseminated in order to remove or at least reduce the information asymmetry between the company and its different stakeholders [28].

As part of this strategic vision of information, a corporate governance system is henceforth based on information and considered as a new approach to optimize the use of information in order to improve the company's competitiveness. In other words, corporate governance through information corresponds to the will of better understanding information, which is, on the one hand, a crucial component of good corporate governance, and on the other hand, it is becoming more and more vital in economic activity.

In addition, a system of governance based on information provides an accountability framework setting out the principles and basic rules, as well as management methods and information accessibility so that it can be used efficiently in the organization. This objective is the core of competitive intelligence which consists of supplying the company with actionable information to guide policy and decision makers in their strategic choices and actions.

#### *B. Corporate governance and Competitive intelligence: The logic of collective action*

Broadly defined, corporate governance focuses on decision making and aims particularly to ensure the sustainability and survival of the organization. For Pepin (in [29]) corporate governance calls for collective action which fit with the cooperation, coordination and strategic consensus. These elements represent the basic values of the competitive intelligence system:

- **Cooperation:** any efficient competitive intelligence system involves various stakeholders and lead to the creation of a space for exchange and cooperation between different stakeholders.
- **Coordination:** a good level of coordination between all stakeholders is required to have a successful competitive intelligence approach and to make it efficient.
- **Strategic consensus:** joining competitive intelligence to corporate governance involves a strategic harmony and requires a participatory approach that takes into account the legitimates interests of multiple stakeholders.

So far, competitive intelligence improves the process of decision making and provides a support to the corporate governance system by developing a culture of information based on interaction with different stakeholders. In other words, the company should engage and mobilize the collective intelligence of its stakeholders and involve them in the achievement of its strategic choices and decisions.

The central contribution of competitive intelligence in terms of corporate governance is focused on the following points:

- Competitive intelligence contributes strongly in both the creation and deepening of knowledge that allows the decision maker to expand their own skills and knowledge and help building better strategic vision.
- Competitive intelligence is mainly based on information sharing and skills mobilization of stakeholders; both are

the backbone of governance system especially in the area of partnership approach.

- Competitive intelligence helps to build knowledge and skills, and to improve the ability of the company to innovate, to create investment opportunities and to change their environment.
- Competitive intelligence leads to a better shared decision making between the different categories of stakeholders in order to ensure greater organizational cohesion.

Based on all these findings, it appears that competitive intelligence perfectly fit with the requirements and objectives of corporate governance by optimizing the use of information within the company and contributing further to improve or maintain the firm's competitiveness. In other words, competitive intelligence can be included into a corporate governance system with the aim of mastering strategic information and achieving significantly the competitiveness and the security of economy and business [17].

### V. FINDINGS AND DISCUSSION

As cited earlier, the purpose of this article was to investigate the nexus between competitive intelligence and corporate governance. The results revealed by this literature review points out that competitive intelligence as a competitive tool could be perceived also as a corporate governance component.

Based on the results arising from this literature review, this research suggests that implementing a successful competitive intelligence process require an efficient corporate governance structure, which embolden intra and inter-organizational communication and boost the flow of information.

The combination of these two practices can have a significant influence on firm-level competitive behavior. In other words, if corporate governance and competitive intelligence are theoretically connected, it will be necessary to see, how to measure the gain of taking into account together these two concepts?

To address this issue, the company itself ought to select its key corporate governance and competitive intelligence indicators on the basis of their importance and from the point of its objectives and strategy. Conceptually, there can be a significant gain from taking into account these two concept within the organization. In other words, we may expect an interactive effect wielded by competitive intelligence-related resources and corporate governance on strategic opportunities, as shown in figure below:

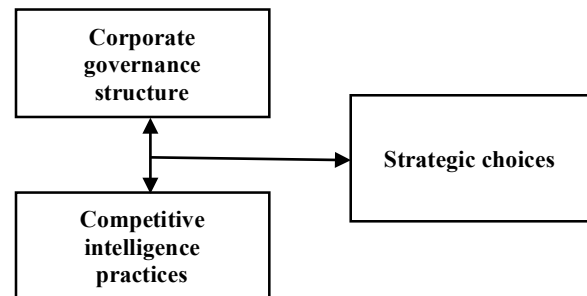


Fig. 2: Towards a cross-fertilization between corporate governance and competitive intelligence

By unifying and combining competitive intelligence and corporate governance, we can see an opportunity for cross-fertilization between these two practices and related disciplines. Corporate governance would definitely benefit from competitive intelligence inputs (information flow). In contrast, competitive intelligence as a comprehensive managerial approach can be seen or recognized as governance tool that integrates all stakeholders who provide relevant information for decision makers.

The true value of this cross-fertilization between corporate governance and competitive intelligence will only be achieved if the organization use the information obtained and convert them into strategic choices.

According to the definition used by the French association for the development of competitive intelligence (AFDIE), the latter is all means which are organized in a management system based on knowledge and aims to produce useful information for decision with the ultimate objective of performance and value creation for all stakeholders. This objective is shared by the governance system which is a set of mechanisms that aims to have the greatest potential for value creation and maximization through knowledge and innovation [30]. This knowledge-based governance attaches great importance to knowledge and skills acquiring and the ability of the company to innovate, to create investment opportunities and to change their environment. This relatively new dimension of corporate governance involves new mechanisms which could include competitive intelligence practices.

Furthermore, competitive intelligence is recognized as a way and a tool of improving business performance by reducing the uncertainty and complexity in the decision making process that benefit the organization and providing powerful assists for decision maker to enable them to have actionable intelligence at hand and it helps firms to make fast, better, and well-informed business decisions and thus can be the source of sustainable competitive advantages.

As depicted above competitive intelligence provides means for extracting information from the stakeholders that would be fundamental and important to support management decision-making.

From the competitive intelligence principles and the synergy between competitive intelligence and corporate governance discussed above, the following common and unique characteristics were identified:

- Competitive intelligence outcomes could be institutionalized into corporate governance in order to help achieve common strategic goals and it is necessary that the alignment between these two concepts be explored. In other words, to achieve organizational corporate performance, competitive intelligence needs to be aligned with corporate governance [23].
- Based on the various definitions of competitive intelligence, it appears that the information remains the cornerstone of any competitive intelligence system. Thus all competitive intelligence approach aims to collect, process and interpret effectively the content of the relevant

information from the business environment that is needed by different levels of decision. It aims also to provide help in decision-making and to create competitive advantage and further to achieve higher organizational performance.

- All elements presented and discussed above reveal that competitive intelligence affects a wide range of areas of corporate governance, and it is a vital ingredient for the formulation of business strategy.

To sum up, competitive intelligence enables reconfiguring the process of decision-making based on the appropriation and interpretation of information with a collaborative, selective and offensive approach. It is a process that helps to better understand and resolve the decision-making problems within an organization and adhere considerably to the corporate governance framework and objectives.

## VI. CONCLUSION

Finally, it is fundamental to highlight that our analysis is inherently theoretical and represents an attempt to depict the nexus between competitive intelligence and corporate governance. In others words, the major purpose of this research was to review the current literature on competitive intelligence with the aim of identifying some theoretical contributions of competitive intelligence to corporate governance. In today's highly competitive business environment, particular attention has been paid to competitive intelligence as a result of the information explosion. Moreover, competitive intelligence has experienced a rapid growth over the past years to become an integral part of largest organizations in the business world. More essentially, from both practice and research it has been noted that information on stakeholders has important effect on firm's competitiveness.

The contribution of this paper is as follows: our study extends the current literature on competitive intelligence practices by shedding light on complementary between competitive intelligence and corporate governance. However, we must also acknowledge some limitations and difficulties in conducting this study. One of the key limitations in this study is its theoretical and descriptive nature. From the research, some opportunities for future research emerge, including detailed, empirical tests on information tools for competitive intelligence building should be conducted so further empirical investigations and accurate confirmations are requested to explore the nexus between competitive intelligence, corporate governance and strategic orientations of the organization.

Finally, the insights of this research will help to offer a ground for future research to further broaden and develop knowledge on issues relating to competitive intelligence.

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# The Adequation Between The Available Resources And The Real Needs Of A Strategic Scanning Project

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**Abstract**— This article proposes to define the resources used in the implementation of a strategic scanning system in Tunisian industrial companies. It is based on an in-depth study of the resources allocated for the operation of the strategic scanning system through research based on an inductive approach that lasted several months. We have been able to identify an inadequacy between the available resources and the real needs which can lead to the dysfunction and even to the abandonment of the anticipatory strategic scanning.

**Keywords**—Monitoring, Real needs, Resources, Strategic scanning

## I. INTRODUCTION

In Tunisia, only fifteen industrial companies have benefited from training on the implementation of Strategic scanning within the framework of the Program for Supporting Competitiveness of Enterprises and Facilitating Access to the Market (PCAM).

As an information system, the Strategic scanning system requires human resources that intervene with material and financial resources to carry out the Strategic scanning.

As several studies and researches, we are interested in our work the combination of two scientific fields namely project management and Strategic scanning. Our research aims mainly to understand the resources allocated in the process of Strategic scanning within Tunisian industrial companies. To do so, we adopted a qualitative methodology to study these resources in depth.

We are only interested in what the actor “does” (Orlikowski, 2002) and our approach consists in studying the strategic scanning mechanisms of industrial companies. This leads us directly to examine the behavior, the functioning and the exchange of information within each device. The desire to understand the dynamics requires the investigations (Hlady Rispal, 2009) which give access to such a large volume of information.

Generally, the results of the analysis of the data are of great importance, thus presenting greater deficiencies between what was anticipated upstream of the Strategic scanning process and the real needs of the companies.

### A. Reports And Problems Of Research

In Tunisia, a number of industrial companies have been trained on the setting up of Strategic scanning within the framework of the Program for Supporting Competitiveness of Enterprises and Facilitating Market Access (P.C.A.M) Which was developed with a view to contributing to the improvement of the competitiveness of Tunisian companies and services linked to industry and to facilitating their access to the international market, in particular of the European Union, and their preparation for new requirements Technical and regulatory implications arising from the A.C.A.A (Agreement on Conformity Assessment and Acceptance of Industrial Products).

It has often been mentioned by the authors that strategic intelligence is a difficult undertaking. Ghoshal S. and Kim, S. K., (1986) found that many companies have set up strategic scanning units. In most cases, they have not been able to achieve the desired level of performance. In addition, many works carried out in this field. Choo CW, (2002), Jain SC, (1984), Lesca H., (2003) Raymond and al (2001) have found that many Strategic scanning projects, although completed, give birth to a device whose life is very short, given the effort spent to put it in place.

At the level of its implementation in Tunisian companies, the strategic scanning raised many problems depending on the nature of the subject presented during the training which is often general and does not allow the execution of the strategic scanning according to the needs of the 'business'.

For our case study, the majority of companies failed to achieve the desired goal following the introduction of a strategic scanning device. It is therefore interesting to consider:

The relationship between failure to set up a strategic scanning project and the resources allocated? And what would the standby training, in the P.C.A.M program, have been done according to the needs of each company?

Working on the evaluation of the strategic scanning training followed during the P.C.A.M program through the relationship between the allocated resources and the actual needs of the strategic scanning cells has not, to our knowledge, been the subject of the investigations.

### *B. Research Question*

So the implementation of strategic scanning takes place in two successive phases, namely, priming and sustainability, and since we are interested in the strategic scanning process after it was set up in the Tunisian industrial companies that participated in the P.C.A.M program, we are only interested in the sustainability phase. According to WHO (2007), sustainability is an action "to designate both the character of what lasts and the action to be taken to achieve it, which creates some confusion. Sustainability is a process that requires a combination of different factors that includes the essential elements of the project and those of its implementation ". Our research question could be as follows:

The degree of adequacy between the resources allocated for the implementation of a strategic scanning system and the real needs of the strategic scanning cells?

Our aim is then to examine the strategic scanning processes within the industrial companies, which have undergone the strategic scanning training during the P.C.A.M program, in order to draw the gaps and identify the dysfunctions.

### *C. Theoretical Positioning Of Research*

Like several studies and researches, we are interested in our work to combine the two scientific fields namely project management and strategic scanning. In fact, the combination of these two areas seems often interesting and difficult at the same time, since it is generally done to analyze the problems of other fields. Also, this combination can be interesting in the time it allows the two crossed domains to enrich and develop constructively through a set of tools.

According to G. Gilles (2011), "project management has profoundly transformed the practices and performance of organizations. It has been internationally disseminated in various sectors: services, mass industries, public companies, SMEs, R & D ... The project can be a very effective mode of collective action but requires resources, skills, Tools and recognition of the people involved ". So the implementation of a strategic scanning system often seems to be a project that is carried out by men in the organization (Garel G., Giard V., 2004), we are interested in project management.

In another measure, we know very well that the strategic scanning problems have opted for a step of formalization of the monitoring (Gilad, 1989) and this according to the preferences and the mode of operation of the companies. "The strategic scanning system should be tailored to the specific needs of each company" (Calori, 1989). The manager is therefore faced with a number of questions concerning in particular how to organize his monitoring activities, the tools allocated and the services involved. At this level, the success or failure of the implementation of a strategic intelligence system is due to several factors internal or external to the company.

The factors of failure of the strategic scanning process have been described in the literature by various researchers who have tried to understand the difficulties encountered by managers in the company when setting up monitoring systems. Today, many strategic scanning projects face difficulties in terms of cost, profit, objectives to be achieved ... (N. Lesca and Caron-Fasan, 2008). This is essentially due to organizational, strategic and behavioral factors (Ezusi-Mensah and Przasnyski, 1991).

These factors are often presented in a general way in the literature and are often ambiguous. Our contribution thus remains in an attempt to define clearly these factors by examining concrete cases through the Tunisian industrial companies that have undergone training of strategic scanning in the program P.C.A.M and who have already established a strategic scanning system. All this allows us to compare the resources allocated for the implementation of a strategic

anticipatory monitoring system with the real needs of the cells in order to determine the malfunctions of the systems.

#### D. Research Methodology

Our research aims mainly at understanding the resources required of the process of strategic scanning within the Tunisian industrial companies. To do so, we adopted a qualitative methodology to study the strategic scanning resources in depth. We are only interested in what the actor "does" (Orlikowski, 2002). Our approach is therefore to study the strategic scanning systems of industrial enterprises. This leads us directly to examine the behavior, the functioning and the exchange of information within each device. The concern to understand the dynamics requires investigations (Hlady Rispal, 2009) which give access to such a large volume of information.

At this level we explored several methods to gather information. With the analysis of the data specific to each company (report, newsletter ...), we conducted semi-directive interviews with different managers. This allowed us to carry out 8 semi-directive interviews at the premises of each company with an average duration of one and a half hours. The transition to the interview takes place in two stages: first, the appointment will be made either by telephone if we have the contact details of the company or face to face. Once the appointment is fixed, we move on to maintenance. Typically, interviews are recorded in audio.

Our sample is comprised of executives who were trained in strategic scanning implementation during the P.C.A.M program. There are fifteen targeted companies spread throughout Tunisia. We conducted interviews with seven companies (the rest did not agree to do an interview) with eight strategic scanning cell managers, two interviewees belonging to the same cell.

Enterprise	Number of persons questioned	Post occupied	Age	Type of strategic scanning system	
				Formel	Informel
STIFEN FRUIT	1	Responsible for quality and safety of foodstuffs	31		X
	1	Director of Operations	45		
SOGIP	1	Purchasing Manager	48		X
RECOPNEU	1	General manager	45		X
TMM	1	Sales and Marketing Manager	28		X
MPC PROKIM	1	Industrial director	45		X
SOMEF	1	Director of Studies and Development	38		X
SIA	1	sales director	40	X	

## II. THE FORMALIZATION OF THE STRATEGIC SCANNING SYSTEM AND ORGANAZATIONAL CULTURE: A USEFUL ACTION AND NECESSARY AT THE TIME

### A. Formalization Of The Strategic scanning System

The work of Gilad and Gilad (1986) has shown that the authors argue for a certain degree of formalization of strategic scanning process in general and of the circulation of information in particular. There is even a link between the degree of formality of the system and the involvement of the members. Indeed, more than the standby process is formalized more members are involved and vice versa. The survey of industrial enterprises showed that six of the respondents said that the type of strategic scanning system is often informal (see table below).

TABLE 2: TYPE OF SRATEGIC SCANNING SYSTEM

	CB : ro formel	CC : ro informal
1 : Cas\CAS MPC PROKIM	non	oui
2 : Cas\CAS RECOPNEU	non	oui
3 : Cas\CAS SIA	oui	non
4 : Cas\CAS SOGIP	non	oui
5 : Cas\CAS SOMEF	non	oui
6 : Cas\CAS STIFEN 1	non	oui
7 : Cas\CAS STIFEN 2	non	oui
8 : Cas\CAS TMM	oui	non

Source: Treatment of qualitative data by NVIVO 8 software: Samar Ben Slimene

Since it is offered free of charge as part of the training in the PCAM program, the system is informal and does not receive any follow-up or control. The fact of not doing is then an action that is not sanctioned. As a result, the Strategic scanning system is transverse to the organization and not rigid. There is therefore a lack of a centralized evaluation function

and validation of information. In this context, we retain this verbatim:

*We have an informal Strategic scanning system so quality may take precedence over quantity in the absence of hierarchical pressures.*

In the light of the preliminary ideas and within the framework of this informal system, we note that the good functioning of the Strategic scanning cell is only due to the willingness of the employee to do research that is not structured random. Another interviewee said:

*Our Strategic scanning system is informal and also the system is down*

The execution of the Strategic scanning by members of the cell, so that it is informal and non-structural, can be explained by the gratuity of that system in terms of implementation, maintenance, and staff training. It is characterized by the redundant sources and information. Another interviewee suggested that:

*There is no pressure from management which means the Strategic scanning is not obligatory.*

This leads directly to the conclusion that there is no strategic vision and systematic identification of needs and priorities. This is why for some manager; the strategic scanning is "a dead letter in the spirit" in the way of doing things. They incorporated the elements they followed during the training and the strategic scanning cell is not as active as they want. In another measure, we can say that there are managers who are aware of the importance of formalizing their strategic scanning system. They estimated replace a system or a proactive strategic scanning process.

*It is true we set up all the necessary documentation, procedures, instructions ... but we have not implemented the system itself*

Examination of the survey data showed that only two of respondents indicated that their strategic scanning system is

'formal'. The narrative of some enterprise seems often beneficial to the enrichment of this reflection.

*Today we are in the formal because it is not free. There are certain things that are subsidized by PCAM and the rest by SIA. Strategic scanning is mandatory and there is a strategic vision and a systematic determination of needs and priorities. We have a formal strategic scanning system. All members are adhered in the said process and we do follow-up. The strategic scanning is mandatory.*

## B. Organizational Culture

To optimize a company's strategic scanning efforts, Dishman and Calof (2008) strongly recommend the presence of an organizational culture oriented towards the competitive environment and a culture of competitiveness. Indeed, for Pole, Madsen and Dishman (2000), "this culture promotes organizational learning, which means that the company increases its chances of increasing its knowledge through the benefits of its strategic scanning process".

Our interviewees all agreed on the important role of 'organizational culture' in the effectiveness of setting up the strategic scanning process with the exception of one interviewee who stated that:

*Within our company there is not a culture turned towards the anticipative strategic scanning that is why the system of strategic scanning is out of order*

TABLE 3: ORGANIZATIONAL CULTURE OPEN TI OUTSIDE

	CA : ro culture...
1 : Cas\CAS MPC PROKIM	oui
2 : Cas\CAS RECOPEU	oui
3 : Cas\CAS SIA	oui
4 : Cas\CAS SOGIP	non
5 : Cas\CAS SOMEF	oui
6 : Cas\CAS STIFEN 1	oui
7 : Cas\CAS STIFEN 2	oui
8 : Cas\CAS TMM	oui

Source: Processing of qualitative data by NVIVO software: Samar Ben Slimene

On the other hand our interviewees confessed that:

*We are open to the outside, the presence of an organizational culture oriented towards the competitive environment and a competitive culture is mandatory in order to optimize strategic scanning efforts.*

The results of the strategic scanning are not overnight. For a short period it is likely to have no result, or the results may be a detection of a competitor. It is not a money entry. For the interviewees, the organizational culture must be oriented towards a competitive environment as well as towards a compulsory competitive culture in order to optimize the strategic scanning efforts. This culture promotes organizational learning and increases the company's chances of increasing its knowledge through the impact of its strategic scanning process.

The interviews showed that companies adopt a culture open to their environment. Indeed, members affirm that they have the culture to participate in fairs every year. Contact with the outside is important and they do not put barriers to accept such a supplier or customer. We note that some interviewees do not have the concept of "as long as I earn money I am quiet" or "why I change winning team".

*We are very oriented towards this kind of action fair, conferences ... but a little less structured. It is a culture that encourages groups learning and aims to increase the chances of business knowledge.*

Among the objectives outlined in our survey is the fact to approve new sources, secure purchases and have other opportunities and other markets. All company departments are also affected by the same missions. So, among other things, they must be very open and present in the very scalable markets.

### III. THE INFORMATIONAL RESOURCES

As El Sawy (1985) who states that "Managers and leaders to learn about their external environment use oral / informal sources that are much used as sources written / formal", all interviewees said they relied heavily on 'oral sources'.

TABLE 4: TYPES OF INFORMATIONAL RESOURCES

	C : ri technolo...	D : ri relation...	E : ri orale	F : ri externe
1 : Cas\CAS MPC PROKIM	oui	oui	oui	non
2 : Cas\CAS RECOPNEU	oui	oui	oui	oui
3 : Cas\CAS SIA	oui	oui	oui	oui
4 : Cas\CAS SOGIP	oui	oui	oui	oui
5 : Cas\CAS SOMEF	oui	oui	oui	oui
6 : Cas\CAS STIFEN 1	oui	oui	oui	oui
7 : Cas\CAS STIFEN 2	non	non	oui	oui
8 : Cas\CAS TMM	oui	non	oui	oui

Source: Processing of qualitative data by NVIVO software: Samar Ben Slimene

The transcript of the interviewees is very interesting. It is here that a manager of a company told us that he has heard of such information is not disseminated. It is not concrete information but its transmission is usually in verbal way. He admitted that there are types of information that cannot be found in the press. Taking the example of staff recruitment, which generally does not appear in the media. This information is distributed by word of mouth. Indeed, the information from the field can only be face to face.

*Information flows from word of mouth. There are reports that are drafted and communicated. However we try to record it in black and white and communicate it to the interested parties.*

The interviews revealed that at the commercial level, companies receive information about the local market orally. Some managers have already pointed out that at the local market the problem of collecting information exists. It is thus difficult to find published formal information. For this reason, they relied on information from word of mouth.

*In our process, the sales persons who were traveling had a visit card. They visit the customer or the supplier and note what they saw, what they talked about. Thereafter, this form will be filed and this is what happens at the commercial level.*

The majority of interviewees (seven) said that the information resources are mainly 'external'. Just like Ghoshal's work. (1988) who asserted that "managers and leaders to learn about their external environment use external sources insofar as the object of the strategic scanning is precisely to learn about the external environment. Indeed, our interviewees stated that the

information is generally external. It comes mainly from seminars that bring together a number of companies in exchange, as well as fairs... Also, the development of relations with certain structures, which promotes partnerships, can present a large source. All this without forgetting the conferences where the professionals meet.

In another measure, six of interviewees focused on the importance of creating relationships. This was discussed with Aguilar F.J. (1967), Keegan W.J. (1974), Nishi K., Schoderbek C. and Schoderbek P.P. (1982), El Sawy O.A. (1985). The latter have shown that managers and leaders to learn about their external environment use personal / field sources that are much more solicited and used than impersonal / documentary sources. By referring to these ideas and analyzing the survey data, we were able to identify several ideas through the stories of the interviewees. First, we can say that information is scarce and incomplete and especially in the technological scanning, ingredients and supplier. They cannot be found and especially with a new ingredient.

*You have to look for the supplier who makes the new ingredients, you have to call him for information on this type of ingredient, and you take the datasheet to inquire about the scope.*

Then we were able to emphasize the importance of the novelties. The most important information, 80%, comes from suppliers (meetings, mail...) or the representatives / distributors of these suppliers.

*You look right and left to see what's new.*

In turn, the results of our investigation are rich and of great importance. The survey made it possible to identify the different sources of information presented above. But that's not all. Indeed, all interviewees stated that they used 'technological sources'.

*When you arrived you found me doing some research. I am looking for certain information in relation to a particular subject. It is here that it seems interesting to me to say that you will have the information that by RSS feed.*

## VI. HUMAN RESOURCES: TRAINING PROBLEMS AND THE LEVEL OF IMPLICATION

The company's members do not necessarily have innate abilities to track own the weak signals. In this same vein, Thietart (1991, p. 99) argued that training in environmental analysis is "paramount so that everyone to distinguish between banal and capital information. It is therefore necessary to develop an awakening state which must make it possible to detect and select the relevant information when the latter presents itself".

### A. The Training Problem

Of course, our interviewees' encountered problems related to training that we have tried to reveal. The 'lack of communication' appears as a major obstacle in the strategic scanning cells. Some have asserted that in their organization everyone do the strategic scanning according to their own duty. In other words, each member does the strategic scanning in an individual way. This may explain the lack of cooperation between the members and the strategic scanning cell. This lack of communication leads to the emergence of a 'problem of creating meaning' and 'animation' as well as 'sharing information'.

*We encounter problems related to training because it is a matter of offering different training depending on whether we train people to collect, analyze or animate the monitoring process.*

With the lack of communication, there is the 'degree of capitalization of information'. A well-defined portion of the interviewees argued that, apart from some people who are not used to formalizing, writing... there is a problem of capitalizing this information. They showed us this combination through a specific example.

*Taking the example of a salesperson who is in frequent contact with customers and suppliers, he may not be accustomed to writing accurate reports after visits ... it's here that we have to concentrate on Work because there is a lot of information in the visits regardless of suppliers or customers. This information can be exploited if you have the eye and presence of the mind. After what is interesting is the formalization of this information. That is where I can tell you that there is a capitalization problem.*



In another measure, four interviewees argued that there are 'skills' and analytical skills in their organization, and there is also 'collective intelligence'. The stories are rich and we retain the following:

*Collective intelligence within the company is very beautiful. I think it's not a bad thing to have good communication. In all that is happening today, I understand new things despite the fact that communications are not well perceived.*

Another interviewee said,

*External laboratories, whether in Tunisia or elsewhere, can be used to characterize this product. We precisely have the ability from this characterization to reproduce and make a similar product.*

Similarly, a small proportion of respondents (two) said that their organization, the animator has a capacity for 'mastering of the subject'.

*The animator must have mastery of the topic above all and have direct responsibilities in the company. He has a responsibility for the goals he wants to achieve. Thereafter, we add the tools of animation: an animator is someone who communicates well, someone who is clear in his ideas, in his communications, in his discussions. It is someone who ensures a certain rigor and that must be respected by the members and must be nice.*

In another way, two interviewees spoke of 'recognition'. In fact, they have put indicators of strategic scanning that allow them to guarantee the durability of their strategic scanning system. All this so that the strategic scanning will be not diluted or forgotten. The General Direction has set monthly and weekly monitoring indicators. These are linked to the person performance contract. If the member does not meet the objectives, he will be penalized in relation to his annual bonus. If a member fails to fulfill these indicators, he must put behind an action plan to describe the actions that should be implemented to absorb the delay. And this action plan will be followed, of course, as part of the monthly indicators.

*For the commercial part we obliged the commercial member to publish a bulletin of monitoring every week when it collects five major information, it can be more but at least five information. For the purchase part, it is necessary to have a monthly monitoring where it is necessary to put at least three important information in relation to the axes of research. First of all it is very visible at the level of the base and of course the indicators are monitored within the framework of a scoreboard of the company since we have other indicators among other production, commercial, turnover etc. These indicators are therefore reviewed once a month within the framework of the management committee. They are called "strategic scanning indicators." Of course, we can do all this within our quality management process and we can do the indicators so that we will see them monthly since we have a monthly review of all the indicators.*

The work of Lesca. N, Caron-Fasan M.L (2005) emphasized the importance of involvement in the strategic scanning cell. It is here that five of the respondents stated that the general framework is qualified by "member involvement".

*In MPC PROKIM, we are all involved in the search of information. Look, participative management is practiced almost a much generalized way. We keep listening through some instruments. Generally, it must be said that Involvement is mandatory. We connect monitoring process for internal business process described by a certain procedure.*

The rest of the interviewees, three, argued that in their companies there is 'lack of involvement'. Indeed, their companies were not able to continue in the strategic scanning because they are not involved, they have not followed the steps of the strategic scanning process and they have not even practiced them. This is mainly due to a lack of involvement on the part of the organization and the overload of work.

## V. TECHNOLOGICAL RESOURCES

Just like Lesca. N, Caron-Fasan M.L (2005), all the interviewees affirmed that the strategic scanning requires a 'technological support' otherwise it remains theoretical concept. Indeed, our survey showed that each company has set up a social networking system inter-company YAMMER,

Outlook, RSS, Rssowl, Nuxeo, Wysigot ... These are software that were provided free of charge during the PCAM program. For this reason, all companies that have taken the standby training have the same software.

Indeed, YAMMER and Outlook are like the social network Facebook but they are inter-company. They provide all new regulatory information in the vendor market. In fact, there are interactions, comments, likes ... All this is done in collaboration with the director of the company. The latter requests information and verification of the source ... For Rssowl software, it is software that collects RSS feeds. Indeed, members are used to connect to this site to save RSS feeds on this software. Every time there is new information the Rssowl makes an alert. The stories are numerous and we retain the most important to know:

*We have YAMMER, Rssowl. These are basic tools. The tools depend on your stage. For our primary stage, these two tools are largely sufficient*

Or,

*Compared to the strategic scanning, we made a subscription to the RSS feed. We made a subscription to everything that is called for tender.*

In addition,

*We have Nuxeo, RSS feeds, Wysigot and Rssowl. We also have an intra network like everyone else's Outlook.... So we exchange a lot and we work a lot on that. Really it is an indispensable tool. When there is a document that interests us, we exchange it through our internal network. The people in the operational field continue, of course, as we said, to participate in the fairs and to listen to the news on the net.*

Finally, it must be said that the affirmations are valuable. They show the importance of technological resources in the operation of the strategic scanning cell. In the event of a breakdown, members can stop the strategic scanning process

like what happened with a few companies that could not intervene to unblock this malfunction.

TABLE 5: TECHNOLOGY RESOURCES

	CD : rt besoin ... ▼	CE : rt support... ▼
1 : Cas\CAS MPC PROKIM	non	oui
2 : Cas\CAS RECOPNEU	non	oui
3 : Cas\CAS SIA	non	oui
4 : Cas\CAS SOGIP	non	oui
5 : Cas\CAS SOMEF	oui	oui
6 : Cas\CAS STIFEN 1	non	oui
7 : Cas\CAS STIFEN 2	non	oui
8 : Cas\CAS TMM	non	oui

Source: Treatment of qualitative data by NVIVO 8 software: Samar Ben Slimene

We note here that almost all the companies that have received this training have the same technological supports, namely Nuxeo, RSS, Wysigot, Rssowl and Yammer, which are set up during the PCAM program.

Only one interviewee 'SOMEF' said that his company 'needs other tools' even if it has a device that has been set up. He puts forward the idea that the need for tools can emerge, while the strategic scanning device is already well engaged. The tool is then necessary and indispensable for the operation of the cell.

## VI. CONCLUSION

The survey conducted among the Tunisian industrial companies allowed us to say that the majority of strategic scanning systems are informal. This explains, in a way, the absence of the company's involvement in this process despite the presence of an outward-oriented culture.

As for the information resources, the information collected comes from the technologies set up as part of the strategic scanning process. These informational resources are generally oral and external sources. They are essentially based on the development of relational networks.

Concerning human resources, the interviewees put forward some problems encountered, namely the lack of communication, the degree of capitalization of information and the lack of involvement. On the other hand, others have stated that they have skills, that collective intelligence is very

present and that there is a mastery of the subject. It is for this reason that in some companies there is 'recognition' which can explain the involvement of the members.

Finally, for the technological resources, all the interviewees affirmed that the strategic scanning requires technological support. We note here that almost all the companies that have received this training have the same technological supports that are put in place during the P.C.A.M program namely Nuxeo, RSS, Wysigot and Rssowl, Yammer. Some companies have expressed their willingness to invest in other technologies.

Generally all companies surveyed have expressed their need to have a well-equipped strategic scanning system and that can be the company's tool to achieve progress and follow the path of technological change. It is here that the ability of organizations to survive depends on their ability to anticipate external changes and adapt (Duncan, R.B., 1972). Alignment depends on the organization's ability to obtain "important information about the current and future environment" (Subramanian R., et al, 1993). strategic scanning is therefore a technology that helps companies to evolve and to face competition by offering a rich information base. It has somehow the immune system to ensure the survival of the company.

The examination of the resources allocated for the implementation of a strategic scanning system with the real needs of the Tunisian industrial organization showed significant discrepancies between the "wanted" and the "realized". Differences that may lead to the absence of a global and strategic vision able to study the environment of the organization in order to produce a program plan of the establishment of a strategic scanning.

The inadequacy between allocated resources and actual needs has meant that several Tunisian companies have abandoned the strategic scanning system. Knowing the causes of this dysfunction at an early stage often seems beneficial in defining failure factors for a strategic scanning.

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# Moderating effect of information culture between Economic Intelligence and firm performance: A Conceptual Modeling

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**Abstract** —Everyone knows that are difficult times for all organizations of all sizes and in all sectors.

The importance and the usefulness of the economic intelligence within the companies are no longer to demonstrate in a world very fluctuating, and the current competition is without precedent, where it is essential to demonstrate competitiveness, proactivity and permanent vigilance for a better development of the company, Therefore the achievement of a better performance is even the central objective of the economic.

The main purpose of this study was to conceptual and Empirical review the work who treated the relationship which exists between the economic intelligence practices and performance, and then propose a conceptual framework

**key words** :Economic Intelligence, Performance, Firm Culture...

## I. INTRODUCTION

**I**n a world very fluctuating, complex, and shaped by the information. The current competition is without precedent, where it is essential to demonstrate competitiveness, proactivity

and permanent vigilance for a better development of the company,

In fact successful organizations depends on their ability to provide relevant information,

So the practices of the economic Intelligence (IE), which al

To search for reliable information and necessary, the collect, for end of decision-making in general; it is track donations as the key which allows to take decisions and closing the tracks of uncertainties

And since the information which the Organization have needs must be reliable, economic intelligence is susceptible to have an impact on the performance of The Company (S.Habhab, 2007);

So despite the role that can play the practices of the Economic intelligence in the achievement of a better performance, a little researches have treated this relationship.

In this order of ideas that this communication will attempt to put the light on the work who treated the relationship which exists between the practices of the economic intelligence and performance while trying to then propose a conceptual model

## II. REVIEW OF RELATED: LITERATURE REVIEW:

### A. Conceptual Review: Economic intelligence

As for many concepts in management science, the definition of the IE poses theoretical debates but also practices. The authors use, in effect, definitions diverse and varied to designate

this practice; each stressing the different characteristics of this activity,

In effect the economic intelligence is more than an activity of supervising environment, and it is distinguished from the economic espionage, by the fact of being a responsible attitude to protect the information and the company against the threats and vulnerabilities (S.Habhab2007)

According to A.Juillet (2003); The economic intelligence is the set of actions coordinated research, treatment and distribution in view of its exploitation, useful information to the economic actors, these various actions are conducted legally with all the safeguards for the protection of the necessary for the protection of the Heritage;

This definition puts the emphasis on other dimensions very essential: the protection of the heritage and the information cycle.

For the report of Martre (1994); "Economic intelligence is defined as the set of coordinated research, processing and distribution of information useful to economic actors".

According to B.Carayon 2003: "the Economic intelligence is a public policy of competitiveness, economic security, of influence, including with international organizations, and training, it proceeds in a grid of original reading of globalization which takes in count the daily life of markets, the circumvention of these rules, the games of power and influence"

In fact most of the definitions of the economic intelligence list a number of dimensions all constituents of the practices of the economic intelligence,

Most of the definitions proposed in the literature tend to describe the activity of IE from three dimensions aimed at the improvement of the decision-making: the Monitoring Environment (In French Veille), the protection of the Heritage informational and the influence (Paturel and Richomme-Huet, 2010).

#### 1) *Monitoring environment:*

Monitoring environment is considered as the first and most well-known of the functions of the economic intelligence (Laghzaoui 2016), is defined as a continuous activity and largely iterative aimed at active monitoring of the technological environment, competitive, etc. ...; to anticipate developments; it is a cyclical business and processual in function of informational flows 'standard'<sup>1</sup>;

Therefore Monitoring environment is a set of facts transforms the information obtained from different sources for the benefit of a user and according to Martinet and Ribault (1988), Monitoring and watch environment as organized attitude of listening to the signals from the environment of the company likely to put in because of strategic options, these elements refer finally to an organized collection of the information available in the environment The Organization

Coutenceau (2012) cited in Laghzaoui ;(2016), says that the management of the information passes by several operations called 'Information cycle .

#### 2) *The protection of the heritage material and informational:*

Is the fact to put in place measures to protect the intangible capital of the organization; it aims to protect the intangible heritage and informational of the company and everything that could confer a competitive advantage (Breillat, 2010; Paturel and Richomme-Huet, 2010).

The function of protection may cover the following aspects: the safety and security of the information, the counterintelligence, the fight against the rumors, the patenting..., etc. (Larivet, 2009). Cited by Laghzaoui, 2016)

#### 3) *The influence:*

The influence it is the a Diamond point of the Economic Intelligence, according to E.Delbecque (2015), is the fact to manufacture the consent and configure specific contexts in order that the rival or the ally take decisions going in the direction of the interests of the influencer.

The function of influence is to implement a series of direct pressure and/or indirect effects on the influential actors in the sector of activities. The goal is to force the maintenance or the taking of a competitive position (Boumard, 2000).

According to (Larivet, 2009), cited by (Laghzaoui; 2016) two natures of influence can be identified:

- The Lobbying: This practice is intended to influence the external stakeholders with a view to serve the interests of the company (Jakobiak, 2009). By doing this, a company may proceed to interventions intended to guide the process of development, from the application or interpretation of the legislative measures, standards, regulations and, more generally, any intervention or decision of the public authorities (Larivet, 2009).
- The Management of Competitive signals: this strategy of influence in competitive field consists of the sending of deliberate signals in order to influence a competitor and persuade them to modify its positions (Marcon and Moinet, 2011).

#### B. *Conceptual Review: A Firm Performance.*

Batz and Haltin define their performance 'the performance of a multi-dimensional structure of the variables it depends on several factors; they also suggest that goal setting, evaluation assessment and behavior of performance result is much more important'

Firms performance measurement can be divided into two components namely Financial Performance (Kapal and Norton, 2011) and non-financial performance, which respectively evaluates firms monetary and non-monetary

<sup>1</sup> Defined by AFNOR (standard XP X 50-053, April 1998).

dimensions (Daly; Madanoglu; and Okumus, 2011).

### 1) *The Financial Performance:*

Financial performance reflects the Firms financial situation which can be evaluated using indicators such margin profile, return on assets (ROA), returns on sales (ROS), return on investment (King) and others (Tee et al, 2010)

The evaluation of the financial performance of a business is done through its financial ratios.

Over the past three decades, empirical studies have been carried out to prove the usefulness of these ratios (Chen and Shimerda, 1981). In effect, these are required to analyze the financial health of a business to know: the profitability, liquidity, the estimate of the benefit future, the analysis of the competition and the prediction of the bankruptcy of the companies (Zeller et al. ,1996, cited in Z. Samlal 2016).

### 2) *The Non-Financial performance:*

Non-financial measures inherently focuses on the long term achievement of firms by concentrating on customs gratification internal business process,

Productivity, invention, and employee fulfillment (Avci et al; ..., 2011). So according to (Zigan and Zegglat (2010) , Customer satisfaction and loyalty were also found to be the core components firms non-financial performance:

### C. *Empirical Review: Economic intelligence & Firm Performance:*

The importance and the usefulness of the economic intelligence within the companies are no longer to demonstrate in a world very fluctuating, we can say that the achievement of a better performance is even the central objective of the economic intelligence;

The management of the economic information has become, one of the essential motors of the overall performance of economic agents.

Economic Intelligence lead targeting of the organization and shows the competition positions and makes the company to be able for forecasting and developing their markets through analyzing the behavior of the competitions and environment to identify opportunities that in long run will lead to innovation (Britt, 2006).

Companies with using Economic Intelligence and analysis of competitor's strengths and weaknesses are able to predict opportunities of market development and having better performance rather than competitors (Cobb, 2003).

Therefore, performance results à process seen as a strategically important, condition for the survival of any organization intertying to improve their performance in terms of profitability (Antoncić and Hisrich, 2000).

F. Jakobiak (1998), has noticed the difference in performance between firms depending on the location and the use of system of monitoring environment, it has concluded that the most

successful companies are those equipped with systems of supervising environment.

According to C. Cohen (2007), the economic intelligence has for main missions to propose and carry out actions, in the aim of helping the strategic decision making, to improve the competitiveness and performance of the Organization.

Economic Intelligence practices can be a source of sustainable competitive advantage by enabling a firm to develop, implement and monitor strategies that create as well as protect shareholders value in the long term (Protiviti, 2011);

So competitive intelligence practices can make to measurable impact on the firm performance by a proactive manner to enhancing business performance;

In fact, according to several researchers and specialists (Peters, Waterman, 1993) ,the ability of an enterprise to monitor its environment can explain a large part of its capacity and its performance.

In effect the study VASIC has demonstrated that the activities of monitoring explain the variance of the performance of the company in terms of the capabilities of mastery of the environment.

The study of Audet (2003), which focused on the innovative SME has for the purpose of verifying the existence of relationship between the intensity of standby, the integration of the information in the strategic process in order to establish if this relationship has an impact on the performance of SMES studied, the results show that the leaders of the most performing SME's have a strong propensity to innovation.

Bournois and Romany have made a study on 1200 French companies, after these authors the fact to practice or not to practice economic intelligence is linked directly or indirectly to the economic performance they have in fact put in relation economic intelligence practices and financial performance.

The study conducted by S. Habhab (2007) on high-tech SMES shows that SMES the more efficient is distinguished from less efficient by the sharing of information.

Stubbart 1982, in his study emphasizes that there is a direct link between performance and intelligence, however, in several cases the association may be negative, the fact that performance problems cause a change toward a regular monitoring.

In the same sense of idea in 1999 Kaish and Gilad find a decline in activity of the supervising when SMES reach a experience and a sufficient profitability, because according to them the leaders, when they focus on the internal management they neglect the search for new opportunities for that they reach a satisfactory level of performance .

Shakoori, Alvedari, and Mosafri (2014), cited in (Hope N .Nzewi and al.; 2016) conducted a research in selected banks in Iran on the role of competitive intelligence in moving customers towards high level loyalty; They finding revaluated that among component of high level loyalty, trust, affection, satisfaction, value, brand value and resistance to change have more importance in direction, customers towards an ideal loyalty and making ambassadors for bank .



Phani, Madhumita, and Paurav, (2011) conducted research in India on the impact of Competitive intelligence practices on the firm's performance in the emerging market of India; Their finding revealed that Indian firms exhibit higher levels of competitive intelligence practices indeed achieve better financial performance result (Hope N. Nzewi and al., 2016).

### III. ELEMENTS OF PROBLEMATIC AND THE RESEARCH HYPOTHESIS:

#### A. Problem of research:

The literature review on the practices and the dimensions of the economic intelligence also on the links that exist between the practices of the economic intelligence and the performance of the company on the other side, has made initiated certain questions that deserve a reflection and a deepening, the fact that the studies which have treated the relationship between performance and the practices of the economic intelligence are somewhat limited by the fact that they do not specify the indicators (S. Habhab 2007);

So the work focused on the nature of the link that exists between performance and economic intelligence does not concern the public companies, these reasons and other lead us to ask the question:

What characteristic of practices of economic intelligence are having the impact OF the Financial and non-financial performance of public enterprises?

#### B. A conceptual Framework: conceptual model

In order to build our conceptual model, we had to articulate a vision based on the theoretical and empirical studies conducted on the practice of the economic intelligence and its impact on the firm performance.

As well, the conceptual model that we are going to present bringing together the dimensions of (EI) and those of the performance of the company. And we assume that the dimensions of the practice of (EI) have a significant impact on the financial and non-financial performance of the company.

So implementing a company's strategies successfully depends on the organizational design, the processes of selecting the right combination of structure, control system and culture. Firms need to monitor and oversee the organizational design process to achieve competitive advantage.

Murphy (2005) noted that effective organizational structure enables a firm to economize on costs of collecting, analyzing and disseminating information as well as enhancing the ability of the company's value creation function to achieve superior efficiency, quality, innovativeness and responsiveness to customer needs. According to P. Waithaka (2016).

Organizational culture is a critical element in the successful implementation of any corporate strategy. It is about values, beliefs and ideas about what kinds of goals the members of the organization should pursue and about appropriate kind or

standard of behavior organizational members should use to achieve these goals according to (Murphy, 2005)

Furthermore, and according to C. Cohen (2007) there is some elements that play an important role in the effectiveness of the economic intelligence between other;

The quality of the participants to the activity of the economic intelligence, and the existence of a collective culture of sharing of information as well.

(F. Lainée, 1989) postulates that economic intelligence is a state of mind, and the matter of all, a true collective culture of sharing of information promotes its effectiveness.

By its nature, the IE involves communication, interaction and the sharing of information to define an action collective. The culture of the business - as a system of values, beliefs, standards, which determine the behavior of individuals - must therefore promote the sharing of information, facilitate the exchange of data between the members and the adaptation to changes.

Alain Juillet stressed that where in his speech that the French companies must change their organizational culture and open on their environment.

According to C. Choo (2013): There is Four, representing information culture types which we label: Result-oriented; Rule-following; Relationship-based; Risk-taking.

-In a Result-oriented culture, the goal of information management is to enable the organization to compete and succeed in its market or sector. The organization seeks information about customers, competitors, markets, as well as data to assess its own performance.

-In a Rule-following culture, information is managed to control internal operations, and to reinforce rules and policies. The organization seeks information about internal processes and workflows,

- In a Relationship-based culture, information is managed to encourage communication, participation, and a sense of identity. These values promote collaboration, cooperation, and the willingness to take the initiative to contribute and act on information. There is a focus on internal information.

-In a Risk-taking culture, information is managed to encourage innovation, creativity, and the exploration of new ideas. There is a focus on external information. The organization seeks ideas for new products, new markets, and information about trends and changes in its environment.

Of this fact, the research model developed for the purposes of this research (Figure No. 1) postulates that the dimensions of the practice of (EI) (Monitoring Environment; Protection, Influence), have an impact on the firm culture specially (Information culture) and that this last influence the level of the performance of the company.

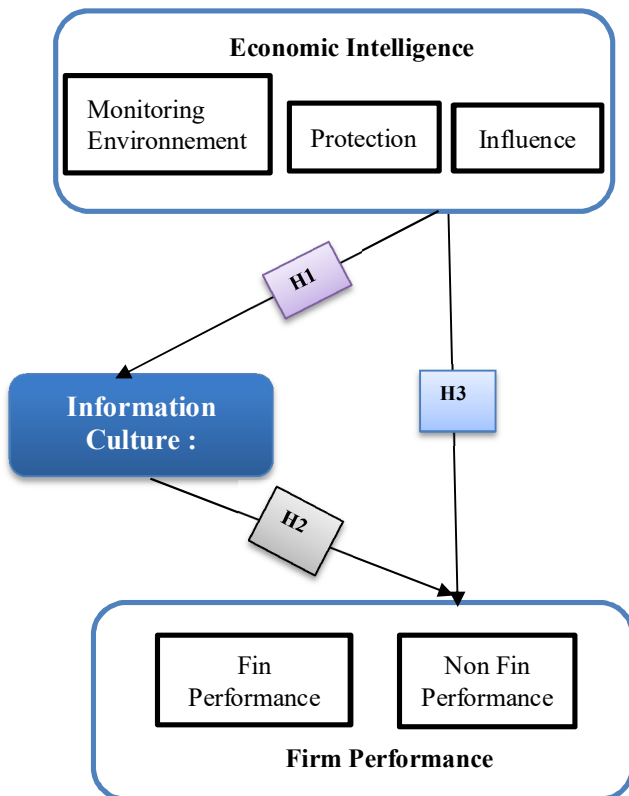


Figure 1: Research Framework

As well, practices of (EI), forming the block of independent variables (explanatory), include the dimensions and sub-dimensions:

- **Monitoring environment**, evaluated using the 4 under the dimensions of the information cycle: The expression of needs in information, the collection of information, the analysis of the information and tools for the dissemination of information.
- **Protection**: appreciated by the importance of this practice for the company. Two sub-dimensions are selected: the sensitivity to the security of information and the security measures adopted by the enterprise.
- **influence**, measured by the ability of influence of the company on its environment.

As to the financial and non-financial performance, representing the dependent variables (explain),

-**the financial performance** will be measured by:ROA(Return on assets);ROE(Return on Equity)and Tobin's Q, according to (E. Al-Matari et al.,2014) researchers revealed that the accounting based measurements like ROA, ROE, profit margin and others are used for the short-term performance of the firm while the market-based performance of the firm is gauged through Tobin's Q as a representation of future long-term performance. Therefore, the integration between the two provides a clear picture of the firm

-**the non-financial performance** will be measured by: customer satisfaction;

by report to the variable mediator who is the culture of sharing of information within the company it will be measured

by:

Of this fact, and with the help of these different variables, two major assumptions will be tested.

-The first hypothesis

**(H1) postulates that there is a positive link between the Economic Intelligence practices and the Information culture in Moroccan public Companies**

This hypothesis is subdivided into three sous-hypothèses.

H1-1: There is a positive link between the practice of Competitive intelligence in the Moroccan public companies and the information culture

H1-2: that there is a positive link between the protection in the Moroccan public companies and the culture of the company

H1-3: There is a positive link between the practice of the influence in the public enterprises Moroccan women and the culture of the firm.

The second hypothesis:

**(H2): Postulates there is a positive link between the culture of the company and the dimensions of the financial and non-financial performance of the company.**

**(H3): Economic Intelligence through Information Culture affects on Financial and non-Financial firm performance.**

### C. Research Methodology

We are adopting a mixed design (a qualitative and quantitative approaches) of descriptive and explanatory survey research. According to Sekaran and Bougie (2009)

A researcher should use more than one design to enhance the study; hence these two designs were used to achieve the optimal results as recommended by (Saunders, Lewis & Thornhill, 2009). Mixed methods can elicit insights that may be overlooked by a mono-method and can produce more complete knowledge contributions to theory and practice (Niglas, 2008)

It should specify the maturity of our research subject is not yet reached. To date, it is difficult to identify major robust empirical trends in Economic intelligence supporting hypotheses shared consensually by the scientific community. It is in this logic that we have opted for PLS Partial Least Squares as a choice of software because it is adapted to predictive causal analyzes in situations of high complexity and weak theoretical information (Jöreskog & Wold, 1982).

It is a nonlinear iterative procedure following partial least squares which minimizes the residual variances under a constraint of "fixed point" (Croutsche, 2009). We will therefore apply a second-generation, exploratory statistical method for modeling complex relationships between observed variables and unobserved variables.

The model chosen to confirm or reverse the assumptions made previously. We will seek to define the systems that constitute Economic intelligence practices and to identify its interactions with performance indicators. So we will use the method of structural equation modeling (ESM).

Our methodological choice will test the relevance of a set of hypothetical relations through a mixture of exploratory factor analysis and multiple regression. It should be specified that the statistical verification of the hypotheses will be carried out through two types of analysis:

- A) Exploratory Factorial Analysis
- B) Confirmatory Factor Analysis

### Target Population

The target population for this study were all the Public Moroccan companies. There are 50 companies.. The study targeted the manager or directors in-charge of planning /strategy, and Information System Managers.

### Objective of the study

Is to determine the moderation effect of Information Culture on the relationship between competitive intelligence practices and performance of Moroccan Public enterprises.

### Conclusion:

This article is a part of a Ph.D. program that aims to understand what impact of the practices of the economic intelligence on the performance of Moroccan public enterprises . In other words, our doctoral research project will try to answer the following research questions: What importance is given to the practices of economic intelligence in Moroccan public enterprises and what is their impact on performance In order to answer our research questions, a qualitative research will be adopted. This research is appropriate in the sense that the aim of our investigation is to obtain a holistic and integrated understanding of How do Moroccan companies judge their practices of economic intelligence. Given the nature of the research questions and objectives, in depth semi-structured interviews will be selected as our research method. For that purpose, the dimensions of the framework proposed in this article will be transformed into observable and measurable elements. The objective of the empirical part of our research would be to present The characteristics of firms that practice economic intelligence and what impact their practices have on their financial and non-financial performance

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# Decision Making System for Remote Laboratory using Data Mining Algorithm

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**Abstract**— Remote laboratory is new technologies apply in E-learning system for allows student to Realizes the practical work of physique via the web as they also exist in the laboratory In order to solve a set of problem. The research realized by the university Cadi ayyad and its partnerships to develop this system of e-learning reaches an important and advanced level Begin with laboratory management Then respects the system the norms pedagogic of the teaching , Arriving at the last stage which is the evaluation of the student According to a set of criteria Then makes the decision to target student gaps Based on the data mining algorithm and the university information system.

**Keywords**—E-Learning, Remote laboratories, Data Mining Algorithm ,grid evaluation, php, Node js, library socket.io and FS, Html5, Canvas, Pcdduino;

## Introduction

Many projects of Remote laboratory have been done to improve the system of E-Learning but among the reasons that push us to make a new conception we find :

-Educational and pedagogical standards followed in teachings: (Realization an electrical diagram and schema is a skill) . In the electronic field, to understand the running of some component electronic and the realization of a practical work requires the creation of electrical circuits, that is to say, it is the students who are to choose the components and link them for to get the schema of the circuit and takes the desired measurements. But the current system does not give this opportunity to the student; we find just the predefined schema with only the switch or buttons that the student can be open or close. So we created an application that gives hand to the student to choose the component and be connected to realize their own schema.

-Laboratory management:

In the old system, for each practical work, the laboratory preparer must program a client-side application and a server-side program, and, likewise, to realize the real assembly of the specific circuit of that practical work in the laboratory so that the student can control remotely the TP real.

Since the electronic field contains many TP to achieve and realize, the preparer must for each TP repeat all the works. So this method is not efficient and requires much effort and time. Since our systems allows to realize any electrical diagram by one program, will solve this problem. More than that, in the existence each TP needs a pcdduino card to orders the real assembly. So our system with a single card pcdduino can do several TP even at the same time depending on the need, thanks to another application that will make the management of

the laboratory easier by taking the appointment of the practical work for any student or researcher.

-Student Assessment: The evaluation of students in the course of practical work is often limited to the grading of a report While this practice makes it possible to properly account for the knowledge and Editorial know-how , It leaves aside two other aspects which seem to us fundamental: Know-how and experimental know-how.

This paper presents the process of developing a generic tool, Consisting of a system which defines a criterioned grid and a summary table intended for the teacher for evaluate students and target their gaps. These elements allow teachers wishing to engage in this process to benefit from a solid starting point for To adapt these tools to their context and to their audience.

## I. ARCHITECTURE AND TECHNOLOGY SYSTEM

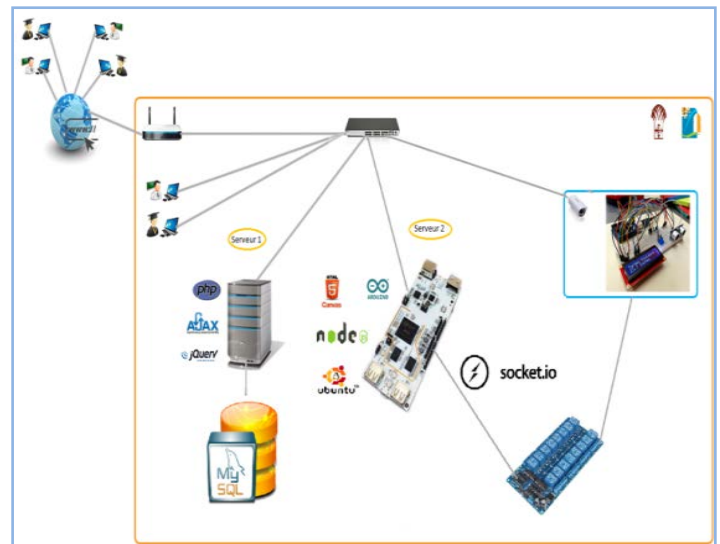


Figure 1:Architecture and technology system

In the diagram of Figure 1, there are two perimeters. The first is the web (Internet) and the second is the perimeter of the university (specifically the local school network LAN). In the perimeter of LAN, we have two web servers, one containing the learning platform that represents the central faculty information system, where all information is found.

The second server is a **pcduino** that contains the application that will allow students to handle the practical work. The process would work as follows: a teacher or teachers connect either using the Web or the local network; each teacher defines one or more TP, puts the theoretical part and the scenario after having made the TP reservation for all students.

On the other side, students connect using either the Web or the local network ( Most of the time, students will use the web, because the use of web was among our goals from the beginning). If the student has a TP, he consults and reads the scenario, then he checks the reservation. If the reservation time arrives, he manipulates the TP; during this stage each reservation is destined towards the server 2 (pcduino card). If the reservation time elapses, the TP ends and the material resources are released for a future reservation.

## 2-1 Platform of management

For the management of the laboratory we have created a web application by the interaction of several programming languages (php, ajax, sql...) This platform is divided into 2 parts:

- Admin Part where the administrator organizes the laboratory by the management of students, using a set of criteria (branch, group, module...), and the creation of the niches and the appointments for the manipulation and particle work.

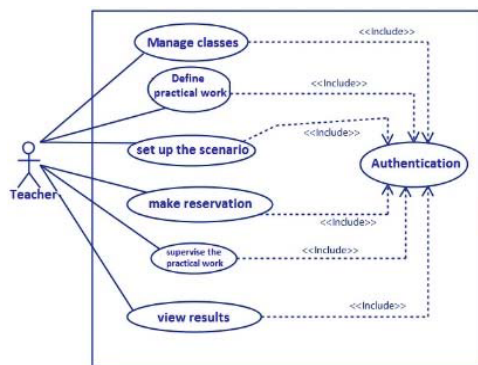


Figure 2: Use case of Admin

**Actor** : "Admin or Teacher":

- Authentication: the application checks that the teacher is what it purports to be then it gives the access authorization.
- Manage classes: allows teachers to manage classes, specialty and students.
- Define TP: enables teachers to set a TP, put his name, objective and theoretical part.
- Put the scenario: allows the teacher to work a practice scenario, which defines the steps to be implemented to make this work convenient.
- Make reservation: allows the teacher to create a reservation for each student to a specific practical work.

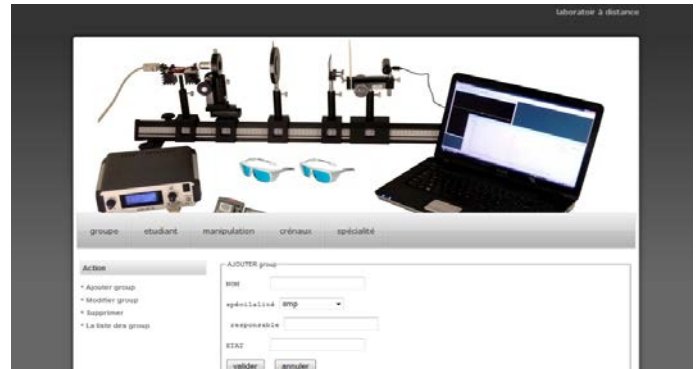


Figure 3: Application of management admin part

-The 2<sup>nd</sup> part concerns the client part in which the student, after authentication in the management platform, will see if he has an appointment for a manipulation; he will even know the date and time with which to start the TP. If the time comes, the link of the manipulation will appear and who will send the student towards the 2nd application that are the our electronic simulator in the web .

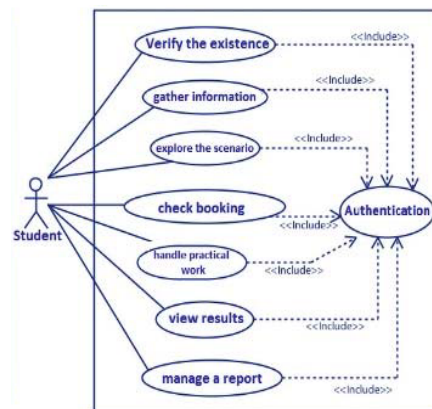


Figure 4 : Use case of student

**Actor**: "Student"

- Authentication: the application verifies that the student is what it purports to be and then gives the access authorization.
- Check there is a TP: enables student to check if he has a practical work.
- Gather information about the TP: enables the students to see and learn the theoretical work.
- Read the TP scenario: allows the student to read the script, to know all the steps and details to bring up this assignment.
- Check the date of handling: allows the student to check the reservation practical work in order to know the exact time of manipulation.
- Handle the TP: enables the student to handle the practical work Using another application in server 2 (web simulator ) but this will happen only when the reservation time for this student is checked.



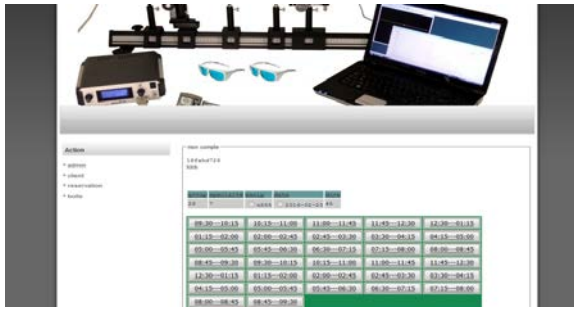


Figure 5: Management application of student

## 2-2 The electronic simulator via the web

the student will achieve the electrical schema of the circuit and can control and order the real Assembly of laboratory via the web. The great technologies used in this application are **html 5** especially its suitcase **canvas**, **Node.js**, **websocket** (**socket.io**) and the **pduino** card.

What is new in our system is the following: To have reactivity between the client and the application we used the **canvas** suitcase of **html5** that comes to replace the flash. Then this technology will allow to virtualizes the real practical work and realize the circuits by using the pictures and animation that will be the ways by which the student will manipulate and control the real TP.

To develop an application in **html5** (<**canvas**>) for have a animation and flexibility to choose the device and link them requires using a lot of **JavaScript**. That is why we used the **Node.js** technology that will allow to set up a web server on our electronic card **pduino** (it's Also the card by which we will control the real circuit). The advantage of using **Node.js** is that it allows running the **java script** in the server side instead of the client side and is based on the engine of **google chrome V8** that makes faster the execution of **JavaScript**. This technology already used but what is new ,is in the **socket.io** library that allows the exchange of information between the client and the server: this library in the latest projects is used, but it does not operate the interest in this Library; they are only used for sending the request from the client towards the server, knowing that we can do just with **Ajax** because it actually allows the client and server to exchange information without reloading the page. But in **Ajax** it is always the customer who request and the server repeats. The server cannot decide by itself to send information to the client. So with **Socket.io** this has become possible, and we were going to exploit it since our server is itself our **pduino** card by which we are going to protect the real circuit and device. If the voltage of the threshold levelis exceeded, then the server must inform the client to pay attention to the protected component and device.

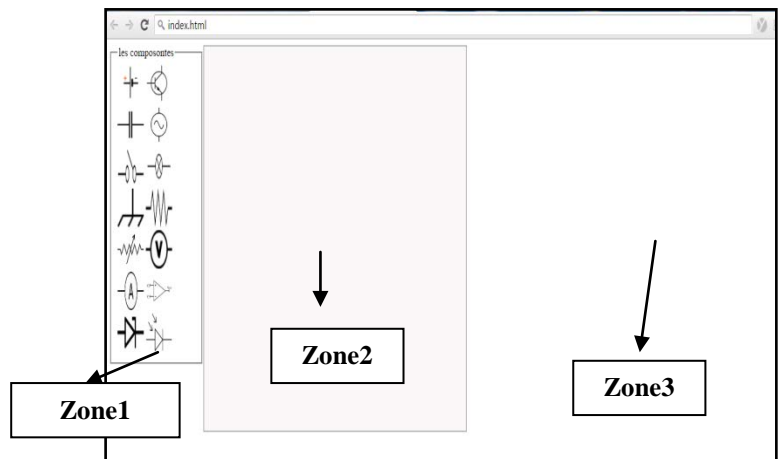


Figure 6 : simulator

**Zone 1:** This zone contains all the electronic-components that the student has to choose and works at.

**Zone2 :**It is in this area where the student must carry his electric scheme.

**Zone 3 :** This area will display the control interface when the student will choose the measuring tool or power because we will exploit the existence of some measure of material and source of energy configurable and controlled via the web from a web interface such as tools of **InfiniiVision**agilent



Figure 7: Oscilloscope agilent

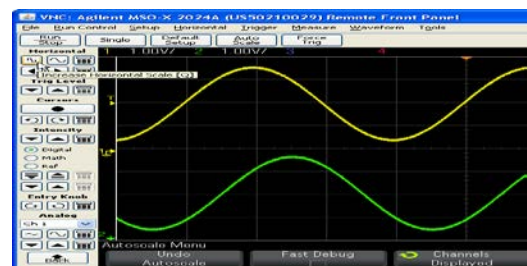


Figure 8: Interface web of oscilloscope

We gather the control interface of the specific device (oscilloscope, generator) and simulation interface. In one interface we are using the tag of **html5** :<**iframe**>. For example, when the student chooses the generator and oscilloscope, he will get the following interface:



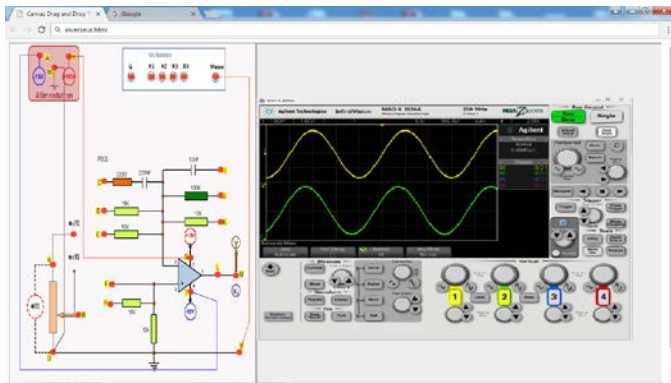


Figure 9 : Simulator and electric tool of measure

### 2-3 Hardware Part

The laboratory must be equipped with a pcdiuno card and a board on which all the electronic components mounted depending on the given needs. These components are connected between them by relays; we will even exploit the existence some measure of material and source of energy configurable and controlled via the web from a web interface In the **pcdiuno card** we will use the Node.js technology that will allow us to create an http server and the application of simulation. This card uses a Linux operating system, and from the Linux file system we can control and order the pins of pcdiuno-to manipulate the assembly:

- GPIO digital pin: 18 I / O 3.3V
- Analog inputs: 2 x 6 bits 0-2V and 4 x 12-bit 0-3.3V.
- Analog outputs: 6 x PWM (2P "fast" in 520Hz - 8-bit and 4-pin "slow" in 5Hz - 20 levels).

So, in order not to overload the memory of the card, by to install the set tools (python, pcdiuno, editor...) to program the card, we just used the library <FS> of Node.js which will allow access for the control file of the pcdiuno pins. The all in a single program (http server program and the pcdiuno control and command parts).

The files fixing the input or output mode are set in the Linux directory:

`/sys/devices/virtual/misc/gpio/mode/`

- Files containing / defining the state of the pins are placed in the directory:

`/sys/devices/virtual/misc/gpio/pin/`.

When the student chooses the electronic element and links them, for every link a request will be sent by the library **Socket.io** of Node.js towards http server which processes and hands over pcdiuno for the sake of controlling the relay.

Our system is designed to solve the problem of having to program every time an application for a lab TP and create an assembly for this TP. So our solution is in the web application that is like an electronic simulator, but the difference is that it is used in the web, and in the pcdiuno program and in an assembly which includes the electronic component which are connected together by relay.

### III Evaluation And Make Decision About student Gap .

At the University, particularly in the scientific fields, the evaluation of the experimental skills of the students is done

most often in the framework of practical work And is based essentially on the production of a report .This approach, apart from the fact that it is based on widely shared teaching practices, provides a good understanding of how students master :

- Knowledge related to the issues addressed in the session, which are essentially Disciplinary proceedings;
- Editorial know-how, such as plotting, interpretation of experimental data or the ability to synthesize, and which broadly transcend disciplines.

On the other hand, evaluation based on a report does not allow us to access two other dimensions that are essential to our eyes:

- Experimental know-how, such as the ability to choose and use the Hardware, the quality of the measures, or the respect of a protocol (capacities chiefly specific to each discipline);
- Skills, which integrate the student's involvement, his or her autonomy or ability to Work in groups, and whose nature is eminently transverse.

We present here the approach of developing a generic evaluation tool, aimed at providing teachers with a basis to adapt to their own context, enabling them to address the 4 categories defined below (knowledge, editorial skills , expertise Experiments, well-being).

The desire to develop a tool as objective as possible led us to orient the work towards the development of criteria- ried grids, which are widely described in the literature (Daele, 2010, Reddy & Andrade, 2010). The work has therefore refocused on the formulation of criteria, the choice of performance levels, and the writing of descriptors.

#### 3.1 La formulation des critères :

The courses in our university are divided into semesters, and the courses with an experimental component typically offer 7 to 8 practical sessions per semester. To avoid a profusion which will prove to be unmanageable then, We proposed to limit the number of criteria to about twenty overall by teaching, While knowing that for each session it will be difficult to consider more than 5 to 10. . For their formulation, we chose to write them in the form of aptitudes relating to identified content, Such as "using experimental equipment". This declination allows a homogeneity of the grid, and avoids the utterances too general.

#### 3.2 Performance levels

Based on the recommendations of Bernard (2011), we chose 4 levels without Middle point. Starting from the target level ("correct" level), the counterpart naturally appears as Being the "insufficient" level; At these two levels is added an "excellent" level, which must remain accessible although demanding, and an "unacceptable" level, which we assume to set the requirements especially in the first cycle university. We thus limit the level of detail to the strictly necessary, as advised by Mueller (2005). The addition of an adjective systematically associated with the level ("unacceptable", "insufficient", "correct" and "excellent") makes it possible to clarify the expectations of the teacher and to align the different criteria with a common reference Level.

Criteria		Level unacceptable	Level insufficient	Level correct	Level excellent
<b>A. KNOW-HOW:</b> Relate to the involvement, the autonomy, ...	<b>A-1</b> Anticipating the TP session	The student arrives without having Does the preliminary work	The preliminary work is Very incomplete	Preliminary work has been Made seriously and drafted Cleanly	The preliminary work is impeccable (complete, Accurate and properly worded)
	<b>A-2</b> Manage the TP session time	Some important parts of the TD were not addressed for lack of time	The pairs often wait to be relaunched by the teacher to move forward	The pair managed their time correctly (full work or appropriate reaction to a difficulty)	The binome benefits from its efficient management of time to deepen the subject
	<b>A-3</b> Distributing work and helping each other within the binomial	The work is distributed unevenly among the students AND they do not cooperate	There is an imbalance in the distribution of work between the students OR they do not cooperate	The workload is fairly distributed AND the students cooperate so that everyone can master the overall work	Level and the student is able to help the other pairs at the time the teacher allows it .
	<b>A-4</b> Working independently	The binomial does nothing without soliciting the teacher	Only the basic tasks are performed autonomously	The binomial answers the questions posed in the statement autonomously or asks the teacher wisely	Level and the pair poses pertinent questions for further discussion
<b>B. EXPERIMENTAL KNOW-HOW:</b> Relate to the ability to handle, compliance with a protocol, quality of measurements and recording of results ...	<b>B-1</b> Using experimental equipment	The student uses the material in a hazardous or inappropriate manner (Possible damage)	The student uses the adapted material but he does not know how it works (unsuitable settings)	The student uses the material wisely and he knows how it works (settings Adapted)	Level and the student knows the limits of the equipment used
	<b>B-2:</b> Estimate measurement uncertainties	The binomial does not worry about the uncertainties	Uncertainty is poorly estimated or unjustified	Uncertainties are properly estimated and Justified	Level and the binomial refines the experimental protocol to minimize them
	<b>B-3:</b> Record experimental results	Some important information is not Readings	Results are uncoordinated (draft copy,...)	The student notes the results but he is the only one who can exploit his notes	The results can be easily a colleague
<b>C. KNOW-HOW EDITORIALS:</b> Are related to the exploitation and the analysis of the results, to the writing of a report including the capacity of synthesis, the taking of retreat ...	<b>C-1</b> Write an introduction that specifies the context	No introduction	The introduction takes up exactly the text of the TP	The introduction is reworded, but it remains focused on the course of the session	The introduction is reworded with reference to the context and potential applications
	<b>C-2</b> Establish a Scheme of the Experimental Device	No schematic	The schema is incompletely drafted, or remains inoperative for a reader not familiar with the system	The scheme is complete and exploitable but lacks care or rigor	The schematization is complete, exploitable, neat and rigorous
	<b>C-3</b> Introduce the principle and the experimental protocol	The results are presented directly without the manipulation or associated principles being described	The principle and the protocol are copied without appropriation by the student	The experimental protocol is reformulated in a clear and justified way	Level and at least one proposed improvement of the protocol is formulated
	<b>C 4.</b> Draw a graph from measurements	The graph is very rough, the space is badly used (scale), it lacks the title, the label of the axes (magnitude represented • unit), graduations ...	The scale is adapted, the axes are graduated regularly, but badly Denoted (absence of the magnitude represented unit), lack of title	The axes are labeled, the scale is adapted, the graph contains a title and a legend, the measurements are well reported with a trend curve	Level CORRECT and error bars materialize uncertainties or annotations make it easier to interpret the results
	<b>C-5</b> Establish a literal expression (including Uncertainties)	Literal expressions prior to numerical calculations are often Absent	The literal expressions are established, but often erroneous	The literal expressions are generally correct and the notations introduced by the student are explicit	The literal expressions are systematically correct and the notations Explicit
	<b>C-6</b> Present a finalized result	The results are presented in a Disordered	Units are missing or numeric values are false	The results are correct, with good results Units, and with a number Appropriate numbers Significant	Level and an original presentation highlights important results
	<b>C-7</b> Interpret the results, draw conclusions	No interpretation	The student discusses the results obtained in a Very superficial (repetition of the speech of The teacher, ...)	Results are compared to expected values, and outliers are reported	Level and the conclusions put the results in a more general context in relation to the introduction

### 3.3 computerize the evaluation

For evaluation of a teaching to be useful, it takes a little time to analyze the results. Unfortunately for teaching in large groups, the task can be considerable. Therefore, in the case of teaching to groups of more than 25 students, We have prepared a summary of the results by examining the results of the last years , We have tried to computerize the evaluation method .

Recently, the governance of information system through the use of decision aid has posed a serious challenge for the leadership of universities. In this paper, we present a decision aid system for student evaluation based on a set of different decision aid algorithms, through Naive Bayes, Decision Tree, and OneR. For illustrations we treat the case of a public university. In our work, we choose to work with free software Weka, because it contains different classifiers in order to make decision for grants and funding. Firstly, we choose to work with Naive Bayes classifier, decision trees classifier and OneR classifier. The three classifiers are highly efficient in evaluating a series of parameters to predict the forecast of an overall annual grant that the institution manages according to its needs.

Our Mathematical model can be modeled in terms of Set Theory. The proposed system is represented as follows:

-S= {I, P, O}

where S= represent the proposed system,

-I= {I1, I2, ... , In}

Where I = inputs,

I1	I2	I3	I4	I5	I6
Last general note	Theoretical part note	Practical note	Nb absence	Nb inscription in modul	SEX

-P = {A, B, C} Where P=Processes

A= know-how = { A<sub>1</sub>, A<sub>2</sub>, A<sub>3</sub>, A<sub>4</sub> }

B= experimental know-how = { B<sub>1</sub>, B<sub>2</sub>, B<sub>3</sub> }

C= know-how editorials = { C<sub>1</sub>, C<sub>2</sub>, C<sub>3</sub>, C<sub>4</sub>, C<sub>5</sub>, C<sub>6</sub>, C<sub>7</sub> }

They Are the criteria we have described in the table above.

and They are the criteria that our system must evaluate From the input parameter From the input parameter .

O= { O1, O2, O3, O4 }

Where O= output, It is the result of decision.

O1= Level unacceptable.

O2= Level insufficient.

O3= Level correct.

O4= Level excellent .

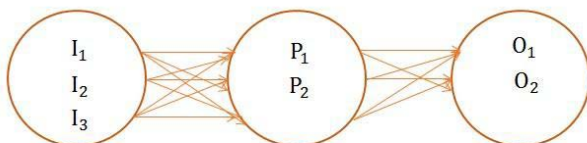


Figure 10 Venn diagram of Proposed System

The probabilistic model for a classifier is the conditional model:

$$P(O_i | I_1, I_2, \dots, I_n)$$

Where  $O_i$  is a dependent class variable whose instances or classes are few in number, conditioned by several variables  $I_1, I_2, \dots, I_n$  characteristics . Using the Bayes theorem, we write

$$P(O_i | I_1, I_2, \dots, I_n) = \frac{P(O_i)P(I_1, I_2, \dots, I_n | O_i)}{P(I_1, I_2, \dots, I_n)}$$

In practice, only the numerator interests us, since the denominator does not depend on  $O_i$  and the values of the characteristics  $I_i$  are given. The denominator is therefore constant. The numerator is subject to the probability law with several variables and can be factorized in the following way, using several times the definition of the conditional probability:

$$\begin{aligned} P(O_i) * P(I_1, I_2, I_n | O_i) &= \\ &= P(O_i)P(I_1 | O_i)P(I_2, \dots, I_n | O_i, I_1) \\ &= P(O_i)P(I_1 | O_i)P(I_2 | O_i, I_1)P(I_3, \dots, I_n | O_i, I_1, I_2) \\ &= P(O_i)P(I_1 | O_i)P(I_2 | O_i, I_1)P(I_3 | O_i, I_1, I_2)P(I_4, I_n | O_i, I_1, I_2, I_3) \\ &\vdots \\ &= P(O_i)P(I_1 | O_i) \dots P(I_n | O_i, I_1, I_2, I_3, \dots, I_{n-1}) \end{aligned}$$

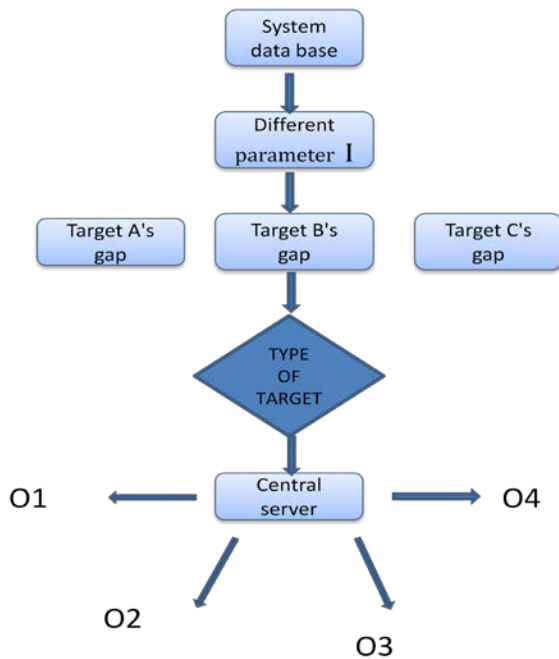
This is where we apply the naive hypothesis: if each  $I_i$  is independent of the other characteristics  $I_j \neq i$ , conditionally to  $O_i$  So

$$P(I_i | O_i, I_j) = P(I_i | O_i)$$

For all  $j \neq i$ , therefore the conditional probability can be written, hence the conditional probability can be written

$$\begin{aligned} P(I_1, I_2, I_n | O_i) &= \prod_{i=1}^n P(I_i | O_i) \\ P(O_i | I_1, I_2, \dots, I_n) &= \frac{1}{Z} P(O_i) \prod_{i=1}^n P(I_i | O_i) \end{aligned}$$

Where Z (called "evidence") is a scaling factor that depends solely on  $I_i$ , namely a constant insofar as the values of the characteristic variables are known.



Concerning the input parameters  $I_1, I_4, I_5, I_6$  are extracted by the information system of the university and  $I_2, I_3$  Are the notes of each practical work . Then the system uses these parameters to calculate the probability by the developer methods above for the 4 levels  $o1, o2, o3, o4$  for each Criteria Then compares it Then the Criteria takes the level that has the high probability . The system repeats this method for all the criteria and for all the students.

## Conclusion

This project was a real opportunity to present a management system of Remote Laboratory in Moroccan public university, case of Cadi Ayyad University in Marrakech , using the tools of artificial intelligence and also the data of scientific research imported from the Presidency of the university. We conclude that system minimizes efforts for the management laboratory and Decision Making System for Remote Laboratory using Data Mining Algorithm for evaluation the student. In the near future, we will propose a new method which will propose another new improvement of scientific research.

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# Marketing and Knowledge Management

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**Mots clés— Knowledge Management, MIS**

## I. INTRODUCTION

The term "Knowledge Management" (KM) really emerged in the mid-nineties, even though the premises of this discipline were already in place with document management during the previous decade. Many actors agree today that the expression is very often used wrongly because it covers important diversities, many of which come from the Electronic Document Management [EDM] and the watch Around Economic Intelligence. What definition can be given?

Globally, Knowledge Management is the set of methods and techniques used to perceive, identify, analyze, organize, memorize and share knowledge among members of one or more organizations, and In particular the knowledge created by the company itself. According to Pierre Mariot, a knowledge engineer at Ardans, an information systems consultant, "Knowledge Management has to improve the quality / price ratio of a company in order to obtain a competitive advantage in a market where economic performance 'Relies on very strong know-how'

For Jean-ves Prax, founder and president of Polia Consulting, two approaches to KM are possible. "One turns to the accumulation of explicit knowledge: it consists in capitalizing on good practices or in obtaining a consensus so that the latter becomes a norm or a standard." It is then a matter of capitalizing on the curative actions of To prevent them from recurring. Transmitting business knowledge becomes necessary. "The second approach," continues Jean-Yves Prax, is entitled "Human networks of knowledge". The biggest part of the knowledge is tacit, inscribed in the brain. In fact, an individual can not transmit knowledge, but only transfer information to another individual, who will have to do a great job of appropriation to put into practice what he has just learned. An example is that of athletes who need a lot of time and practice to progress. "

It is in this perspective that we pose the following question: how and why organize and manage knowledge?

In order to define the concept of knowledge management and to answer our problem, we will deal in Part I with the KNowledge Management and in Part 2 the Marketing Information System put the action on the concept Information and its role in the taking Of decisions.

## I. Knowledge Management (KM).

### 1. The 5 approaches to Knowledge Management

Knowledge management is:

An approach which consists in translating and implementing unstructured information into technological solutions based in particular on the intranet, the extranet and the Internet.

Advice in organization for 3 reasons:

-Knowledge Management requires a suitable organization to conserve and make the knowledge live.

- Knowledge Management is an organizational consultancy because one of its objectives is to free up the brakes associated with the sharing of knowledge and know-how within organizations.

-Knowledge Management is a new method of organization because it helps companies to reach a new threshold in terms of productivity and quality.

A new approach to organizations that is characterized by 2 important aspects:

-The mode of network work that allows a transverse dissemination of information.

-The sharing of information and not their retention with the new tools.



A new leverage of organizations: the objectives differ according to the type of organization but Knowledge Management concerns all organizations, public or private.

A new use of new technologies: New technologies are the triggers of Knowledge Management. These technologies are those based on the Internet, extranet, intranet, technologies based on GED (Electronic Document Management) and technologies such as datawarehouse and datamining. Knowledge Management thus makes it possible to see new technologies as new strategic weapons for the development of organizations and not as cost items.

It can therefore be said that Knowledge Management is the conscious, coordinated and operational management of all the information, knowledge and know-how of the members of an organization serving this organization.

## 2. The basics of Knowledge Management.

Having proposed a definition of Knowledge Management, the presentation of the two main bases namely knowledge and the specific approach is necessary.

### 2-1-Which informations ?

Definition of petit robert: information is "information that is brought to the attention of a person, an audience".

There are two types of information:

Internal information that characterizes organization-specific information, and external information that corresponds to the market, outside the organization.

Structured information that is related to digital data and unstructured information that corresponds to the knowledge and know-how of the organization.

Knowledge Management corresponds to the manipulation of internal as well as external but unstructured data. However, it is not impossible to use Knowledge Management to access the structured data of the company from which the introduction of datawarehouse technology.

### 2-2-What knowledge and know-how?

Knowledge is new information obtained through an intelligent process. At this level, the author carries out a more detailed analysis of knowledge from the point of view of tacit and explicit knowledge.

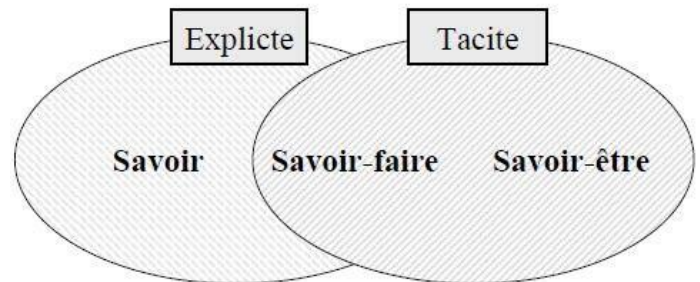
- The tacit knowledge corresponds to those which are intrinsic to each of us and which have not been explained (decision mode on changes in stock values).

-The explicit knowledge corresponds to tacit knowledge that has been explicated (book of portfolio management).

All knowledge is first explicit, then it becomes tacit to become explicit again and again tacit.

Know-how is a set of knowledge necessary to carry out a specific task.

It should be noted that there are constantly going back and forth between tacit and explicit modes. This virtuous circle thus appears:



### 2-3-What technological skills?

The technology makes it possible to make use of knowledge management put in place.

In terms of information systems, it is necessary to have skills in:

architecture of systems;

-data base ;

- electronic document management systems;

- Hypertext document management techniques;

-search engine ;

- Push management of documents.

These skills must be complemented by those based on Internet, Intranet and Extranet technologies.

It should be noted that the age pyramid is reversed, the most competent are the youngest.

## 3. The 6 contributions of Knowledge Management:

The spread of excellence within the organization: this contribution

Best practices "because the sharing of" best practices "leads to comparison and therefore to the upward attraction in terms of know-how.

It is therefore necessary to put in place a "knowledge repository" that allows to capitalize these best practices ".



The ability to make better decisions: at a time of over-information in terms of unstructured data and the lack of tools to analyze these data finely, Knowledge Management by its ability to disseminate information and knowledge is in direct contact with an observed phenomenon makes it possible to restore a correct "signal-to-noise ratio" for a relevant analysis of these data.

Reduction of decision cycles: Decision cycles are reduced by the instantaneous availability of "best practices" and knowledge through sharing tools.

The reduction of subjectivity: the availability of structured information derived from classical computing resources and unstructured information derived from knowledge repositories via the diffusion tools not only allows subjectivity but also "plot" all the reasons of a decision.

The development of innovation capacity: having the knowledge of an organization at its disposal through the knowledge repository and being in contact with the best experts through a culture of sharing leads inevitably, if the system of Knowledge management is part of the integral life of the company to a new capacity for innovation.

The development of learning capacity: indirect consequence of the establishment of a knowledge repository, the training of newcomers in an organization is facilitated and accelerated. The sharing of on-line training courses by means of a knowledge repository and the possibility of accessing them at all times is a factor of security both in the short term (capacity to integrate any new concept) but also in the longer term (capacity to evolve by self-training).

#### **4. Objectives to be achieved with Knowledge Management**

The contributions of Knowledge Management will be translated into 5 objectives for the organizations:

Being global and local in homogeneity: this expectation of localization and globalization makes it possible to introduce Knowledge Management to structure the local qualitative elements in order to obtain a global vision.

In this regard, the sharing of best practices from local entities for global dissemination is one of the first challenges when setting up a Knowledge Management program.

It is therefore necessary to have a dual flow, namely the capture of these best practices and their dissemination.

These two flows are complemented by a rewinding of the organization so that the system is self-sustaining in best practices and thus reaches a new level of global expertise.

Being fast: all organizations today want to be fast on the market especially around the following processes:

- Reduced design time;
- reduction of manufacturing time;
- reduction of maintenance time;
- reduction of the period of adaptation of the organization to its market.

All these reductions have often been seen in terms of pure supply chain processes or the transmission of structured data to all the players in the organization (ERP, CRM, etc.).

#### **4-1-Do not reinvent the wheel by using the knowledge repository:**

Knowledge Management makes it possible not to reinvent the wheel with every new design, every launch of products and services. However, 2 brakes appear that are lack of sharing tools and lack of sharing culture.

#### **4-2-The sharing tools are:**

O Infrastructure and dissemination tools that form the foundation of Knowledge Management (the company's messaging system, Internet, Intranet).

O The capitalization tools that allow to receive the knowledge and to structure it (the datawarehouse systems ...)

O Working tools that make it possible to exploit them (analysis systems based on known cases ...)

These tools are essential to the deployment of an effective knowledge management program. They must be easy to access (same messaging) and simple to use.

#### **4-3-Creating a Sharing Culture:**

Creating a culture of sharing is more a psychological approach than a technological one. As such, it is essential to ask 4 essential questions:

- O Why Sharing?
- O What interest to share?
- O What to share?
- O How to share?

#### **4-4-Changing management mode:**

While organizations reduce the number of intermediate levels of leadership, the

Knowledge Management is a valuable aid for:

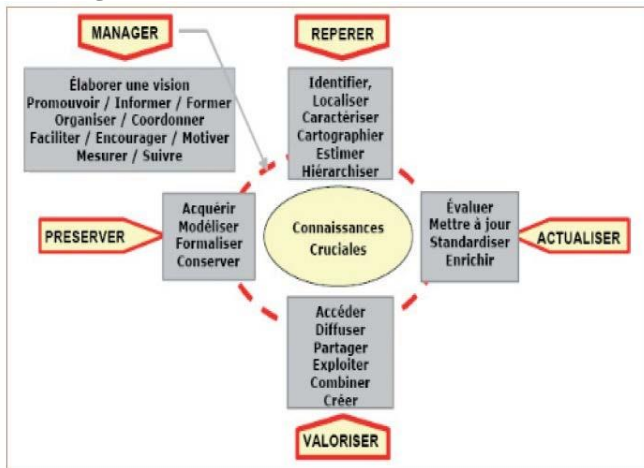
- maintain a constant level of expertise whatever the number of levels
- Move from a hierarchical culture to a networked culture.

- serve as a tool for team empowerment.

Thus, in the organization, there are only two levels, namely the general management and the knowledge workers (all the actors manipulating the company's information and knowledge for use by the company).

## 5. The issue of knowledge capitalization:

**Figure 1: The problem of capitalizing knowledge.**



As represented in the figure above, the problem of capitalizing knowledge is divided into five facets as defined by Grundstein (2002):

- The first aspect of the problematic concerns the problem related to the identification of crucial knowledge, that is to say the knowledge and know-how which are necessary for the decision-making process: they must be identified, localized, characterized Make cartographies, estimate their economic value and prioritize them.

- The second facet of the problem concerns the problems related to the preservation of knowledge: when knowledge is explicable, it is necessary to acquire knowledge, to model it, to formalize it and to preserve it. Where knowledge is not explicit, the transfer of master-apprentice knowledge and communication networks between people must be encouraged.

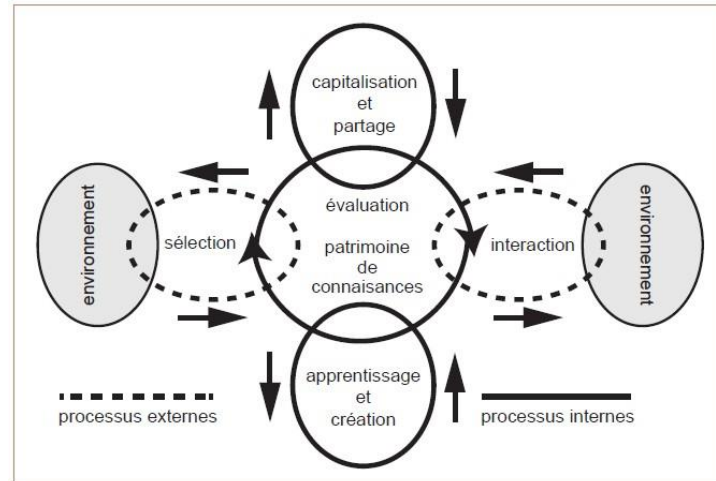
-The third aspect of the problem concerns the problems linked to the valuation of knowledge: they must be put at the service of development and expansion of the company, that is to make them accessible according to certain rules of confidentiality And disseminate, share, exploit, combine and create new knowledge.

-The fourth facet of the problematic concerns the problems related to the updating of knowledge: they must be evaluated, standardized, updated and enhanced as experience returns, the creation of new knowledge And the contribution of external knowledge.

- The fifth facet of the problem concerns the interactions between the various problems mentioned above, which is the position of the management of activities and processes intended to amplify the use and creation of knowledge in the company.

## 6. Knowledge management processes:

**Figure 2: Knowledge management processes.**



Knowledge management is intended to address the issue of knowledge capitalization. It is a managerial function, which consists in orienting, organizing, ordering and controlling the activities and processes intended to amplify the use and creation of knowledge within Of the organization (Grundstein, 2002). Its purpose: to combine knowledge and know-how in the process and products, to create value. (Prax 2003).

These key processes are organized according to a so-called daisy model. They can be described in four large classes, which correspond to the petals of the daisy and a class that corresponds to the heart of this model.

- The process of capitalization and sharing of knowledge: it is the process that ensures the sharing of knowledge resources in the company;

- The process of interaction with the environment: the process that transforms information flows from the environment into knowledge capital, useful for the business and complex. It is, among other things, the process of intelligence or economic or strategic intelligence.

- The process of learning and creation of knowledge, an endogenous and collective process that underpins the evolution of knowledge. It includes the issues of learning organization and creativity.

- The process of selection by the environment, the evolutionary process par excellence, of selection of the knowledge created, by market criteria, of acceptability both economic and sociotechnique. It includes marketing, customer relations issues ... the problem of KM is to integrate this type of problem in a strong relationship with knowledge of the trades, for example.

- To all these processes one can add a fifth, which is entirely internal to the heritage of knowledge, since it is the process of its evaluation: qualitative, quantitative and financial.

## II. Marketing Information Systems (SIM).

The marketing manager constantly needs data and information to make decisions, analyze situations, solve problems, exploit favorable opportunities. The data are facts, words, numbers, images and raw information about an aspect of reality. They become information once they have been captured, processed, analyzed, contextualized and interrelated, interpreted and presented in an easy-to-read format. Data may be informal or formal.

### 1. Definition:

A marketing information system is a collection of people, equipment (tools) and continuous interaction procedures that collect, sort, analyze, evaluate and distribute relevant, up-to-date and accurate information to marketing decision-makers . The components of a MIS are as follows:

- The data;
- Methods of data collection;
- Analysis of data;

## 2. The role of a MIS:

The better the company knows, understands and anticipates current and potential customers, competitors, markets and macroenvironment, the better the marketing decisions. Information must therefore be subject to rigorous management. This is the purpose of a marketing information system, which addresses marketing information needs.

The role of the marketing information system (S.I.M) is to provide the necessary data and information, the S.I.M helps managers to:

- To better understand and understand the needs, expectations and desires of current and potential clients and their behavior and characteristics in order to better respond to them;
- Innovate, differentiate the company's offer, better position its brand (s), segment more effectively, target the right clientele and segments;
- Conceive new services or products, improve services or products, price, distribution and communication.
- Better forecast the evolution of markets, customers, competitors and the macroenvironment to adapt better. Base marketing planning on solid information that complements experience and judgment. Evaluate the performance and profitability of the various marketing actions implemented and reorient them.

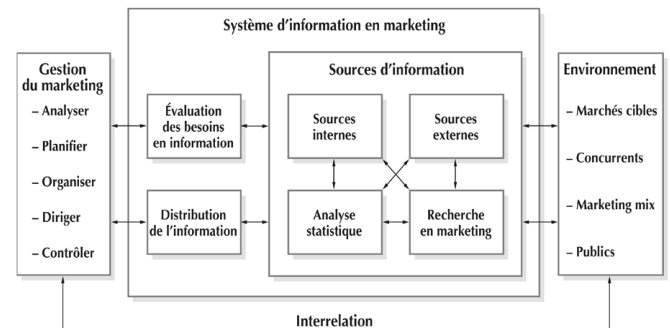
**2-1-A S.I.M thus presents different roles addressed as follows:**

- Ensure the collection, processing, analysis, storage and systematic dissemination of internal company data;
- Enable specific studies to meet specific needs;
- Enable the use of statistical tools, decision support models and information technology.
- S.I.M leads to the constitution of a "nerve center" of information relevant to the objectives;
- An information system must have an interface with the main functions of the company through: setting objectives, drawing up plans and managing the company.
- A S.I.M allows the computer tool, but a computer system is not an information system.
- A SI may be more or less complex and sophisticated depending on whether it is oriented towards a system of decision more or less vast.

We note that the SIM operates on both strategic and operational aspects, so it proves to be a sine qua non for the marketing decision-maker.

### 3. The Information Process in Marketing:

**Figure 3: SIM process.**



### 3-1-Assessing Information Needs:

The head of the information system must first identify the information that managers would like to receive in terms of their actual needs and what they can offer, taking into account the cost-value of information.

The needs assessment should begin with a meeting with decision-makers to clarify the nature of the information required.

### 3-2-Sources of marketing information.

#### - Internal sources

The majority of marketing managers regularly use internal files that contain all the relevant information available within the company.

#### - External sources

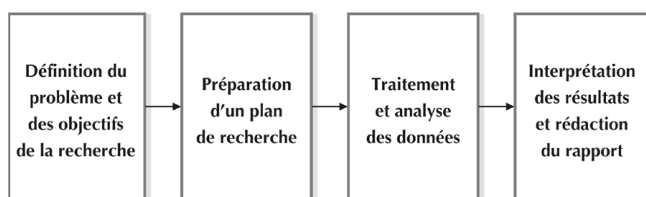
External sources refer to all relevant information available outside the company. External sources provide information about what is happening in the company's macro-environment.

### 3-3-Marketing research:

Marketing research is: The collection and systematic analysis of data related to a marketing problem, as part of a structured project, leading to the preparation of a research report, which will provide useful information for decision-making.

### 3-4-The marketing research process.

**Figure 4: The process of searching for information in marketing.**



#### First stage :

The definition of the problem and the objectives of the research

#### The researcher must:

- Define the problem
- turn the marketing problem into a marketing research problem in order to allow the researcher to develop the research objectives;
- ensure that the problem is well understood;
- choose the appropriate type of research: exploratory research, descriptive research or causal research.

second step: The preparation of a research plan:

The research plan makes it possible to clarify the nature of the particular information needs and to prepare a scenario to gather the data effectively.

#### The nature of the data:

- Secondary data are those that already exist and have been collected for purposes other than those of interest to the researcher.

- Primary data is original data that is collected precisely according to the problem under study.

#### Methods of data collection:

- Observation is a method of collecting primary data by carefully examining the behavior of individuals in different situations.
- The survey is a method of data collection based on the use of a questionnaire, that is, an ordered set of questions that will be asked in the same way to all respondents.
- Experimentation is a structured method of collecting data to measure a causal relationship.
- Qualitative research aims to determine, through open-ended questions, consumers' deep motivations for purchasing or non-purchasing situations.
- Qualitative research is usually associated with the focus group.

#### Sampling:

- Researchers usually draw their conclusions and generalize the results of their study from a sample.
- A sample is a segment of the population selected according to characteristics that represent the whole group being studied.
- The plan should include: composition, size and sampling method.

#### Step Three: Data Processing and Analysis:

The third step consists of classifying the data, constructing frequency distributions, calculating averages and dispersion measurements, and crossing variables using multi-varied methods of analysis.

#### Fourth step: Interpreting the results and writing the report:

The objective of the fourth and final step is to draw conclusions from the report.

- The research report should contain a title page, a table of contents, a research summary, an introduction, the methodology used, the results, the study boundaries, the conclusion and the recommendations

#### Interpretation of the results:

Information has no value unless managers use it to make decisions. Information must be distributed to the right person at the right time. New information technologies make it possible to decentralize the information system.

**Conclusion:**

By focusing on the knowledge and know-how of companies, by establishing the conditions for information exchange and knowledge sharing, Knowledge Management contributes to building the skills needed to face the challenges Globalization, the liberation of the economy and the transformation of the enterprise into an extended enterprise. (Grunstein 2002).

# Financial Markets Micro-Structure Analysis Using Artificial Neural Network

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**Abstract.** This present document presents a model of Neuronal Networks Artificial RNA for the prognosis of the rate of nominal change in Colombia, including flow orders and the differential of the interest rates like variables of entrance to the model. Additionally methodological conclusions from the traditional treatment of the series of time were extracted.

**Keywords:** Artificial Prognosis, Not-Linear model, Neuronal Networks, Micro-structure of the financial markets.

## 1 Introduction

The analysis for modeling and forecasting the exchange rate of one currency against other has had several important stages. In this sense, the first models developed have, as its starting point, the balance of flows between countries, the raised of the rate could be determined by supply and demand functions for foreign exchange each of the countries, including models are part of this line of development are those of Meade (1951) and Mundell - Fleming (1963) mentioned by Manrique (2001).

Subsequently with the dynamic acquired by the financial markets and the collapse of the Bretton Woods, several models appeared in which the international trade, international flows of trade, the price of exports, domestic goods and international portfolio of assets, were taken as variables relevant to the determination of the exchange rate. This approach is called the balance of stocks or asset market, which is divided into monetary models (flexible price, sticky prices) and balance models, which attempt to explain the fluctuations in the exchange rate using a process similar to that Prices are subject to other financial assets. Currently in Colombia the literature dealing with microeconomic models and the exchange rate is not very wide, in contrast to the literature on real rates, Cárdenas (1997) mentioned the work of Wiesner (1978), Urrutia (1981), Lopez (1987) and Steiner (1987) on the process of crawling peg in Colombia's crawling peg system. The work of Cardenas (1997), analyzes the determinants of nominal exchange rate in the period 1985-1986, under the two regimes, crawling peg and band's[65] system, through: a simple monetary model, the fixed-price monetary model and portfolio balance model, the conclusion about the determinants suggests that the monetary model



with flexible prices is set in a good way the behavior of the Colombian exchange rate. According to the exchange rate model responds to changes in the money supply and interest rates. In this context, based on the microstructure and RNA, and taking into account the criticism entirely macro models of Evans and Lyons (1999) and expressed by Barkoulas, Baum, Caglayan and Chakraborty (2001) on the processes and martingale type long-term memory, this paper examines the behavior of a forecasting model of the TCN of the peso against the U.S. introduce a variable dollar of market microstructure (order flow) in a system of daily observations with macroeconomic variables (interest rates), under a non-linear modeling of RNA, daily time-series of one (1) year seeking to measure the predictive power and behavior modeling using the root mean square error (RMSE) and absolute average percentage error (MAPE) [67].

For this item is divided into four sections: The first section covered the introduction. Section 2 reviews the related to the RNA and the microstructure of financial markets. Section 3 describes the data, analyzes and presents the results. Section 4 is for conclusions and recommendations.

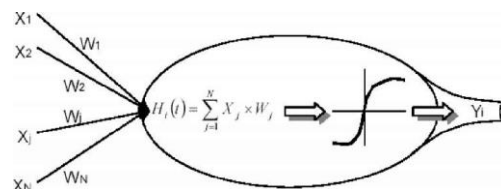
## 2 Artificial Neural Networks -ANN- And Financial Markets Micro-Structure

### 2.1 Artificial Neural Networks

An Artificial Neural Network (ANN) is an attempt to perform a computer simulation of the behavior of the human brain through small-scale replica of the patterns that it plays in shaping results from the events received. More formally the ANN is nonlinear statistical models used mainly for classification and prediction of data and variables, inspired by biological nervous systems, which try to simulate the human learning process in the belief that having been created by the selection process natural mechanism to be efficient. (Montenegro, 2001).

The structure of an artificial neuron is an emulation of a biological neuron so that it could do the following parallel with the biological neuron:

- The inputs  $X_i$  represent discrete pulses from other neurons and are absorbed by the dendrites (UTP, 2000).
- The weights  $W_i$  represent the intensity of the synapse connecting two neurons. 0, is the threshold value the neuron must overcome, to produce the biological process within the cell when activated, analogy can be seen in Figure 1.



**Fig. 1.** ANN structure.

Where

- $H(t)$ : Potential synaptic neuron  $i$  at time  $t$ .
- $X_j$ : input data from the information source  $j$ .
- $W_j$ : The synaptic weight associated with the input  $X_j$

In this project the Multilayer Perceptron-MLP-learning ANN architecture was used, with the back propagation technique, in which the topology can have an input layer with  $n$  neurons, for this case study, we used a two neurons layers for the first model (the order-flow-ODF and the difference between the DTF and the Libor-DDL-with the following setbacks:  $ODF_{t-1}$ ,  $ODF_{t-2}$ ,  $ODF_{t-9}$ ,  $ODF_{t-13}$ ,  $ODF_{t-36}$ ,  $DDL_n$ ,  $DDL_{t-5}$ ,  $DDL_{t-6}$ ,  $DDL_{t-8}$ ,  $DDL_{t-9}$ ,  $DDL_{t-17}$ ), and five neurons ( $TRM_{t-1}$ ,  $TRM_{t-2}$ ,  $TRM_{t-3}$ ;  $TRM_{t-4}$  and  $TRM_{t-6}$ ) for the second model, at least one hidden layer (with four and eight neurons, for first and second ANN models respectively) also with  $n$  neurons and an output layer with  $m$  neurons, for these models are only used one output neuron-TRM-in RNA synthesis considered has an architecture with an input layer, a hidden layer and output layer, so it can be expressed as RNA (I, H, O).

The functional architecture of the network is:

$$Y_t = g\left(\sum_{h=1}^H c_h g\left(\sum_{i=1}^I x_{it} w_{ih} + \theta_h\right) + d\right) \quad (1)$$

Where  $c_h$  are the weights that connect the neuron  $h$  in the hidden layer neuron to the output layer and  $d$  the threshold of the neuron in the output layer, weights ( $w$ ,  $c$ ) and thresholds ( $\theta$ ,  $d$ ) are adjusted during the training of the network. The formula for adjusting the weights of the network depends on the position of the weights connecting layers, particularly if the weights are in the hidden layer or output layer.

The base model of the artificial neural network worked is:

$$Y_t = g\left(\sum_{h=1}^H c_h g\left(\sum_{i=1}^I x_{it} w_{ih} + \theta_h\right) + d\right) \quad (2)$$

## 2.2 Financial Market Microstructure and Exchange Rate

The microstructure of financial markets is the study of the processes and outcomes that occur in exchanging assets under explicit trading rules (Marín and Rubio, 2001). This microstructure focuses on the interaction between the mechanisms of the negotiation process and its results in terms of prices and quantities traded. It is recognized that specific rules under which the negotiation process occurs directly affect the outcome of such processes, i.e. the behavior of agents in the game of supply and demand determine the price and transaction volumes.

The support of the microstructures for the TCN study is summarized in order flow and spread, the first concept concerns the volume of transactions and the same meaning, i.e. the volume to settle and if bought or sold, which is treated as excess demand, any time you perform an operation does not necessarily imply a zero-sum balance, the latter in turn is conditional on the price as it enters the information asymmetries in financial markets will. It is also important to mention that the approach of modeling TCN microstructures at the following address:

$$P_t = f(X, I, Z) + g(i) + \varepsilon_t \quad (3)$$

### 3 Empirical Analysis

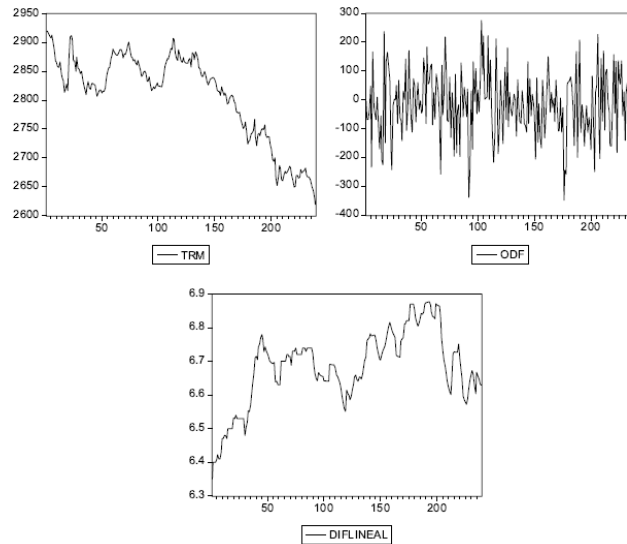
#### 3.1 Available Data

The availability of detailed databases on the intraday and daily activity in financial markets has opened the possibility to econometric research on the functioning of these markets, therefore the flow volume order ODF, TRM and the differential rate DDL Libor interest from April 16, 2003 to April 16, 2004. The set of training artificial neural network is defined according to a measure of error between the data generated and the training set (actual data), this value usually varies, whereas small values.

In the training process is likely that if the RNA undergoes a process of overtraining, which causes the RNA from a loop or has a sub training process, then both processes, the RNA lose their adjustment capacity, prognosis and generalization (Buitrago and Alcalá, 1998). In regard to the variable interest rate differential (DDL) was taken, the libor ninety 90 days macroeconomic component of the U.S. economy, the source of the data is the system REUTERS and Colombia is ninety took the DTF 90 This data comes from the website of CORFINSURA. The foreign exchange market in the country is relatively new 1991. Finally, taking into account the definition given before order flow, this is calculated as the difference between all the purchase transactions initiated (T) and all transactions initiated on sale (P) on the same day, so if  $OD > 0$  is more intent to purchase and therefore upward pressure on exchange rate - which is not necessarily explained by macro variables of the market - and when  $OD < 0$  the reverse process occurs.

#### 3.2 Results Analysis

Figure 2 shows the variables in levels. Hopefully, a high volatility characteristic of financial time series. Using the ADF and KPSS tests determined the stationary of the series.



**Fig. 2.** Level Series

**Table 1.** Unit root tests

	ADF	Critic Value 1%	KPSS	Critic Value 1%	Decision
TRM (1)	-1.829393	-2.574714	1.550905	0.739	KD
ODF(2)	-15.03944	-3.457747	0.173559	0.739	I(0)
DIFERENCIAL	-2.66635	-3.457865	0.851827	0.739	KD

- (1)  $Q(36) = 44.25(0.163)$
- (2)  $Q(36) = 43.19(0.191)$
- (3)  $Q(36) = 22.937(0.955)$

The results show that at a significance level of 1%, and TRM series of interest rate differential is not stationary. ODF Series is stationary. Additionally we present the Ljung-Box test for the residue of the auxiliary regression in each case and in brackets the p-value associated with the test. In the case of parametric models should be considered the property of stationary. Below are the results of Johansen co integration test and univariate models for forecasting TRM worked with the first difference in natural logarithm (which is the return compounded continuously).

### 3.3 Artificial Neural Network Models - ARN

As explained previously, RNA did not have a specific parametric model, which was done, was to vary the input vector, independent variables, order flow, differential interest rate (DTF-Libor) at time  $t$  and lag in  $t$ .

For the first model to implement the 8 - test, we obtained the following most significant setbacks for the model: ( $ODF_{t-1}$ ,  $ODF_{t-2}$ ,  $ODF_{t-9}$ ,  $ODF_{t-3}$ ,  $ODF_{t-36}$ ,  $DDL_{t-1}$ ,  $DDL_{t-5}$ ,  $DDL_{t-6}$ ,  $DDL_{t-8}$ ,  $DDL_{t-9}$ ,  $DDL_{t-17}$ )

For the second model considers the TRM  $t = 1$ , like an AR (p), in this case, gives significance to the lags  $TRM_{t-1}$ ;  $TRM_{t-2}$ ;  $TRM_{t-3}$ ;  $TRM_{t-14}$ ;  $TRM_{t-16}$

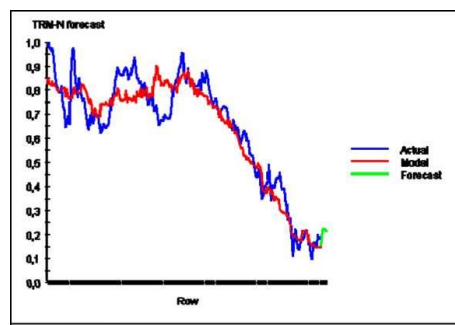


Fig. 3. ANN First Model Forecast  $h = 10$



Fig. 4. ANN Second Model Forecast  $h = 10$

Finally, we see that as time goes by (days) in second model of RNA loses predictability, however, their test statistics (MAPE, RMSE and approximately  $R^2$ ) behave appropriate and acceptable values, which makes RNA techniques to forecast the TRM a viable tool in the manner presented.

Table 2. Statistical Models AR (p) and RNA - One year

	Forecast 10 datos		
	RMSE	MAPE	$R^2$
RNA First model	0.0775	1.054.870	93.54

RNA Second model	0,036	5.671	973.662
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### 3.4 Time Series Model Multivariate Analysis

The following table presents the Johansen co-integration test. In all cases occur in the trace test. Results were obtained using 2 lags. In all cases there is one co integrating vector. However, as discussed above, one of the variables is 1 (0), which may affect this conclusion, in particular, this variable may be the one that forms the co integrating vector. Using the Schwartz criterion, the model was first considered appropriate. In estimating the VEC was obtained the following results:

**Table 3.** Johansen co-integration test

Vectors	First model	Critic Value 1%	Second model	Critic Value 1%	Third model	Critic Value 1%	Fourth model	Critic Value 1%
None	99.38	29.75	104.03	41.07	100.82	35.65	106.29	48.45
At least one	7.90(*)	16.31	12.36(*)	24.6	9.59(*)	20.04	14.94(*)	30.45
At least two	2.42	6.51	2.54	12.97	0.00	6.65	3.52	16.26

**Table 4.** Alpha Matrix and Co Integration Vector

	TRM	ODF	DIFERENTIAL
Coefficient	1	32.33773	446.6811
Statistical t		[10.4216]	[16.9962]
<b>Alpha Matrix</b>			
Coefficient	-0.00268	0.024488	-4.18E-07
Statistical t	[-9.72161]	[ 5.37546]	[-0.61896]

**Table 5.** Granger causality and Portmanteau Test

	Exelude	Test	P-value
<b>Caused: TRM</b>	D(ODF)	96.86	0.00
	D(DIFLINEAL)	2.43	0.30
<b>Caused: ODF</b>	D(TRM)	2.32	0.31
	D(DIFLINEAL)	1.04	0.59
<b>Caused: DIFERENTIAL</b>	D(TRM)	1.120	0.571
	D(ODF)	1.163	0.559
	Portamen-tau(40)	699.439	0.6377

### 3.5 Time Series Model Univariate Analysis

It was considered an alternative model of the first difference in the rate of change. A GARCH (1.1).

**Table 6.** Garch(1,1) Model

	<b>Coefficient</b>	<b>z-</b>	<b>P-</b>
c	-0.05	-2.05	0.04
D21	1.52	9.95	0
D25	-1.48	-3.9.4	0
D203	0.87	6.13	0
AR(1)	-0.34	-1.9.3	0.22
MA(1)	0.55	2.31	0.02
<b>Variance</b>			
C	0.03	1.68	0.09
ARC(1)	0.27	2.97	0
GARCH(1,1)	0.45	2.19	0.02
	<b>Test</b>	<b>P-</b>	
Ljung-Box	34.74	0.17	
Jarque-Bera	0.31	0.85	
Arch(4) Model	1.62	0.80	

**Table 7.** Forecast Evaluation With Models

	<b>Garch(1,1)</b>	<b>Vec</b>	<b>First model ANN</b>	<b>Second model ANN</b>
Rmse	22.90	20.66	31.98	17.24
Mape	17.94	15.72	26.93	12.78

The forecast evaluation results show that the neural network second model has a better prognosis than the parametric models introduced.

## 4 Conclusions and Recommendations

This work moves in the direction of the recent work of Evans and Lyons of the micro-structure and exchange rate, making a first approach to the case of Colombia, together with a new non-linear approach to model-ANN-raised in the case of Mass inflation, Lopez and Cherub (2002). This approach allows the analysis of how signals are perceived differently by actors and somehow reflected in the microstructure of the information, being, however, asymmetries of the forex market.

The use of ANN, which is typically non-linear statistical models, which can be expressed as a generic model forecasts allowed approximation of functions acceptably good for a model of TRM according to the RMSE, with the inclusion of the variable microeconomic order to flow.

The explanatory power of macroeconomic variables, as mentioned by Evans and Lyons (1999), behavior exchange rate in the short term, daily-is very significant, since for the developed models behave as non-significant in this sense the financial market with speculative behavior, explained largely by the order flow is a determinant dollar price in the short term, as the daily trading volume far exceeds the volume of bids and actual



demand of the economy, which largely explains the power of financial markets in determining price them.

The structure of the market is in itself is a determinant of prices and the determination of the nominal exchange rate, specifically the order flow as an indicator of the mechanisms of negotiation, agreement and settlement, it affects the price behavior. As a recommendation on methodology, it would be appropriate to initiate the study of research that merging different techniques of bio-inspired computing such as genetic algorithms and fuzzy logic in order to thus obtain predictive and optimization methods more effective and powerful as they try to simulate human behavior in ways different from the traditional linear models and computational.

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## **Selecting integrated CRM/ERP software for a Small and Medium sized Enterprise (SME)**

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### **Abstract:**

This paper is about the process of analysis and election of an open source integrated CRM/ERP software for a medium sized company in UK. First the current and desired business model for the company has been analyzed. Then pros and cons of different choice has been reviewed. Finally based on the different facts and figures a package is selected to be implemented in the company.

### **Introduction**

The purpose of any business is finding and keeping customers. On the other hand in order to produce a product or supply a service, companies need to manage information flow during the product/ service realization. For very small companies with certain number of customers and limited processes, it is easy to manage both of the relationship with customer and information flow in the company, but for bigger companies, a software is needed. A CRM software facilitate management of relationship with customers and an ERP assist companies for data driven decision making. According to Xu & Walton (2005), a CRM Improves customer satisfaction level, attract new customers and keeps the existing customers, provides better strategic information to sales and marketing. Using CRM enable companies to have a 360° view of customer relationship. An ERP integrates the business processes and automate the flow of information, material and resources within all functions of a company (Seo, 2013).

LC is looking to implement integrated ERP and CRM systems, by using an Open Source Software. OSS refers to software that are available in the internet for distribution and modifying for free. Then company will be able to save money of buying a Commercial -Off-The-Shelf

(COTS) and the customize it based on the organization's needs (Ettrich, 2001). Basically because of bounded budget, small and medium enterprises (SMEs) are interested in using OSS. This text is aimed to explain how implementing ERP/CRM will help LC to better manage relationships with customers and utilize enterprise resources in an optimized way.

### **Analysis of Business Process Models**

At first it is needed to analyze the current business processes of Loud and Clear (LC) and propose an improved system. In order to visualize the process for the process stakeholders, tools like BPMN are being used. BPMN (Business Process Modelling Notation) is able to capture the work flow of a system and model the complex processes. A manager together with the stakeholders may simulate the current status of system (As is) that shows the work flow, sequence of activities and distribution of information. Then in the next step, they could improve the business model and propose a future status (To Be) model. (Mendling et al., 2010)

After reviewing the current business model in detail, process analyst may improve the system via different ways. Following are some examples of them: *-Eliminating activities without value added for customer*: Process analyst should ask whether the tasks produce any added value for customer or not. If not, the process should be modified. *-Minimizing hand offs*: Handoffs are the points that information is being passed between two different systems. Hand offs are very vulnerable and risky for disconnection. *-Eliminating information bottleneck*: Bottleneck is obstruction of information in a point because the process of information in that point is slower than what system expects. Regardless of mentioned ways, process analyst may improve the system by *upgrading from a manual to automated process, in some cases*. (Carmignani et al., 2014)

Figure No.1 illustrates the existing business model, by using BPMN notation. Business model of LC is shown in two different pools for customer and company. When company receives an order from a customer, the office worker should check the availability of resources and decide about approving or rejection of the order. Currently, resources are being controlled via spreadsheets. Either the response is approve or reject, a notification should be sent to the client. If the order is approved, then company will allocate resources for performing the job and send invoice to client. Also during the preparation time before the event, and also within the event, client could ask for receiving progress report.

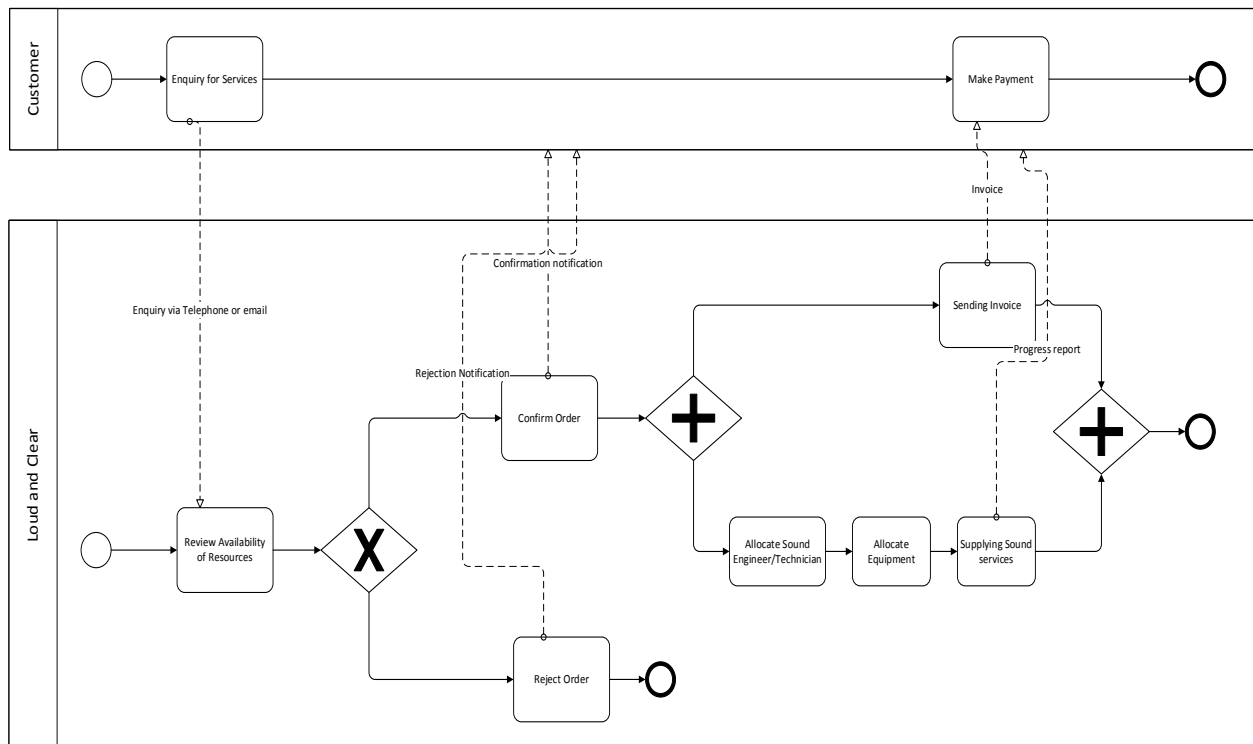


Figure No.1 current business model

At present company does not own a software neither for communication with customers nor for processing the orders. As shown in figure No.1, there are several handoffs in the system. Taking into account the manual systems for communication, there is a high potential for disconnection or missing the information. Company perform too much orders simultaneously, but number of

staff in the office is limited, then there is a high work load for the office workers. This heavy work load have made a bottleneck of information. Office worker's tasks vary from communicating with customers to planning resources and even calculating invoice. Moreover, there is a risk of postponing orders, because office workers have to work with time consuming tools. Therefore the proposed change in the business model is basically about upgrading the information system to implement integrated CRM and ERP instead of using a couple of disconnected applications and software. Figure No.2 illustrate the proposed business model.

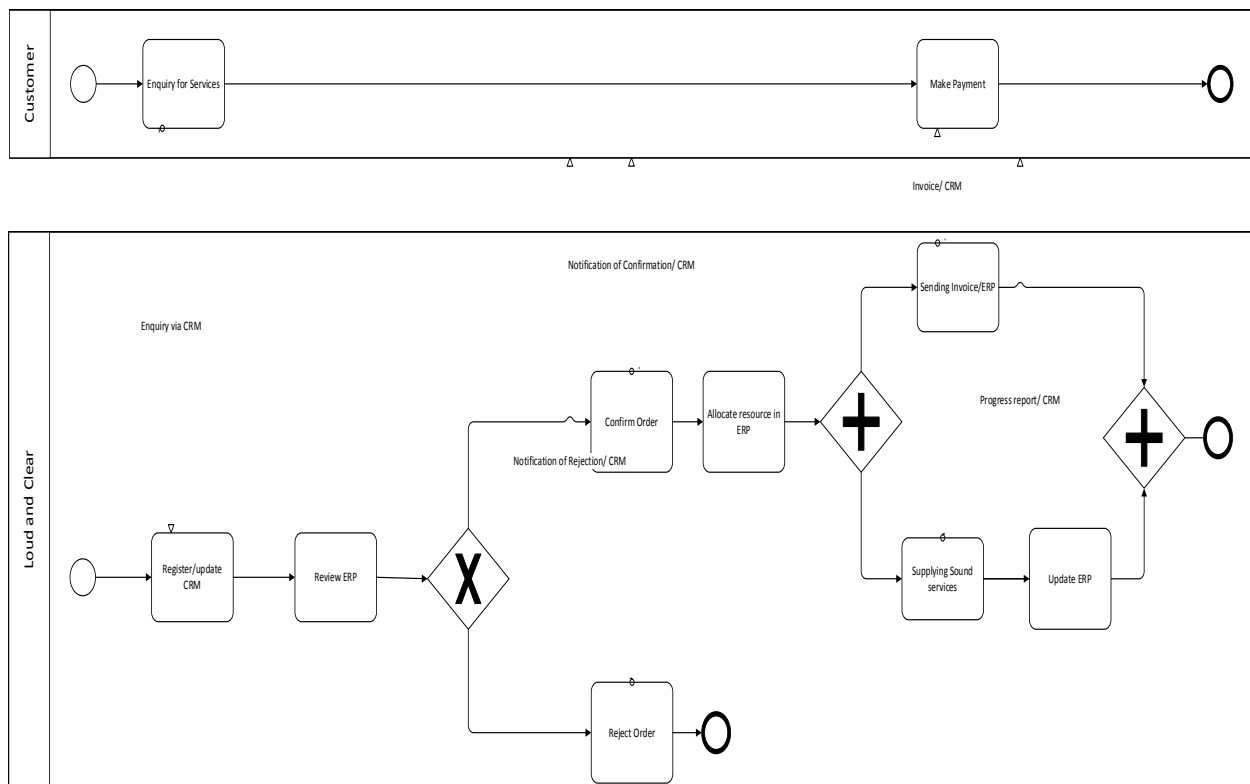


Figure No.2 Proposed business model

Using CRM for managing the relationship with customer will secure the flow of information between customer and the company. It will allow the customer to track the progress of ongoing works in LC. On the other hand utilizing ERP software, will enable the office workers to have control over the whole business from one single platform. The proposed model will improve the

productivity and quality. It will also reduce the cost and human mistakes of using manual system.

### PESTLE Analysis

In the PESTLE framework, positive and negative impacts under six categories of Political, Economic, Social, Technological, Environmental and Legal will be listed. The aim of PESTLE analysis is identifying external factors that influence LC business (Johnson et al. 2008). There could be lots of factors with potential impacts, but only the critical ones has been listed in table No 1.

Political factors	Political stability and transparency
	Government's attitude to worker cooperative groups
	Taxation/Trade regulations
	Terrorism
Economic factors	Market share of company
	Inflation rate
	Interest rate
Social factors	Population growth
	Age mixture
	Multi-cultural population rate
	Tendency to gatherings and partying
	Diversity in the society
Technical factor	Technology for the products, services and communication
	Tendency to wireless equipment
	Role of social networks in the society
	Internet coverage
Environmental factor	Weather condition in different locations
	Tendency of respect to environment
Legal factor	Labor/ employment laws
	HSE rules

Table No.1- PESTLE Analysis

According to PESTLE analysis, UK government provides a stable and transparent environment for business. Due to government's approach for reducing costs, LC has experienced a slight decline in the governmental events last year, but thanks to the stable economic condition number of customers from private sector is growing. Although UK is a secure country, but the risk of act of terrorism has been increased in Europe. Risk of terrorism could reduce number of events in the country. LC needs to track any changes related to taxation and financial regulations and adapt the strategies based on them. Currently company has 20% of the UK market, but number of events in Northwest UK is growing fast and telephone inquiries has been doubled. There is the opportunity of improvement to be the market leader, by developing target market or merger with smaller competitors in Northwest of UK.

Type of services ordered by customers is mainly influenced by their beliefs, attitudes and social conditions, hence there are lots of variety events in UK as a diverse society. Number of events in the universities and high schools has been increased in the last year. LC needs to keep updated about the fast changing sound technologies and utilize emerging equipment. New generation of sound technology are focused on the smaller, digital and wireless equipment. Company need to adapt itself with the fast changing technology and train the employees for new technology. The competitive edge of LC is having expert and experienced staff. Most of personnel are performers themselves and if company keep them up to date about the upcoming sound technology, it will retain the competitive advantage for future. Weather has negative impacts to quality of our services in the outdoor events, especially during cold seasons.



## Open Source Software Comparison Table

There are several open source integrated ERP/CRM packages available in the market like: Adempiere, Compiere, Dolibarr, Epesi, Tryton, Apache, OFBiz. ERP5, Opentaps, Postbooks, EBI Neutrino R1, Keen, Onix, IntarS. The first five packages have been compared in table No.2

System	Features	Scalability *	Database Backend	License	Language Of programming	Operating system	Customer service and support	Security	Presence in the market	Remarks (Price, key traits, etc.)
Adempiere	<ul style="list-style-type: none"> <li>ERP: HR management, Order management, Lot Management, Multiple currencies and multiple organizations,</li> <li>CRM: Sales principle management, Contact and Lead management, Support management</li> <li>Other Features: Supply Chain Management (SCM), Financial Performance Analysis, Distribution management, Integrated Web store, Material Requirements Planning</li> </ul>	Scalable, it scales to 100 concurrent users	My SQL, Oracle, PostgreSQL	GPLv2	Java	Linux, OS X, Unix, Windows	Customer support via blogs and active community forums during business hours	Possibility of defining roles, having control over window access, field access, and record access	First release in September 2006 Last version released in March 2015	Free to download and modify for an unlimited number of users
Compiere Community Edition	<ul style="list-style-type: none"> <li>CRM: Sale force Automation, Webstore, Customer history</li> <li>ERP: Order management, material management, global financial management, purchasing, warehouse management</li> <li>Other features: Performance management</li> </ul>	Scalable, Ability of deploying multiple application servers	Oracle XE, Oracle10g R2, Oracle 11g R2, Oracle 12C, Enterprise DB Postgres	GPL	Java, JavaScript, PL/SQL	Any OS which supports Java, like Linux and Microsoft Windows	Installation guides and getting starting document are available, Support via community support forums	Role based authentication, a user may obtain several roles, possibility restricting view of different users	Registered in June 2001 Last version released in 2010	User friendly, Used in 40 countries, A full package of CRM system Reduced cost of ownership due to using Amazon's Elastic Compute Cloud (EC2)
Dolibarr	<ul style="list-style-type: none"> <li>CRM/Sales: prospects,</li> </ul>	Scalable,	MySQL,	GPLv3	PHP 5.3.x	Cross-	FAQs,	Some reports about	First issue in	The main features

	<ul style="list-style-type: none"> <li>opportunities, orders, mas emailing, subscriptions, import/export</li> <li>Human relationship</li> <li>Finance and Billing</li> <li>Marketing: commercail proposal,</li> <li>Product catalog and Stock management</li> <li>Productivity</li> <li>Invoices</li> </ul>	the software reacts to the traffic changes by allocating more resources	PostgreSQL	, SaaS		platform	Knowledge Base, Online Support, Phone Support	lack of security due to vulnerabilities of multiple cross-site scripting (XSS)	2003 Last version released at Sept 2015	are free of charge, but plugins like project management, digital documentation, pricing tables and telephone management could be purchased via Dolibarr store
Epesi	<ul style="list-style-type: none"> <li>ERP</li> <li>CRM: Shared contacts, calendar, tasks, phone calls, Advanced record history</li> </ul>	not scalable	MySQL, PostgreSQL, AdoDB, others	MIT	PHP 5.x/ Ajax	Cross-platform	Forum, User manual, Framework documentation	Ability to record other user's activities. Cross-site Scripting (XSS) vulnerability has been reported	First release in 2006 Last release at January 2016	All the free modules and free premium modules are included, but commercial modules could be purchased via store
Tryton	<ul style="list-style-type: none"> <li>Accounting</li> <li>Invoicing</li> <li>Sale Management</li> <li>Purchase Management</li> <li>Analytic Accounting</li> <li>Inventory Management</li> <li>Manufacturing Resource Planning (MRP)</li> <li>Project Management</li> <li>Lead and Opportunity Management</li> </ul>	Scalable	PostgreSQL, MySQL, SQLite	GPLv3	Python	Cross-platform	Mailing List, Internet Relay chat, Support from professional partners	Access control	First release in 2008 Last release in April 2014	Limited CRM abilities

Table No.2 Comparison of OSS CRM/ERP packages

\*Scalability: performance of system in the higher workloads (Williams and Smith, 2004)

\*\* Source: <https://sourceforge.net> and official websites of above five companies.

## **Implementing an integrated ERP/CRM package**

Currently there is a general manager and an assistant who are in charge of office works such as marketing, booking of events, invoicing and salary payment. General Manager and the assistant are currently using a combination of disconnected spreadsheets, company website, database of clients, email address books and business email for management of relationship with customers. According to PESTLE analysis, number of customers is growing fast. Hence proper contact management is getting difficult for office workers. Moreover, different databases are stored in the disconnected spreadsheets, while all of these isolated islands need to be connected in order to make an integrated information system.

Office team also utilize an online shared calendar and several spreadsheets for managing the planning the resources. They use a unidirectional channel for sending messages and emails via mobile phone to the technical team. Number of customers is increasing, but information systems are still basic and traditional. As a result, human error in the processes like resource allocation and calculation of salary is increasing. Thus company needs to upgrade the information system and prepare required hardware and software.

The objectives of upgrading information system are:

- Empower tracking and reporting capabilities of the company
- Present a single way of contact both internally and externally
- Analyzing customer taste and improving sales opportunities
- Making a system that easily can be modified for the future needs

Currently, customers enquires for services via telephone or email, while in the proposed business model it should be done via a CRM (Customer Relationship Management) software. CRM software serves as an efficient communication channel between the company and customers. An ERP software will allow the company to unify the functions of all departments in a single

application. In the proposed business model, company will use an ERP software instead of current solutions like the shared calendar and pricing spreadsheets. Then in the proposed business model all the internal office works will be performed in ERP module and CRM module will be used for managing the relationships between company and customer.

Thanks to the contact management feature of CRM software, all the customer details will be stored in a centralized place. Using CRM will make it possible for the company to keep track the progress of each service order and maintain an efficient way of communications for confirmation/rejection notification, technical clarifications, invoices and reports.

Company will take advantage of the ERP software in all of the critical processes such as resource planning, invoicing and supplying services. All in all, by using compatible CRM and ERP software, company will have access to all information in all areas of the business. For instance, a customer would only need a case number to call the company for following up an order. Using that number, the office workers will be able to track all the critical information in the company like pricing, invoicing and order status as well as contract, history of communications etc. and inform the customer about the latest status of order.

### **Software selection criteria**

There are several criteria that could be considered for selecting a software. Rowley (1993) proposed a framework for investigating different software. It included cost, lifetime history, originator, supplier, support, maintenance, technical considerations and compatibility, ease of use, interface and integration. While Chaffey and Wood (2005) listed Functionality, Ease of use, Performance, Scalability, Compatibility or interoperability, Extensibility, Stability or reliability, Security and Support as main criteria for selecting software. Damsgaard & Karlsbjerg (2010) suggested seven guiding principles for selecting software packages including both of COTS and OSS.

Inspired by above mentioned criteria, table No.2 compares five integrated CRM/ERP packages by considering ten factors such as scalability, presence in the market and security. Since the packages are open source, factor of cost has not been considered in this comparison. Each of the five packages have some advantages and disadvantage. Perhaps one is user friendly and scalable but unsecured, while other one is not scalable but a secure package. Therefore a deep analysis is needed to select the best package for company. After careful considerations of pros and cons of each software, Compiere is recommended for use in LC. As illustrated in table No.2, Compiere is a secure and scalable OSS with great ERP and CRM features and good support.

### **Challenges ahead**

- Seo (2013) has pointed “lack of support from management” as the first challenge in this kind of change.
- Lack of employee’s buy-in. Khamees & idhyapeeth (2013) has listed employee’s resistance against implementation as one of the top challenges.
- Lack of ERP/CRM expertise in the company. As company implements this kind of software for the first time, most of employees are unfamiliar with concept and benefits of information system.
- Security of information and preventing data leakage. Defining a data management strategy will help the company to define the information access levels for employees.
- Some of the customers will be reluctant to provide the required information in CRM, for instance some won’t provide contact details, due to cultural or security reasons.
- Employees need to be connected to system via desktop/laptop PCs in the office and the smart phones for technical staff. Internet coverage in different locations will impact the connectivity. Company should provide a secure high band width internet for office and high speed mobile packages with good coverage for technical employees.

### **Conclusion and recommendation**

Implementing change initiatives, like utilizing a new software, is challenging in the companies. Some of the employees are not aware of importance of the change and some have personal reasons for resisting against it. Showing management support and commitment will help to reduce resistance. Also holding a training course about ERP/CRM will brighten the objectives of project and motivate staff to move toward the same goals.

It is recommended to company to define a test period for transition between current and new information system. In this period, company can test the factors like business needs, employee's needs, network speed etc. and then modify the system before utilizing it permanently. Company will need a part time software engineer for customizing the open source software. Although it will impose costs to the company, but instead LC will use the opportunity of developing a socio-technical approach by focusing on the needs of business and employees.

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## Project Risk Management: Case of quantitative risk analysis in an oil and gas Project

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### 1- Abstract

Projects are unique, have limited resources and some of them are complex. There are some uncertain threats against the project success which are called risks. Therefore project risk management is one of the most critical processes of project management and implementing it could help to the project oriented organizations to improve the performance. There are several global guidelines and standards for risk management. In this text, the concept of risk (known unknown) and uncertainty (unknown unknown) has been reviewed, then the process of project risk management is explained according to the PMBOK guideline. According to this approach, The risk management is a process including six sub processes namely risk management planning, risk identification, qualitative risk analysis, quantitative risk analysis, risk response planning and control phases. Author has the experience of being a member of project risk committee in an oil filed development project. (AFD Project) During the investigating the literature and theories in risk management area, some real examples of risk management at AFD project has been presented too.

### 2- Introduction

Projects are unique and some of them are very complex. They involve a wide range of resources including material, equipment, human resources, money etc. to achieve the project objectives. Project objectives can include scope, schedule, cost and quality (Greiman 2013). Grey and Walker (2005) say risk is about the possibility of damage or profit, or deviation from a favorite result because of uncertainty. According to PMBOK (2012), Risk is an uncertain event or condition that, if it occurs, has an effect on at least one project objective. Whether the effect is positive then the event is called opportunity and if the effect is negative, the event is a risk.

A risk may have one or more causes and if it occurs, it may have one or more impacts to the project objectives. (PMBOK 2012)The goal of project risk management is decreasing the risk of not obtaining project objectives and also increasing the advantage of the opportunities within a project. Royer (2000) believes that unmanaged or unmitigated risks are one of the initial reasons for project failure. Therefore project risk management is one of the most critical processes of project management and implementing it could help to the project oriented organizations to improve their performance.

There is a direct relation between risk and uncertainty, risk occurs when uncertainty exists. Uncertainty and on the other hand cost of the change varies during each stage of project life cycle. For instance at the initial stages of a project, a lot of risks could exist, but instead project team have more freedom for changing in the project characteristics. Cost of the change will become higher when project progress and approach to the closing stage. Then it's very vital for a project manager to take keep in the mind the risk management tasks related to each stage of project life cycle. In the table No.1, Royer (2001) has categorized Risk management tasks for each stage of project life cycle.

Project life cycle	Initiating	Planning	Executing	Controlling	Closing
Risk management process	Project opportunity assessment	Risk Management planning	Continuing Risk Management	Project risk audit	Risk knowledge transfer

Table1. Risk management processes among the project life cycle

Then project risk management applies within all phases of the project. For instance at the concept development of a project proposal, project team try to determine the alternative strategies and perform contractual negotiations at the bidding stage.

Many project management organizations in different countries have developed standards and guidelines for project risk management. Some of the global risk management standards are:

- 1- Project Management body of knowledge (Chapter 11), PMI , USA
- 2- Integrated Risk Management Framework, Treasury Board of Canada
- 3- PRAM guide, Association for project management, UK
- 4- Risk management standard, AS/NZS 4360, Australia

In the following, risk management process will be reviewed based on the PMI definition. According to this approach, The risk management is a process including six sub processes namely risk management planning, risk identification, qualitative risk analysis, quantitative risk analysis, risk response planning and control phases. Qualitative risk analysis.

### **3- Risk Management planning**

Risk management planning is the sub process of describing how risk management activities should be approached and conducted in a project. The output of this sub process is "Project risk management plan". It defines the methodology, roles and responsibilities, budget and schedule for risk management in the project. Methodology could be included the templates, forms and diagrams, Methods of risk identification, Methods of risk qualification analysis and Methods of risk quantification analysis. PMBOK (2012) has counted several tools and techniques for this sub process including: analytical techniques, meeting and expert judgment. All the stakeholders should agree on the risk management process, since risk management team will need the stakeholders support during the next stages. There would be the need for holding several meetings with project manager, chosen members of project team and also stakeholders. In these meetings the responsibilities for risk management will be defined and assigned. Also the degree and type of risk management activities needed for a specific project will be planned in this stage. For instance depending on the availability of historical data in the organization and project needs, project risk management team could decide whether they should execute qualitative or quantitative risk analysis.

### **4- Risk Identification**

Risk identification is the second sub-process of risk management process and specifies which risks might happen during the project and which issues have been occurred, and document their characteristics. There is a belief that risk identification is the most important step of risk management, even more important than risk analysis. In order to analyze, rank and response to the risk, it firstly should be identified. Al-tabatabai and Diekmann (1992, cited in Bajaj et al. 1997) described that historical data, experience and insight are the initial sources of risk identification. Although it should be considered that the projects are unique and same risks couldn't apply for the similar projects. Jeynes (2002) proposed a framework for identification and categorization of the risks. She defined ten headings for risk auditing of a project including: premises, product, purchasing, people, procedures, protection, process, performance, planning and policy. In the next step, by considering five risk factors for each heading, project team to could identify the risks. Her proposed risk factors are: employment, legislation, security, competitive and financial.

Charette (1989) suggested a method for risk identification including information gathering and risk categorization. According to him, risk categorization should be done based on risk causes and predictability level. He stated that the best source for identifying risks is information based on previous records. Therefore he believed that historical

data from various sources should be gathered to find the causes of risks. The sources are including: traditional knowledge, historical data of other/similar projects, personal judgment, experiment and tests and statistical surveys. PMBOK (2012) has suggested several tools and techniques for identifying the risks such as expert judgement, documentation review, information gathering techniques (including brainstorming, Delphi, Nominal Group technique and interview), check list analysis, assumption analysis, historical data and diagramming techniques. The most frequently used tools for risk identification are: check lists, brainstorming and interview sessions. (Raz and Michael, 1999) (Maytorena et al., 2007)

In order to communicate identified risks between the stakeholders, Risk Breakdown Structure could be used (PMBOK 2012). There are different approaches in structuring the RBS. Holzmam, and Spiegler (2011) classified all the RBS methods to two types: Generic and Industry oriented RBS. Generic RBS types could be used for any type of project, but industry oriented RBS types are determined for specific type of projects. Based on the project essence and project kind and expectations or project risk management process, all project risks and issues could be classified throughout one of the following approaches: By risk source (Internal/ external), based on the environment area (physical, social, political, operational, economic, legal) , Operational, Departmental, or a combination of the mentioned approaches.

Author was a member of risk management committee for an oil field development project in Iran (at Petroiran Development Company). Project risk supervisor and myself, as risk coordinator, were in charge of preparing the risk management plan, designing the templates and forms, holding interviews for risk identification, qualitative analysis, responding and reporting. Since it was the first risk program in the company, there wasn't any information from past such as check list or risk register, then we had to hold interviews with risk owners. A sample of risk identification form is shown in Fig.1

Risk Identification form				
Project name: AFD      Department: Technical      Process: Construction				
Risk owner: XXX      Interviewer: YYY      Date: ZZZ				
No	Risk Cause	Risk description	Consequences	Remarks
1	Bad quality of soil	Delay of finishing access road	Delay in starting construction works	
2	Field location used to be frontline of the war with Iraq at 80s	Existence of Maine and military ammunition in some areas	Explosion during construction work	tense wind and flood could transfer Maine from un-neutralized parts to the construction area
3	...			

Fig.1- Sample of risk identification form for construction works

Risk identification is a time consuming activity, but it worth it. The more time spent for risk identification, the more and higher quality risks will be identified. Brief figures about risk identification at AFD project is presented in table No.2. The speed of identifying proper risks depends to the knowledge, experience level and age of risk owners/interviewees. For instance, there was only one meeting held with commercial risk owner to find 19 risks, while 25 man hours were needed to identify 19 risks in the contractual and legal section. Totally after 30 meetings and spending 108 man hours, 161 risks had been identified at the planning stage of AFD project.

Risk Breakdown Structure	Number of Interviews	No. of Interviewers	No. of Interviewees	Time(Man hour)	No. of identified risks	Percentage
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Contractual / Legal	4	2	4	25	19	%11
Financial	3	2	2	8	12	%7
Commercial	1	2	1	6	19	%11
HR	3	2	3	8	20	%12
HSE	3	2	3	9	18	%11
Socio- political	1	2	1	2	4	%2
Technical	15	2	18	50	69	%42
Total	30	(Ave. ) 2	33	108	161	%100

Table No. 2 summarizes the figures about risk identification interviews

## 5- Risk assessment

The core method or risk assessment is evaluating the probability of risk occurrence and its impact. It could be done by subjective judgment, then this method is called qualitative risk analysis, or could be done mathematically by using probability theory, then it is quantitative risk analysis.

### 4-1 Qualitative risk analysis

Qualitative risk analysis is the third sub process of project risk management and including methods for prioritization of identified risks and issues. In this step risk analyzer predicts all the risks' occurrence probability and impact. It doesn't need in this step to acquire a precise number for occurrence probability and impact, and only predicting their level is enough. (PMBOK 2012) Occurrence probability and impact of risks could be prioritized in three, five or seven levels like: Low, Medium and High. The occurrence probability of each risk is multiplied by risk impact throughout the P&I matrix. Samples of Probability and impact diagrams, P&I matrix and list of top ten risks for AFD project is presented in table No. 3 to 6. The tables had been made based on the project needs and size.

In AFD project, total impact score was resultant of time, cost, quality and HSE scores. Even risk management committee decided to split the HSE factor to four different subjects including People, Equipment, Environment and Company HSE reputation. For having a more accurate analysis, AFD risk committee decided to allocate different weight factors to Time, Cost, Quality and HSE. Weight factor will reflect the importance of each quartet factors for the project. For instance 0.4, 0.3, 0.15 and 0.15 for time, cost, quality and HSE. The output of this analysis sometimes looks to be more scientific than practical. Since analyzers' focus s only on multiplying two estimated values together. And this is the main limitation of this method (Harris 2009)

Probability Level	Range	Score
Very Low	1%-10%	0.1
Low	11%-30%	0.3

Medium	31%-50%	0.5
High	51%-70%	0.7
Very high	71%-99%	0.9

Table No.3 probability diagram for AFD project

Impact Level	Time	Cost	Quality	HSE				Score
				People	Equipment	Environment	Reputation	
Very very Low	< 1/2 Months	< \$10K	Quality degradation barely noticeable	No health effect/injury	No damage	No effect	No impact	0.05
Very low	1/2- 1 Months	\$10 K-100K	Only very demanding applications are affected	Slight health effect/injury	Slight damage	Slight effect	Slight impact	0.08
Low	1-2 Months	\$100 K-1M	Quality reduction requires client approval	Minor health effect/injury	Minor damage	Minor effect	Limited impact	0.13
Medium	2-4 Months	\$1-10 M	Quality reduction unacceptable to client	Major health effect/injury	Localized damage	Localized effect	Considerable impact	0.2
High	4-7 Months	\$10-60 M		Single fatalities	Major damage	Major effect	National impact	0.32
Very high	7-10 Months	\$60-100 M	Project end item is effectively useless	Multiple fatalities	Extensive damage	Massive effect	International impact	0.51
Very very High	> 10 Months	> \$100M						0.8

Table No.4 Impact diagram for AFD Project

			VVL	VL	L	M	H	VH	VVH
			0.05	0.08	0.13	0.2	0.32	0.51	0.8
Probability	VH	0.9	0.045	0.072	0.117	0.18	0.288	0.459	0.72
	H	0.7	0.035	0.056	0.091	0.14	0.224	0.357	0.56
	M	0.5	0.025	0.04	0.065	0.1	0.16	0.255	0.4
	L	0.3	0.015	0.024	0.039	0.06	0.096	0.153	0.24
	VL	0.1	0.005	0.008	0.013	0.02	0.032	0.051	0.08

Table No.5 P&I Matrix for AFD project

TABLE 6

The Severity Of Risks By Using Traditional Methods	The Severity Of Risks Without Considering The Interactions Between Risks			
	Probability	Impact	Severity of Risks	Ranking of Risks Based on Their Priorities
Unspecified contracting strategy	VH	VVH	0.72	1
Difficulties in project finance	VH	VVH	0.72	1
Economic unfeasibility	M	VVH	0.4	2
Nonconformity of well completion with drilling plan	H	VVL	0.035	6
Inappropriate definition of subcontractor's scope of work	M	VH	0.255	4
Inappropriate contract strategy with sub- contractors	M	VH	0.255	4
Inappropriate insurance policy with subcontractors	H	VH	0.357	3
Ambiguity in contractual issues	VH	VVH	0.72	1
change in location and number of wells	H	VH	0.357	3
Ambiguity in drilling plan	H	H	0.224	5

Table No.6 list of top 10 risk at AFD Project

## 4-2 Quantitative risk analysis

Obviously it would be better to have objective data to run quantitative analysis. But such data would be impossible to achieve in the real world and extremely expensive if it were possible to be collected. Even subjective data can lead to better analysis and decision making. Some of the ways to come up with quantified probabilities and impacts are similar to qualitative risk analysis, but with a cost or time impact and a percentage for probability. Some of the best ways to quantitatively come up with probabilities and impacts are: (PMBOK 2012), (Harris 2009)

- Guess at percentage probability, cost or time impact using subjective judgment
- Calculate actual cost/time impact: Of course there is no such thing as an exact probability
- Use historical records: surveying time, cost and probability single value estimates or distributions on other projects.
- Delphi technique.
- Interview.

For determining the degree of validity of the data defined for project objectives and determining the cost and schedule in different cases due to risk, some methods are applying. Due to the scope or category of risks some methods like PFMEA, DFMEA, Decision Tree, Economic studies etc. are used and overall impacts are determined by some methods like sensitivity analysis, simulation (Monte Carlo) and risk management software like @Risk simulation tool (Grey 1995). Pertmaster software could calculate the project completion chance with different cost & Finish dates.

There are different techniques for qualitative analysis, such as PERT, GERT, VERT, Beta, Monte Carlo, The important point is selecting the best and effective method for the project. Monte Carlo analysis is always a simple general solution, but sometimes it is like using sledgehammer for breaking a nut. (Williams 1993) Quantitative risk analysis provides a more accurate result than qualitative analysis. But in the other hand it costs more for the organizations to allocate professionals for modeling or simulation. Also sometimes the historical data is not available in the organization.

## 6- Risk Response Planning

Risk Response Planning is including developed options and determined actions to enhance opportunities and reduce threats to the project's objectives. The risk owners must consider the project risks, starting with the most serious, and decide upon the actions to be taken to response them. Although some of the possible responses are not strategic and are in the operational level, but based on the risk scores and the criteria, responses should be defined. Jeynes (2002) suggested a framework for planning the responses which these items should be defined there: actions required, where, by when, by whom and required resources. There are some typical strategies for responding risks and risk owners and risk analyzer can use them as strategies to develop adequate responses: Avoid, Transfer, Mitigate, Accept (PMBOK 2012)

Threat avoidance is about modifying the project management plan for eliminating a threat. In other word: Eliminating a threat by eliminating its causes. Eliminating a risky work package from scope of work could be a good example for this strategy. Threat transfer requires transferring the negative impact of a threat to a different party. Examples are subcontracting and buying insurance for risky activities. Threat mitigation indicate reducing the risk magnitude either by reducing the probability or impact to an accepted threshold. For instance conducting more quality checks or selecting a qualified contractor will reduce the probability of failure. Accepting strategy implies that project management team let the risk to happen. In other word: If it happens, it happens. If project response to the risk after occurrence it's called passive acceptance and if they



think in advance about the responses, then it's called active acceptance. Assigning buffer and having a contingency plan are examples of acceptance strategy. Similar to the treatment with the risks, there are strategies for maximizing the opportunities. Typical ways for opportunities are: Exploit, Share, Enhance and accept.

## 7- Risk controlling and reporting

Risk Monitoring and Control includes identifying and analyzing new risks, reanalyzing and tracking the risks on the watch list and evaluating the effectiveness and appropriateness of risk management. (PMBOK 2012) Based on the project risk management plan, risk reports will be issued in this stage and top risks and issues could be subjected in the project meetings and the preventive, proactive and corrective actions will be facilitated.

It's probable that some risks remain after doing their probable responses. These risks name Residual Risks and risk management team should provide a fallback plan to control them. It's probable that the provided actions for responding risks or consequences of primary risks cause some another risks. Those risks are named Secondary Risks and are processed as primary risks.

## 8- Conclusion

Risk management is an ongoing process among project life cycle. Each sub process is an important component of risk management chain, then each step needs to be done properly and in order. Depending on the project size, a project team member or a team of risk experts could be in charge of implementing risk management. But regardless of risk expert/management team, project manager has a key role in execution of this process. Project manager also needs to implement the culture of risk awareness in the project by showing his/her commitment and support to the subject.

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