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Application Integration and Portals : A Brief Survey and a Roadmap

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ABSTRACT

The purpose of this paper is to analyze the level of system integration among organizations that have deployed intranets or portals. In spite of being independent technologies, portals and EAI have in common the integration issue, and the combined usage of both may produce the synergic effect on application integration processes. The paper presents an instrument to analyze the integration level and the PMM (Portal Maturity Model) which can be used to assess the contributions of intranets and portals to Knowledge Management initiatives. According to the identified issues, this study suggests some guidelines for system integration projects.

Keywords

Portals
KM
technology
PMM
EAI
application integration

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1. INTRODUCTION

At the beginning of computing, information was processed in centralized systems. The demand for systems integration occurred in an environment that was more heterogeneous. However, over time, the paradigms of computing were changing and new technological platforms emerged. As a consequence, most of the organizations currently use multiple types or generations of systems developed over the years. These legacy systems have value for businesses, but this may mean little if they cannot "talk" to other systems, thus becoming islands of information. Adding to this complex scenario the advent of web-based technologies, generating the need for integration between this environment and a set of applications dispersed among the various departments in the organization.

In the mid-1990s, an approach known as EAI (Enterprise Application Integration) emerged as an alternative making possible the integration of enterprise applications with less customization than required by the ERP systems (Enterprise Resource Planning) (1). The EAI contemplates the tools, methods and planning that enable the organization to gain a competitive advantage with the integration of all applications in an enterprise system unified, able to share the information and support the processes of business flow. The approach of EAI search the unrestricted sharing of data and business processes (5), reducing the complexity of integration (6). In addition, some technology companies have provided their products with new features and capabilities to meet those needs.

In parallel to the movement of systems integration, since the end of the 1990s, the term “portal” has been used to designate a new focus on systems based on the intranet and Internet. The volume of information that needs to be managed by organizations is that with portal technology originated from the Internet is very useful for organizing the corporate environment. Organizations have implemented portals in an attempt to consolidate departmental intranets, because one of the main attractions of portal 2 technology lies in its ability to integrate disparate sources of information through a single interface to the user (21). The mission of corporate portals is to do away with the islands of information systems, by integrating them into a single application that would be port of entry for all users.

Although they are independent technologies, the portal and the EAI have in common the goal of integration. The ability of the portal to provide a unified interface to the information systems can be highly leveraged with the adoption of EAI in the rear. Considering the potential for synergistic combination between these two technologies,

this article proposes to analyze the level of integration of applications in the context of intranets and enterprise portals of medium and large Brazilian organizations.

The article is organized as follows: section 2 presents an overview of the technology of EAI. Section 3 discusses the main features of a corporate portal, identifying variables to the instrument for the evaluation of the level of integration. On the basis of the problems identified in 94 Brazilian organizations, sections 3 and 4, it is proposed a roadmap for systems integration. The conclusion summarizes the main points and suggests future work.

2. MECHANISMS AND SYSTEMS INTEGRATION

Recently, the term EAI has been used to label solutions for integration of systems that use middleware technologies (2, 3, 4, 9). Some patterns of EAI are described in (1, 3, 4, 14, 17) and in (2) is presented with a view to reducing the middleware components in the industry. Based on the literature of the technologies used in EAI, are presented below, some types of solutions and technologies that provide support for the integration of enterprise systems.

There are systems of middleware that allow an application to communicate with another application. A type of middleware called point-to-point allows an application to establish a connection with a application B and communicate through messages or calls of procedures, RPCs, among others. The middleware is responsible for establishing communication and translation of messages between the application A and the application B. An example for such a link are the applications connected by middleware guided by messages (MOM).

In the integration of applications in an organization, the number of end-to-end solutions can grow exponentially to allow sharing of information between different systems. The connections between the systems can be set up in disarray, without centralized control and management. To resolve this type of problem, a class of middleware products allows the connection many-to-many applications.

Application Servers and ESBs (Enterprise Service Bus) are some examples of the type of middleware many-to-many, among others (2, 3, 4, 7). The Application Servers are the communication in a variety of ways including calls to procedures and connections of type MOM. They can be used to ensure that the rules of business and maintain the integrity of the data or even allow the creation of entire applications with transaction services. Its usefulness in EAI is facilitated due to its ability to integrate 3 back-end and the possibility of uniting various applications using adapters and connectors. Additionally, the standard most commonly used is the Java within the initiative of J2EE (Java Enterprise Edition) (10, 11, 13, 17) and an alternative are the implementations of the scaffold of Microsoft's .NET (8).

Already the ESBs consist of the implementation of the principles of service-oriented architectures (SOA) that describe a type of information technology infrastructure in that its components can be accessed as services and are called through an interface (7). Some commercial vendors have incorporated this type of architecture to their respective Application Servers (7, 10, 11, 13).

For the integration of data, some tools do the work to move and transform the data while maintaining the integrity of a database management system (Oracle's for another Oracle's. There is also an approach called database system unifying that enables us to treat different models, restrictions and languages of consultation between separate databases in an organization (12). A class of middleware includes extraction, transformation and loading (ETL) of critical applications of the organization for the data warehouses with the purpose of providing support to the decision-making processes (2, 12). Another type of middleware, called bridge or SQL gateway, facilitates access to Oracle's through a common interface as the Java Database Connectivity (JDBC) and others, thus allowing access to the databases that reside in distinct environments.

The communication between the applications can also be done through some types of interfaces. For example, a type of connection establishes a common point of integration using communication mechanisms of the interfaces of the users. This means that applications that operate in the mainframe environment can be displayed visually to the user. This type of integration can be achieved by technologies similar to those adopted in terminal emulators. Another mechanism allows, through the programming interface of the applications (API), access the processes and data from ERP systems such as SAP, Baan and others. Another type of technology includes systems for workflow or workflow management, which allow the definition and the automation of workflows and the mapping of processes in organizations. These systems can be built as a tool in ERP systems or in a set of integration solutions (8, 10, 15).

The frameworks are important allies in the understanding of the complexity of the elements to be integrated in the context of EAI, for they establish the relationships between the various technology components to be integrated and also allow the reuse of subsystems, architectures, and the code in existing applications. Some standards are used in the context of J2EE from Sun and Microsoft's .NET.

In called componentization, you can define data and business rules as reusable components that will be integrated with legacy systems. This means that any Java application, or .NET can be developed and carried out the encapsulation of another existing application environment in the mainframe. however, the challenge is in the resources needed for its implementation from a single solution provider.

Finally, in some integration scenarios, the corporate portal uses a common interface for the integration of data and processes. This approach allows the use of Web browsers on the client side for access to systems and data sources of corporate organizations on the server side. The Application Servers and Web servers provide the basic infrastructure for solutions based on portals (3, 15, 16).

3. PORTALS

The intranet is an important channel of communication between the company and the employee, and is usually characterized by the acronym B2E (business to employee) as opposed to symbols used for Web systems for e-commerce and B2B (business to business) and B2C (business to consumer). The integration of collaborative systems with the intranet and the structuring of networks of communities make the intranet can also be characterized by the acronym E2E (employee to employee).

The intranet can be defined both technically and functionally. In technical terms, the intranet is a computing environment heterogeneous that connects different hardware platforms and operating systems through an integrated interface with the user (26). Already from an organizational point of view, the intranet is a tool capable of integrating people, processes and information.

Since the end of the 1990s, the term portal has been used to designate a new focus on systems based on the intranet and Internet. The corporate portal represents a variation of the concept already very familiar to Internet portals, such as Yahoo and other. Despite the growth of the market of portals, remains valid observation (23) that the terminology related to the term corporate portal has not yet stabilized. For the sake of completeness and technological independence, it was decided to adopt the definition proposed by (22):

"*The corporate portal is a custom interface to online resources that allows information workers to access and share information, to make decisions and perform actions regardless of their physical location, the format of the information and the location in which it is stored.*"

The components of a corporate portal can be interpreted as evidence that aggregate benefits distinct functional for the user. In the literature, can be found different relationships of features of portals and checklists (16, 24, 25, 26, 29 and 30). Among the features mentioned most of existing proposals, can be highlighted as follows: integration, categorization, search engine, content management, workflow, collaboration, personalization, notification and map of knowledge.

Integration is the functionality of the portal that serves as the basis for the other components, and the greatest effort required for the construction of a portal is precisely the systems integration (27). The integration of the various systems is the main problem in the implementation of portals, because without this integration the portal will be just a pretty facade for a structure chaotic informational (25). The technological movement associated with portals can be perceived as the stage latest of an ongoing trend of systems integration, which also has the data warehouses and ERP systems as representatives (25). The type of digital information accessible through the portal varies from highly structured, as the stored in relational databases, until highly unstructured, such as documents, Web pages and electronic messages (30).

Already the functionality of categorization of portals is associated with the definition of organizational information such as lists of terms, hierarchies of categories, Thesaurus, software and ontology. The existence of classification schemes contributes to increase the quality of the searches and consequently the quality of the results obtained by the end user (28). In (30), is defended the position that companies need to develop categories and information structures that make sense for their own business and their specific communities who use the portal, because many organizations have discovered that people don't tend to use search engines.

The functionality of presentation is responsible for paradigm of single point of access (SPOA - single point of access) that characterizes the portal. The corporate portal aims to be a user-friendly interface and integrated, that is, a front-end based on Web standards that east end user in his navigation through the various information systems. The collaboration functionality is related to the ability of the portal is a virtual meeting place for people who share common goals, giving rise to communities of interest and discussion groups. The component of collaboration expands the role of the portal of a kiosk passive information for a forum of organizational interactions (24).

4. 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 (32). 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 (33).

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 (34).

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 (35)	Terra and Gordon (36)	Firestone (37)	Hazra (38)	(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.

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. PROPOSAL FOR THE INTEGRATION OF APPLICATIONS

In view of the above problems, can be proposed a roadmap for the integration of applications in the context of portals, based on (19). The script uses a set of solutions presented in section 2, and is derived from a set of industry standards. The roadmap also adopts integration practices of corporate systems and proposes an approach of bottom-up to the definition of the portal. The suggested steps are the following:

Architecture: comprises the preparation of an updated portrait of systems architectures and which applications and data warehouses that require sharing information. This is an initial step to analyze what technology middleware will allow solving a particular problem. The organization must also understand the processes and data that are available, as each one remains without the cooperation of the other and that it is a requirement of one system or another. Cloud computing also must be taken into account even if the systems are hosted in the provider.

Group: involves the prioritization of the consolidation of systems with similar functions, diagnosing the processes which are competitors among themselves and that they have the same features.

Standard: consists in the use of standards including data models and objects. The definition of an integration architecture and the selection of systems and technologies are important in understanding and analysis of the elements and technological solutions to be used. In addition, it is recommended to re-use of components by using best practices.

Mapping and division: encompasses the logical division of integration components in origins and destinations. The workflow and integration of applications can be understood and mapped with the adoption of this practice.

Project Management: includes the definition of the integration project using practices such as those described in PMBok (20). Includes the identification of scope, technical requirements, quality assurance software, testing methodology, change management and implementation;

Development: consists of the construction of integration services, including the recommendations of the architecture or solution adopted and implementation of ongoing testing of integration. The set of technological elements and business rules commonly bring an additional complexity to the process of integration.

Business requirements: consists in the identification of business processes that require integration of applications. This alignment is important for the setting of priorities and the establishment of plans for short, medium and long term.

7. Conclusions

The linkage developed throughout this article relative the features of portals and the technology of EAI intends to contribute to an increased understanding of the issue of integration. From this perspective, the corporate portal can greatly benefit from tools and techniques existing EAI. Otherwise, the portal can become just a superficial showcase and disposable architecture of chaotic systems.

Another contribution of the article is the roadmap proposed in section 4. This script is not intended to be a full and definitive version for the integration of the entire universe of corporate applications, but a guide to the basic steps of the process of integration of applications. This map is intended for future work analysis of the continuous processes of integration. This guide should also consider the evolution of business processes. The application and extensions of maturity software models will be considered with solutions for application integration.

In situations in which the architecture of information systems is complex and marked by heterogeneity, it is fundamental to prioritize which systems should be integrated initially to the portal. Resources are few and there are deadlines for 'integrating everything at once ". In possession of an instrument of evaluation and a roadmap, organizations will have better conditions to enjoy the benefits of synergy between the technologies of EAI and corporate portals.

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.

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