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Towards a Portal Maturity Model (PMM): Investigating Social and Technological Effects of Portals on Knowledge Management Initiatives

Abstract: The paper's purpose is to present the PMM (Portal Maturity Model) which can be used to assess the contributions of intranets and portals to Knowledge Management initiatives. The PMM was empirically tested in 62 organizations, and it is based on TAM, TTF, knowing organization model and KM maturity model.

Résumé : L'objectif de cet article est de présenter le modèle de maturité de portail (MMP) qui peut être utilisé pour évaluer les apports des intranets et des portails pour les initiatives de gestion des connaissances. Le MMP a été expérimenté empiriquement dans 62 organisations et est basé sur le TAM, le TTF, le modèle d'organisation des connaissances et le modèle de gestion mature des connaissances.

1 - Introduction

Intranet is an appropriate tool to systematize and add the explicit knowledge that is dispersed through departments. Intranets are organizational assets, and an important part of the structural dimension of the intellectual capital (Stewart, 1998). However, the efficient usage of intranets is closely related to a wider comprehension of information management contribution to organizational performance. Intranets should be understood as a part of organizational information context and its usefulness is influenced by culture, values and principles concerning strategic information management.

In an attempt to consolidate the various departmental intranets, organizations are constructing corporate intranets or portals (Choo et al., 2000). A great contribution of portals is to integrate heterogeneous information sources, providing a standard interface to the users. Furthermore, portals are evolving into more complex and interactive gateways through which users can collaborate and perform their business tasks. Due to the evolution from enterprise information portals towards knowledge portals, many organizations are using portals as the major technological infrastructure of their knowledge management (KM) initiatives.

Nevertheless, the deployment of a knowledge management system is a very complex process full of social, technological and behavioral implications. The portal needs not only to be integrated to the existing information systems, but also to the organizational culture, strategy, and human resources' policy. The correct balance between social and technological aspects constitutes one of the portal's adoption greatest challenges. Unfortunately, many organizations are so enchanted with software vendors' promises to be aware of these issues, so it may result in project failures, portal's misuse or low-level exploitation of this innovative technology.

The paper's purpose is to present a framework which could be useful to help organizations in evaluating their portal initiatives. This framework is called PMM (Portal Maturity Model) and can be used by organizations to identify how portals can foster KM initiatives.

This paper is organized as follows. First, portal architecture is discussed in order to generate the technological variables of the PMM. The third section applies the TAM - *Technology Acceptance Model* (Venkatesh and Davis, 2000) and the TTF - *Task Technology Fit* (Goodhue and Thompson, 1995) model to portal's context, and emphasizes the importance of leveraging classical Information Science and Information System studies to understand better the portal phenomenon. These studies offer a background to analyze the impacts of portal deployment on user's behavior, and consequently on KM initiatives. Then, some frameworks and maturity models for KM are presented in order to offer a theoretical support for the KM-based variables of the PMM. The fifth section describes the exploratory research in where the PMM was empirically tested in 62 organizations. Finally, the conclusion describes future works and gives advices about how the PMM can be used.

2 – Portal Architecture

A portal's primary function is to provide a transparent directory of information already available elsewhere, not act as a separate source of information itself (Choo et al., 2000). Common elements contained in corporate portals design include an enterprise taxonomy or classification of information categories that help easy retrieval, a search engine and links to internal and external web sites and information sources.

But portals are evolving into more complex and interactive gateways, so that they may integrate in a single solution many KM systems. They are becoming single points of entry through which users and communities can perform their business tasks and evolving into virtual places where people can get in touch with other people who share common interests. The personalization feature of portals enables users to organize their work by community, interest, task or job focus. Besides providing personal access to knowledge, portals help users in the job of building community places. On-line awareness and real-chat capabilities are available throughout the portal. Therefore, the user can see who is online, connect with them instantly and get immediate answers. As a result, knowledge portals are considered the next-generation of EIP (Enterprise Information Portals).

KM studies analyze people, organizations, processes and technology. Although technology is not the main component of KM, it would be naive to implement KM without considering any technological support. KM is of particular relevance to Information Science and Information System research because technologies play a critical role in shaping organizational efforts for knowledge creation, acquisition, integration, valuation, and use (Sambarmurthy and Subramani, 2005).

KM software can be considered "interdisciplinary business" because their development requires not only technical skills, but also a deep understanding of social and managerial aspects. KM systems need not only to be integrated to the existing IT infrastructure, but to the organizational culture, procedures and human resources (HR) policy as well. The correct balance between managerial and technical aspects constitutes one of KM tools adoption greatest challenges. Culture and user behaviors are the key drivers and

inhibitors of internal sharing, and organizations should develop ways of stimulating people to use and contribute to KM systems (Detlor, 2004).

In theory, portal adoption may contribute to a better system architecture as one of the main differentials of this innovative technology is its capacity to integrate heterogeneous systems. The components of a portal can be seen as features that add different benefits to users. Table 1 lists some of the main proposals for portal's checklists.

(Delphi Group, 2000)	(Terra and Gordon, 2002)	(Firestone, 2003)	(Hazra, 2002)	(Portals Community, 2003)
Integration	Structured and non-structured information access	Integration, structured and non-structured information retrieval	Structured and non-structured data repositories	Internal and external information sources, structured or not
Categorization	Taxonomy	Manual and automated classification	Categorization	Taxonomy, directories
Search engine	Search	Search, text mining	Search resources	Search
Publishing and distribution	Content Management System	Distributed content management	Content Management, version control	Content Management
Process support	Integration with internal and external applications	Decision-making support, workflow	Business intelligence	Business intelligence, workflow, application integration
Collaboration	Collaboration tools	Collaboration	Collaboration	Collaboration
Presentation and personalization	Presentation and personalization layer	Personalization	Presentation, personalization and usability	Personalization, end-user customization
Dynamic learning	Notification	Personal pushing, broadcasting	Event notification	Alerts, specialized content signature
	Security	Security	Security, unified login	Security, unified login
	Measurement tools		Access logs	
	Development environment			Development environment
	Management and organization		User account and privileges management	Portal administration services
	System architecture and performance		Performance, reliability, availability, scalability	
				Expert locator
		Individual and group learning,		

		training		

Table 1. Comparison among portal checklists

The existing checklists were used as an inspiration to derive the technological variables of the PMM. However, as shown by Table 1, many of the existing proposals for portal evaluation place more emphasis on the technological aspects rather than on organizational issues. Indeed, most of the mentioned proposals do not leverage classical studies that exist on Information Science and Information Systems literature. Perceiving the portal as a specific type of information system is a way of avoiding the reinvention of the wheel. Standing on the shoulders of previous user behavior studies and technology adoption research seems to be the most appropriate approach to the development of portal evaluation mechanisms.

3 – Classical Models of Technology Adoption Evaluation

One of the most referenced models of Information System (IS) adoption is the TTF (Task Technology Fit) model (Goodhue and Thompson, 1995). The theoretical analyzes the linkage between IS usage and individual performance. According to TTF, a technology has a positive impact on individual performance when it is utilized and has a good fit with the tasks it supports. In addition, TTF is consistent with the IS success model (Delone and McLean, 1992) in that system use and user satisfaction lead to individual and organizational performance impacts. The TTF model was empirically tested through a sample that included over 600 individuals in two companies. The final TTF factors and dimensions that were successfully measured are listed in Table 2.

TTF Factor	TTF Dimension
TTF1 - Quality	Currency of the data
	Right data is maintained
	Right level of detail
TTF2 –Locatability	Locatability
	Meaning of data is easy to find out
TTF3 - Authorization	Authorization for access to data
TTF4 – Compatibility	Data compatibility
TTF5 – Ease of use / training	Ease of use
	Training
TTF6 – Production timeliness	Production timeliness
TTF7 – Systems realiability	Systems realiability
TTF8 – Relationship with users	IS understanding of business
	IS interest and dedication
	Responsiveness
	Delivering agreed-upon solutions
	Technical and business planning assistance

Table 2. TTF Factors and Dimensions (Goodhue and Thompson, 1995)

The TAM (Technology Acceptance Model) was developed to explain and predict computer usage behavior (Davis, 1989). TAM has received substantial theoretical and empirical support from hundreds of studies, becoming a generally accepted cognitive model for predicting user IT acceptance (Detlor, 2004, 70). TAM has its background in the theory of reasoned action (Fishbein and Ajzen, 1975) which stated that beliefs influence attitudes, which lead to intentions, and behaviors at the end. TAM has two variables which influence attitudes and use. *Perceived usefulness* is defined as the degree to which a person believes that using a particular system would enhance his or her job

performance. In contrast, *perceived ease of use* refers to the degree to which a person believes that using a particular system would be free of effort (Davis, 1989, 320). TAM has also been recently used in a case study that evaluated portal adoption in a large telecommunication company (Detlor, 2004).

A combination of TTF and TAM into one extended model has proven to be a superior model to either the TAM or the TTF model alone (Dishaw and Strong, 1999). Therefore, the PMM will use concepts from both models, adapting them to the portal's context. The PMM has 4 variables inspired by TTF factors, 4 variables related to perceived usefulness, and 2 variables associated with ease of use, which is not only a TAM concept, but also a TTF factor.

It is an accepted scientific practice to remove, with justified reasons, some variables from a generic model when it is applied to a specific context. For different reasons, the following TTF factors have not been taken into account for the development of the PMM: TTF3, TTF6, TTF7, and TTF8. Authorization (TTF3) is definitely not a critical issue for intranets and portals, which are virtual environments that are usually accessible to all the users within the organization. Production timeliness (TTF6) and relationship with users (TTF8) have been removed because they are beyond the scope of this research in that portal managers will be initially involved. Finally, realiability (TTF7) was eliminated from the PMM due to the high predictability of portal environment. As the amount of users is known by the organization, it is quite easy to preview the demand, and scale the system to support it in a reliable manner.

On the other hand, the factors TTF1, TTF2, TTF4, and TTF5 have been incorporated into the PMM. The three quality dimensions comprised by TTF1 are fundamental because information retrieval is the quintessence and the most basic motivation for intranet and portal existence. Analogously, locability (TTF2) is also critical, because it will worthless to have high quality information, if the user is not able to find or understand its meaning. Compatibility (TTF4) was kept in PMM because one of the greatest portal's challenges is to integrate heterogeneous IS. Ease of use (TTF5) was chosen for being not only a TTF factor, but also a TAM concept. The final list of technological and informational variables of the PMM is presented in Table 3.

Technological Variables	Informational Variables
(t1) Integration	(i1) Quality of information
(t2) Categorization	(i2) Locatability
(t3) Search engine	(i3) Meaning of information
(t4) Content management	(i4) Compatibility
(t5) Workflow	(i5) Productivity increase
(t6) Collaboration	(i6) Job facilitator
(t7) Presentation / Personalization	(i7) Job quality gain
(t8) Notification	(i8) Usefulness
(t9) Security	(i9) Ease of training
(t10) Measurement	(i10) Ease of use
(t11) Development environment	
(t12) Infrastructure management	
(t13) Knowledge maps	
(t14) e-Learning	

Table 3. Variables related to portal maturity

4 – KM Maturity Models

The strategic role of knowledge in innovation processes has contributed to the development of Knowledge Management (KM) initiatives. KM refers to identifying and leveraging the collective knowledge in an organization to help it compete (von Krogh, 1998). KM intends to be an area of research and practice that deepens the understanding of knowledge processes in organizations, and develops procedures and instruments to support the transformation of knowledge into economic and social progress (Carvalho and Ferreira, 2001). In fact, different aspects of these issues have been studied for decades in many different disciplines, and one of the most important contributions of the KM concept is creating a space (in academic and business world) where these many groups and points of view may discuss and work together.

Nevertheless, some doubts arise whether the KM initiatives are successful or if KM is just another management fad. To answer these questions, both researchers and practitioners have developed different approaches to understand and measure the impact of KM (Paulzen and Perc, 2002). Two of the most widely known approach among practitioners are the APQC (American Productivity & Quality Center) Road Map to KM results, and the KMMM (KM Maturity Model) developed by Siemens. The APQC Road Map is a methodology to guide organizations through the five stages of KM implementation, with relevant advice concerning processes, structures, and enablers (Hubert and O'Dell, 2004). The APQC Road Map provides a qualitative evaluation of KM practices.

The KMMM provides qualitative and quantitative results, allowing a comprehensive assessment of the KM activities which covers eight key areas: strategy and knowledge goals; environment and partnerships; people and competencies; collaboration and culture; leadership and support; knowledge structures and knowledge forms; technology and infrastructure; processes, roles, and organization (Ehms and Langen, 2002). The KMMM received a strong influence of the CMM (Capability Maturity Model) of the Software Engineering Institute (SEI) at Carnegie Mellon University. Although the CMM (Paulk et al., 1995) is applied to the software development context, the KMMM adopts the same name for its five levels, and adapts the maturity concept to the KM domain.

In a maturity model, the levels are characterized by specific requirements which have to be achieved on that level, and it is highly improbable to skip a level in an evolutionary process. The five levels are: initial, repeatable, defined, managed, and optimizing. The maturity level is assessed for the individual topics and condensed into one maturity level for each key area.

Compared to a subject such as software engineering however, the domain of KM consists more of soft subjects to be considered. However, the existence of open standards and common approaches for KM will allow future work to start from a higher level, and the most arguments which are brought against standardization of KM can be classified as general concern against standardization (Weber et al., 2002).

In order to establish a more consistent link between information and knowledge processes, the Portal Maturity Model proposed in this paper will also have the Knowing Organization Model (Choo, 1998) as a theoretical background. This framework describes organizations as systems where the processes of sensemaking, knowledge creating and decision-making are continuously interacting.

Sensemaking is related to how the organization interprets and makes sense of its changing environment which leads to shared meanings and intent. Knowledge creation is accomplished through the conversion and sharing of different forms of organizational knowledge, resulting in new capabilities and innovation. Finally, the organization processes and analyzes information through the use of rules and routines that reduce complexity and uncertainty (Choo, 1998).

Some of the KMMM key areas overlap with the knowing organization dimensions, so the two models were combined into a single set of KM variables described by Table 4. The technological key area of the KMMM was disregarded here because it was already considered through the technological variables of the PMM.

Variable	Knowing Organization Model	KM Maturity Model
(km1)	Sense-making	Environment and partnerships
(km2)	Sense-making	Strategy and knowledge goals
(km3)	Knowledge creation	Collaboration and culture
(km4)	Knowledge creation	Knowledge structure and forms
(km5)	Knowledge creation	People and competencies
(km6)		Leadership and support + processes and roles
(km7)		Measurement
(Km8)	Decision-making	

Table 4 – KM variables

Therefore, the KM perspective of the PMM receives inspiration from a scholar framework and a practitioner model. Figure 1 provides a graphical perspective of the PMM that is designed to analyze the possible correlation between portal maturity (left side of the model) and KM maturity (right side).

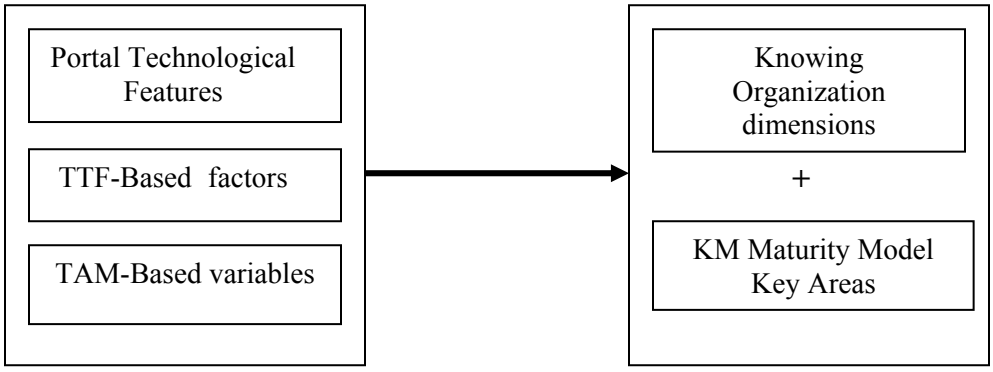

Figure 1 – Portal Maturity Model (PMM)

5 - Exploratory Research

The PMM is a model which consists of key practices associated with portal development and maintenance. These practices are related to the deployment of a comprehensive list of portal's features, content management procedures, and integration to business processes. The research model's variables have been translated into a portal maturity questionnaire, providing a tool for identifying areas where a knowledge portal needs improvement.

The purpose of the exploratory research was to pretest the constructs of the PMM, and proceed the initial steps in order to validate the model. The model variables were converted into a Web-based questionnaire using Likert scales (0-10). The answers were recorded in a secure SQL database. The first part of the questionnaire was related to portal maturity and had 44 items. The second part was KM-oriented with 24 questions, and the last part had 7 social and geographical questions.

Therefore, in the beginning of 2005, the model was tested on 59 Brazilian organizations and 3 Portuguese organizations. All the organizations belong to either Brazilian KM Society (SBGC) or Portuguese KM Society (APGC). All portal projects had more than 2 years, all the organizations have more than 100 employees, and 65% of the organizations had more than 1,000 employees.

Among the organizations, 18% were related to government, 15% belong to the banking industry, 9% were chemical and petroleum industries, 9% belong to the utilities sector, and the rest is distributed across 15 industries. Among the respondents, 42% were from IT department (webmasters, intranet leaders, CIOs), 22% were from HR (Human Resource) department, 16% had specific KM roles (CKOs or KM project leader), and the rest was from other departments (communications, research and development). Users were not involved at this stage of the research. Table 5 shows the mean of the technological variables in a descending order, i.e. from the best to the worst supported feature.

Technological Variable	Mean
(t1) Integration	6.42
(t10) Measurement	5.42
(t12) Infrastructure management	5.39
(t14) e-learning	5.08
(t9) Security	5.06
(t6) Collaboration	4.97
(t11) Development environment	4.48
(t2) Categorization	4.10
(t7) Presentation / Personalization	4.03
(t4) Content management	3.60
(t3) Search engine	3.59
(t5) Workflow	3.56
(t8) Notification	3.20
(t13) Knowledge maps	3.03

Table 5 – Mean of technological variables

It is interesting to notice that the organizations evaluated in this survey have achieved their better score on the *integration* (t1) variable, showing that the portal effort is closely related to the challenge of integrating heterogeneous information systems. However, the integration is still quite superficial, as *categorization* (t2), *content management* (t4) and *workflow* (t5) show the need for a better link between non-structured information and business processes.

Overall, the results demonstrate that the evolutionary path from intranets to portals is not as easy and fast as it may seem. Many of the technological features are deployed at a very basic level, e.g. *search engine* (t3). In addition, *knowledge maps* (t13) have got the lowest

mean, giving some tips that organizations have problems concerning classification not only of documents, but also of knowledgeable persons.

The informational variables have presented a better performance than the technological ones, as shown in Table 6. Within the scope of this survey, portals were considered as *useful* (i8) and *ease to use* (i10) tools, but the *compatibility* issue (i4) was poorly evaluated, reinforcing the hypothesis that the integration level is superficial. Portals work as a launch pad to many applications, but not always those systems share the same interpretations of data or agree upon a common ontology.

Informational Variable	Mean
(i10) Ease of use	6.64
(i6) Job facilitator	6.41
(i8) Usefulness	6.41
(i9) Ease of training	6.39
(i7) Job quality gain	6.34
(i5) Productivity increase	6.10
(i1) Quality of information	5.75
(i2) Locatability	5.66
(i3) Meaning of information	5.47
(i4) Compatibility	3.75

Table 6 – Mean of informational variables

Finally, the KM variables showed that the analyzed organizations are in the early stages of KM maturity. According to Table 7*, measurement* (km7) and *leadership* (km6) gained the lowest grades, indicating the lack of specific KM roles and assessment efforts. In other words, some KM-based approaches can be seen in these organizations, but KM is still done in a quite informal manner. Curiously, *measurement* (t10) of portal usage was one of the best aspects among technological variables, but the opposite happens to *measurement* (km7) of KM efforts. It certainly occurs because the first one (t10) can be easily automated by using web track software, while the other (t10) requires a previous discussion of what needs to be measured and how it should be done.

Knowledge Management Variables	Mean
(km5) Knowledge creation + People and competencies	5.76
(km1) Sense-making + Environment and partnerships	5.47
(km8) Decision-making	5.04
(km2) Sense-making + Strategy and knowledge goals	4.95
(km3) Knowledge creation + Collaboration and culture	4.90
(km4) Knowledge creation + Knowledge structure and forms	4.65
(km6) Leadership and support + process and roles	4.39
(km7) Measurement	3.23

Table 7 – Mean of knowledge management variables

On the other hand, the competitive environment is pushing organizations to look outside its boundaries (km1), and develop partnerships with customers and suppliers. Furthermore, Human Resources (HR) initiatives, such as competence management (km5), are gaining visibility, and the KM initiative may take advantage of this in a long term.

6- Conclusion

The Portal Maturity Model (PMM) presented in this paper intends to be a proposal for a common framework to portal assessment. Portals are being implemented as the major technological infrastructure of KM projects. Therefore, organizations need instruments to evaluate whether the expected effects are being achieved or not. Moreover, organizations may find useful to have a landscape of key areas for portal and KM. The main intention of the PMM is to help organizations in increasing the maturity stage of their portal and KM practices.

Nevertheless, the PMM still has some limitations. Due to the size of the sample at this stage of the research, it is still not possible to verify whether there is any correlation between portal deployment and the success of KM initiatives. It is an interesting point for further investigation because it is not always the same staff who is responsible for both projects (portal and KM) within the organization, making it harder to obtain a synergic effect. In addition, it was also not possible yet to make a factor analysis with Varimax rotation which would allow the refinement of the PMM's variables.

As a future work, this questionnaire will be made accessible to Canadian organizations which have intranet or portal initiatives. Brazilian and Portuguese KM Societies (SBGC and APGC) have already agreed to participate in the next phase of the survey through their discussion lists. The authors are expecting to reach more than 150 organizations from three countries in the next phase, allowing the execution of factor analysis procedures and reliability tests. One of the aspects of the next phase will be the cross-country analysis in order to investigate the distinctive characteristics of KM in each country, and the influence of cultural knowledge on KM practices as well. The last phase of the research will comprise in-depth case studies within two or three organizations, involving a larger number of portal users.

On the other hand, it is important to report that the 62 respondents who participated in the survey have found the PMM quite useful as a diagnosis mechanism for their portals. Some respondents have commented that the PMM has helped them in identifying strengths and weakness of their portals and KM initiatives. The exploratory research presented in this paper was an important step of the PMM validation process. Moreover, the feedback received from the respondents has shown how useful the PMM can be in supporting organizations in their portal evaluations. By using the PMM on a regular basis, e.g. every six months, the organization can track better the evolution of its portal towards a higher maturity level.

The PMM can be considered an innovative model because it combines studies from Information Science and Information Systems literature, adapting them to the portal's context. In addition, the PMM tries to establish a link between technological and management perspectives in order to increase the benefits of using portals to support KM processes.

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