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Maturity of Electronic Commerce: A Review of the Principal Models

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Abstract — **The object of this article is to present the most cited maturity models and the organizational evolutions, instigated mainly by Internet and electronic commerce. We will observe with these theories, how companies become progressively more flexible, more externalized, less centralized within a network, due to e-commerce.**

Keywords— **Internet, e-commerce , maturity stages, integration, new organization**

I. INTRODUCTION

Recognized and adopted by academic and professional circles, the maturity models in electronic commerce allow to understand the progression of information technologies and systems of companies. They anticipate the evolution of the organization and enable it to better study the changes caused by these new technologies.

Indeed, electronic commerce and Internet are at the origin of new, inter-organizational relations and have imposed major changes within companies while offering important opportunities for growth.

Purpose:
This article is a useful analytical framework for describing the company position on electronic commerce. It will allow to understand in what way the company must reconsider its organization with regard to electronic commerce and how it can anticipate major organizational changes in the future.

II. FROM NOLAN'S MODEL…

Long before the emergence of Internet and electronic commerce, the developing stages of computers have been studied by researchers such as Nolan [1], Gibson and Nolan [2], Earl [3], Hirschheim et al. [4], Bhabuta [5], Earl [6], Galliers and Sutherland [7, 8]. Theories on the stages of growth, developed during the mid-70s, were studied due to the increasing importance of information systems within organizations.

Richard Nolan is considered to be the first researcher to provide a structured outline to explain the computing evolution within organizations [9]. He is also the first to have presented a theoretical description of the phases dealing with the planning, the organization and the control of activities in association with the management of computer resources in the organization [1, 2, 10].

Nolan developed a model which permitted to determine the degree of computing maturity of a company by taking into account the evolution of information technologies as an organizational learning process.

Nolan's model has undergone several improvements and is presented under different forms and versions. Indeed, the original model [1, 2] consisted of 4 phases (Initiation, Contagion, Control and Integration). Later, due to the emergence of new applications such as database systems, the initial model was altered to include new phases : Data Administration and Maturity [10]. In general, these stages of computer development show how information technologies along with organizational and managerial strategies evolve with time [11]. Organizations progress therefore through a number of successive and identifiable phases and each phase reflects a particular level of maturity in terms of use and management of information technologies within the organization [12].

The model relies on the organization's computer and information technology budget to determine the different stages of the computer evolution. Indeed, according to Nolan, the penetration and usage model of TI in the organization very much resembles the growth model of the computer budget. He has, moreover, used the latter as a substitute for developing his model of computer maturity [12] :

· Initiation phase : after one computer acquisition, slow annual increase of computer budget ;

· Contagion phase : growing annual increases of computer budget ;

· Control phase : decreasing annual increases of annual computer budget ;

· Integration phase : slow annual increase of computer budget.

Despite the theoretical contribution of Nolan's model, Galliers and Sutherland [13] as well as Swatman [14] find that is incapable of representing the reality of the implementation of information systems.

Galliers and Sutherland [13] add, that the model developed by Noland is inadequate and does not focalize on the organizational and managerial aspects. They criticize

the fact the model does not insinuate in what ways the organization could evolve towards maturity phases. For his part, Earl [6] argues that the organizations could have various learning curves for different types of information technologies.

III.   …TO E-BUSINESS STAGES OF GROWTH

Nolan's model was frequently adjusted and adapted to the managerial reality of the 90s and to the information technologies' evolution during the last ten years. These adjustments were necessary since the initial model, even though it still allowed for the determining of the level of computing maturity of the organization, did not take into consideration new elements such as micro-computing or Internet [15].

Gallier and Sutherland [7] suggest a maturity model describing the phases through which organizations use information systems and technologies. The uniqueness of their model is in the fact that it gives particular attention to interrelations that exist between information technologies of the company and the rest of its functions [16].

New maturity models, better adapted to the realities of electronic commerce, have been developed by other researchers and practitioners. Recent research on growth phases and electronic commerce has shown the usefulness of these models in describing the company position in terms of electronic commerce development and of its possible development in the future [16-21]. Furthermore, besides its descriptive aspect, studies on maturity models help companies choose adequate strategies for moving into new, more advanced phases [16]. Likewise, Rao et al. [21] compare these maturity stages to roadmaps, leading to the sophistication of electronic commerce. They define each stage as an ensemble of signs that characterize the evolutionary nature of electronic commerce.

Among recent models, the following can be mentioned : the electronic commerce maturity model [22], the Matrix Engagement-Execution [23], the levels of electronic commerce [24], the life cycles of electronic [25], the Intranet Maturity model [26], the growth model of electronic commerce [19], the typologies of models for electronic business [27], the technological maturity of B2B electronic business [28], the maturity model of McKay et al. [17], the model of Rayport and Jaworski [20] that is specific to the adoption of B2B Internet technologies, the model of Rao et al. [21] and that of Chan and Swatman [29] based on the use of technologies and applications of B2B e-commerce. However, in spite of these numerous propositions and their strategic contribution to the company, little research has been focused on their pragmatic value and on their validation from an empiric point of view [30].

A.   Earl's model[19]: Toward a learning organization

Earl [19] developed a model which permitted to situate a company's degree of e-business maturity. This suggests that all companies should go through 6 "standard" stages. These are learning phases for the adoption and the support

of electronic business. Earl sustains, however, that these phases are not necessarily definitive and that companies can maintain activities on several neighboring stages simultaneously. Earl [19] suggests the following stages :

Stage 1: External communication
By creating websites, the main goal of companies was purely promotional Their websites were rarely interactive. These sites remained a kind of virtual brochure for external communication without interaction with the internaut.
Stage 2: Internal Communication
After using the web as the external communication media, companies began, from 96-98, to introduce Intranet, using Web and Internet technologies. At this point, information technologies are deployed to facilitate the use of and access to certain systems within the organization and to prepare the latter for the future integration of electronic commerce.
Stage 3: Electronic Commerce
This stage is marked by the use of Internet for the sale of goods and services and not just as a means of communication. During this phase, Internet is adopted as a new distribution channel to complement the other traditional channels.
Stage 4: Electronic Business
During this stage (electronic business), the company effort was focused on the construction of new business models, suitable to the new economy through adjustments and reengineering of the business process.
Stage 5: E-Enterprise
Organizations redefine the way the process is managed to be in tune with the new business process. A new conception of organization emerges with new information technologies that render decision making possible, in real time.
Stage 6: Transformation
Arriving at this stage of maturity, implies that the company successfully accomplished the different adoption phases of electronic business. It has also accepted the challenges of the previous stages and incorporated new business and management models required by the new economy.
Along the same lines as Earl's model [19], researchers at the Centre francophone d'informatisation des organisations [27], studied the different technological applications used by companies (the goal being to derive a typology of electronic business models). Their typology was elaborated taking into account the degrees of integration of the internal and external processes of the company and the degree of complexities of its business relations. This study led to the deduction that the level of integration of technological applications increased with the complexity of the company's business relations. From informational web sites containing no company function and where the business relations are hardly complex, we go to transactional and extranet web sites, portals (vertical or horizontal), electronic business markets and finally, towards the integration of a client/supplier value chain where the integration degree is

optimal and the complexity of the business relation is at its maximum.

B. The McKay et al. [17] model : towards the complete integration of the organization

McKay et al. [17] suggest the organizations implicated in electronic commerce can be evaluated and categorized according to six phases which vary from a very low to a very high level of maturity. These stages can be summoned up as follows [31]:

Stage 1: No presence (observation and waiting phase). No use of Internet or e-mail. The company is still hesitating on whether to invest in electronic commerce.

Stage 2 : Experimental online presence. One-way communication from the company to the client and/or supplier through a static website. The information available on the website deals mainly with the company and its products and/or services.

Stage 3 : Interactive online presence. Two-way communication between the company and its clients and/or suppliers through the website and e-mail. The possibility to pay online is, however, not yet available.

Stage 4 : Electronic commerce. Online financial transactions are now possible. The system is, however, not fully integrated with the "back office".

Stage 5 : Internal integration. All the functions of a transaction can now be done electronically. The back and front office systems are now totally integrated.

Stage 6 : External integration. Creating of a strategic business network between the company and its partners using web technologies. The business process and the network technologies between its given members are integrated through an extranet.

C. The Model of Rayport and Jaworski [20]: towards inter-company e-collaboration

Rayport and Jaworski [20] suggest a development model for electronic commerce specifically for the adoption of inter-enterprise (B2B) Internet technologies. They propose that electronic business using Internet be managed separately from other initiatives. Their model outlines the following stages :

1- Broadcast: The company begins by creating an informational website for its clients;

2- Interaction : Internet technologies are used by the organization to interact with clients;

3- Transaction : The company integrates Internet for making, managing and supporting transactions with its clients;

4- Collaboration : The company uses Internet on an inter-organizational level and within the framework of its relations with commercial partners.

C. The SOG-e McKay et al. [17] model : towards a perfectly integrated organization

According to Prananto et al. [18], one of the limits of classic information technology maturity models is in the fact that they concentrate only on the problems dealing with traditional (or back-office) systems without taking into consideration the impact of Internet technologies within the organization. Furthermore, these models were developed well before the advent of Internet and electronic commerce. However, the new maturity models (those that are specific to electronic business) deal primarily with the aspects of the organization which are specifically tied to Internet and electronic commerce (or front-office). They do not really take into consideration traditional information technologies and systems [17, 18].

Prananto et al. [18] maintain that it is necessary to integrate all these models, while taking into account traditional information systems as well as Internet technologies in order to better study the sophistication of electronic business within an organization. Moreover, McKay, Prananto and Marshall [17], propose another maturity model specifically for electronic commerce. Named SOG-e (Stages of Growth for E-Business), the integrated model takes into account activities based on the organizations Internet technologies as well as their traditional information and technology systems.

The SOG-e model is based on the system information maturity model developed by Gallier and Sutherland [7] combined with the electronic commerce maturity model elaborated by McKay et al. [17]. As with the other maturity models, the SOG-e presumes a progression of levels through time. This progression means the accumulation of knowledge, experience, qualifications and expertise within company [16, 18].

The SOG-e contains six phases of maturity :

In the first phase, the company has no implantation or development strategy for electronic business. Management's electronic commerce projects lack clarity and direction. No precise member of the staff is designated for electronic commerce initiatives. Moreover, the company's traditional business process is not affected by electronic business.

During the second phase, electronic business begins to increase in importance within the organization (despite the lack of a clear and official strategy). The responsibilities of certain members of the staff are extended to the development and maintenance of the electronic business activities. Initiatives on the part of the company with regard to electronic business are perceived as having a limited impact on the process of traditional business.

The third phase is characterized by an increased awareness with regard to electronic business and its role with the organization. The company's electronic business initiatives take on a clearer, more definitive direction. However, this direction is essentially centered on the technological perspectives and not on the company's business strategy needs. A staff, possessing technical expertise, is put exclusively in charge of the company's

development of electronic business. The impact of this development on the existing business process is increasingly visible within the company.

In the fourth phase, the adoption and development of electronic business are mainly focused on the company needs in terms of business strategy. This stage is characterized by the integration and coordination between the components of electronic business (such as : SI/TI and Internet) and the business process of the organization. Furthermore, the technical staff, in charge of electronic business development, works together with (and with the support of) a staff more oriented towards the company's business strategy. Company initiatives, with regards to electronic business, are perceived as a force behind the reengineering of the business process.

The fifth phase is characterized by the integration between the activity and process of the company's traditional business with those of its electronic business. The electronic business initiatives' goal is to bring strategic value to the organization. These initiatives imply the involvement of various company departments. The information technologies and systems are highly integrated within the company. During this phase, electronic business plays an essential role within the company by improving the organizing of its operations and functions.

The final phase marks the total integration of electronic business and the business process, at the heart of the different levels within the organization, internally as well as externally (with business partners and suppliers). The electronic business initiatives create and maintain a strategic advantage for the company. One can also witness a dynamic and strategic group effort between the information technology staff and the managers who are directly concerned by the company's business. The organization has, furthermore, access to all the internal qualifications and knowledge required for electronic business initiatives. Electronic business plays a vital role in the restructuring of the process connecting the different members of the external business network (of the company) and the inter-organizational systems.

The SOG-e model is a useful analyzing tool which helps specialists to understand and describe a company's position with regard to electronic business, including its degree of maturity with regard to information technologies and systems. The particularity of the SOG-e model resides in the fact that it allows for different levels of maturity within the same organization: those that are specific to traditional systems and technologies and those that concern only Internet. However, during the model's two final phases (5 and 6), the company enters the maturity level which incorporates the traditional systems with Internet technology. The different phases that the model offers, allow the company to understand, diagnose and evaluate its current position as well as plan and manage its future strategy for electronic business. Furthermore, Prananto et al [16] prove that the model also helps to understand and study the different forces (factors, facilitators) and barriers

to the implementation of electronic business at each maturity stage.

D. The model of Rao et al. [21] : towards a perfectly integrated organization

Rao et al. [21], maintain that it is beneficial to have a maturity model that describes a logical evolution of electronic commerce and which involves various stages of development. This model would be a guide which helps the company progress towards more advanced maturity stages. The authors propose a model composed of four phases: Presence, portal, transaction integration followed by total integration of the company. They add that the costs, the technology demand and the the complexity increases progressively during the last phases of the model. Rao et al. [21] specify that their model does not require that the company progressively accomplish each stage successfully. They allow that the company could begin with any phase, skipping certain stages of the model. Indeed, a company that is increasingly aware of the importance of information technologies and electronic commerce could begin with a later maturity phase, bypassing the others, in order to accelerate its development process in electronic commerce.

Furthermore, Rao et al. [21] take an interest in the factors that facilitate the implementation of electronic commerce and the barriers that hinder its development at a given maturity stage. The facilitating factors are the elements which have a positive impact on the implementation of electronic commerce such as the company's commitment to attaining certain goals as a result of the web. With regard to the barriers, they consist of the elements which hinder or delay the implementation such as important financial investments or the company's lack of experience and know-how on information technologies.

The model of Rao et al. [21] suggest the following stages :

Stage 1: Presence
During this first maturity phase, the on-line presence of the companies consists of an information web site with one-way communication : with no intention to receive information from internauts [32]. The site is a virtual company brochure with its products and services [28, 33] as well as some general, invariable information. This Internet presence is mainly to attract new clients and does not include any internal or external company process. Boisvert et al. [32] add that these sites generally require little investment.
Stage 2: Portals
Unlike the first phase, this phase includes two-way communication. Indeed, with an informational web site, clients and suppliers can make offers, send comments on the products or service and participate in on-line surveys.

Furthermore, the company uses cookies[1] in certain pages in order to gather information on each visit and better understand the internaut's profile.

Stage 3: Transaction integration

This phase allows for on-line financial transactions, involving the buying and selling of goods and/or services. It implies high structural and technical abilities. The company can create virtual communities which allow participants to share information based on common interests. In addition, the transactional web site can also offer a platform for electronic auctions or a virtual business marketplace for buyers and sellers. At this stage, however, the level of cooperation between the partners is still low. In this maturity phase, the company implements the web only at the level of the organization's internal processes.

Stage 4: Company integration

At this advanced stage, web technologies are perfectly integrated at the level of its internal and external processes. This integration uses the electronic commerce systems to manage its dealings with clients (CRM) and the supply chain. This implies an intensive partnership between clients and suppliers. To arrive at this final maturity stage is ideal for a company who has chosen extensive integration of electronic business with the business processes, internal as well as external.

IV-CONCLUSION

All the above mentioned maturity models describe a logical evolution of the TIC within the company. They demonstrate that its entire organization revolves around the use of information technologies [34]. In more advanced maturity stages, one refers mainly to integration (internal and external), network and inter-organizational cooperation. With these advancements, companies tend to turn towards less centralized models, externalized and network operated [35]. Moreover, since the beginning of the 90s, various researchers have taken an interest to virtual organization and its development phases such as Davidow and Malone [36] or Frery [37]. Others have integrated new notions such as agility [38] or the network of companies electronically connected.

The new models mentioned in this article take into account the reality of Internet and electronic commerce. They show that the company organization is largely influenced by its implementation of electronic business. The latter represents a major stake which requires major organizational, strategic and functional changes [39]. All these maturity models, even though they differ on some points (such as the number of phases or on whether to take into consideration or not, the traditional systems), allow to understand and describe the implementation of the company's electronic business. At the most advanced maturity stage, the company has reached a high degree of

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[1] A collection of information, usually including a username and the current date and time, stored on the local computer of a person using the World Wide Web, used chiefly by websites to identify users who have previously registered or visited the site. Source : http://dictionary.reference.com/search?q=cookie

sophistication which allows it to consider the business process reengineering, disintermediation and virtual collaboration [28].

What's more, these models demonstrate that the organization must constantly evolve, at the same pace as the evolution of electronic commerce. Even if the company can have varied learning curves for the different types of information technologies, it must constantly innovate and adapt itself to its environmental changes. It must also have dynamic business and management models, adapted to the new economy, which provides as many opportunities and dangers. The key to success will be the building of a learning organization that encourages the involvement of all its members [6].

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