Abstract

Competitive organizations are facing a variety of problems as a result of advances in management techniques as well due to the delay in the introduction of these in business management models. One of the biggest and critical problems for competitiveness in the globalised market is the creation of a technological infrastructure for real-time decision-making. But the combination of technologies, such as Service-Oriented Architecture (SOA), Web Services (WS) and Information Architecture (IA), promises to revolutionize the way in which organizations compete, speeds up decision-making, and take leverage of market opportunities. However, these technologies still face challenges that need to be overcome. Based on the literature review, the scope of this article is to discuss the main issues and the development of organizational modeling technologies, and presenting an online and real time business architecture framework.

Keywords: information architecture; business architecture framework; service-oriented architecture (soa); processes modeling and analysis; information technology.

1. Introduction

In Information Technology (IT) field, changes occur at a dizzying pace. One of the reasons is that the patterns and process automation models became commodities worldwide [1]. Automation happens because decision-making needs to keep pace to take advantages of the opportunities and to not lose the competition. The variety of tangible and intangible assets that compete for consumers in the global marketplace also grows at an accelerated rate, resulting in an increased supply and competition, and limiting the ability of sales.

* Corresponding author. Tel.: +55-21-2682-1701; fax: +55-21-2682-4850.
E-mail address: saulobarbara@gmail.com
To operate in globalised markets requires agility, time, resources, and capacity to transform the company into a flexible online and real time organization. As Varajao et al. say, the definition and management of these requirements is the responsibility of managers [2]. Thus, to operate in this kind of market, it also requires managerial competence. This is not an easy task, because each organization has a specific business environment and its own culture [3]. This represents one of the biggest problems in the creation of a business operating model, since operating real time organizations requires reshaping its Information Architecture and its Management Model. In this case, the Business Processes Management (BPM) is one of the essential requirements, but it needs to rely on others technologies that offer support for online business information architecture [4] [5].

This work aim to discuss the main issues and the development of organizational modeling technologies and to present an online and real time business architecture framework based on the literature review.

The rest of this paper is organized as follows. Section 2 provides an overview of process and organizational modeling. Section 3 describes the online and real time information architecture. Section 4 is about the business-oriented architecture, its problems and solutions. Section 5 presents the modeling techniques and the models construction. Section 6 is concerned with consolidation of the proposed framework. Section 7 describes trends and future perspectives. Finally, Section 8 provides conclusions.

2. Process and organizational modeling

The reengineering processes, with the publication of Hammer and Champy’s work [6], attracted the attention of executives and, more recently, the BPM gained importance and expanded to different classes of business, which makes a very vast literature about this topic [6] [7] [8] [9] [10] [11] [12] [13] [14] [15] [16].

A business model, built from observation and study of the real world, represents a business components identification, organized accordingly the relationships among its processes, sub-processes, activities and tasks. In this sense, developing process model eases the business specifications alignment with the necessary technique for the development of its architecture and helps to keep the business vision synchronized with the processes.

The modeling ensures consistency and the capture of relevant information, in a way that analysts and developers understand the business requirements that should be modeled. Models are useful in the analysis of existing processes or to create new processes for improving the existing ones. Modeling begins organizing business processes into sub-processes and proceeds, with the examination of each sub-process to identify its components, services, input and output, policies and measures [10].

The business model can be constructed based on various perspectives. The adopted perspective depends on the understanding of the people responsible for the modeling creation and the tools and techniques used.

Organizational models construction process is arbitrary and based on abstract or mental models, which varies from author to author, whose main purpose is to establish a management model suitable for culture, structure, technology, people and organizational processes. To better understand this issue is necessary to conceive the organization as a system. Schon [17], using the epistemological vision, in which the organization produces and reproduces knowledge, was the first to consider the organization as a system with three dimensions: structural, technological and theoretical. The structural dimension sets out people roles and relationships. Technological dimension is rules, techniques and tools set, whose purpose is to "optimize" the activities and achieving goals and targets. Finally, the theoretical dimension is the repository of rules that regulates the organization functioning.

As another example, Cruz [18] proposes that the organization is understood and administered under a model consisting of three interconnected elements – processes, people, and IT – aimed to support the organizational functioning. Processes refer to the set of activities and tasks, people are attached to their functions and their relationship, and IT means information technology.

In a complementary manner, Nalbone et al. [12] understand that organizations need to be modeled in order to provide the necessary agility, using the following model components: a) the business rules specifications; b) the company business processes model; c) the enterprise model domain; d) company’s vision and mission explanations; e) the organizational model.
Dreiling et al. [5] make the distinction of organizational modeling according to three perspectives: (a) administration, (b) business process analyzer, and (c) the analysis technique. The first allows the communication of process models based on organizational system and administrative functionality. The business analyst perspective allows to "implementing" stakeholders and other organization partners. The technique perspectives allow business processes specification in a way that IT can execute it.

3. The online and real time company

Companies must also anticipate trends, identify new opportunities, transform its strategy and redeploy resources to stay ahead of the competition [4]. Online means the company needs to be interconnected with all stakeholders on its business (suppliers, partners, customers, etc.) through a communication network operating 24 hours per day and seven days per week. Real time means that the critical activities of "business processes chain" are deployed in order to provide, to stakeholders, the business establishment and implementation (purchases, sales, hire, etc.) exactly at the same time the transaction occurs.

As who decides what, who, and where to buy is the client, the opportunities for acquisition of goods and services offered by the company need to be available for consultation by potential customers, anytime, anywhere (online and real time). The IT infrastructure must give the required support to provide customers with all the information necessary for your purchases, such as specifications of products and services offered, price lists, discounts, payment facility, etc., through a communication network able to answer questions, provide guidance and recommendations in an easy, fast and dynamic way. Under this guidance, BPM, along with SOA (Service-Oriented Architecture) and WS (Web Services), provides the technological tools to make the organization able to operate in real time, while managers make use of the resources that enable process governance, giving visibility and transparency in decisions, actions and activities of the business as a whole.

The WS association with other tools, such as BPM Systems (BPMS), BI (Business Intelligence) and large corporate databases (Data Warehouse), gives the organization technological resources for knowledge management based on information and enables better understating of the competition and speeds up decision-making [8].

For Zhao et al. [19], "The web services standards represent a neutral language independent technology platform that enables new e-business partnership strategies to create new service-oriented business and develop a third party software based on an open standard". But to take advantage of these technologies, IT specialists and business strategists must change the conception of how the organization is structured to the business, in order to create new business strategy and IT models. This can be done through the creation of an architecture business support, cases’ modeling, which consists in developing and deploying models.

4. The business architecture, its problems and solutions

The business-oriented architecture is based on a new paradigm: the online and real time organization, or, as called by Cruz-Cunha and Putnik: “The Agile/Virtual enterprise (AVE)”. For these authors, this type of organization cares about “Implementation and Management Support as a highly dynamic, agile reconfigurable network of independent enterprises sharing all resources, including knowledge, market, and customers, using specific organizational architecture that introduces the enterprises true virtual environments” [20].

4.1 Virtual models development and limitations

Another big problem when building an infrastructure that will support the business achievement quickly and safely is the limitation of the IT application (software and systems). Although the software development has evolved significantly, passing the model known as Information Engineering (IE) to Object-Orientation (OO), where lies most of the leading companies in this area, software engineering specialists have already realized that the OO model is not the best solution for developing BPMS, which requires a more dynamic and capable way to incorporate the business world changes with required flexibility and agility [21].
The OO and its predecessor (IE) are data models, which makes the “implementation” of changes in software at the same speed in which they occur in the real world. As business rules also change quickly, modifications, fixes or the introduction of new rules imply software components maintenance, such as computer programs, files, database records, workstation screens, etc., in addition to time and financial resources involved [21]. Therefore, these applications maintenance traditional model is incompatible with the desired online and real-time organization requirements. Also it is difficult to business people to understand the specifications and modeling languages used, what makes the models development strictly for IT professionals, creating and strengthening knowledge feuds or islands: an extra difficulty in the path of technology integration.

The solution may be in the use of business virtual models. Virtual architecture is the main requirement for BPMS efficient functioning, allowing its dynamically update each time the business rules changes, without stopping the system. That is, virtual architecture allows business rules to be changed quickly and pass immediately the new way and business conditions to managing, minimizing time and resources normally wasted in the traditional applications development and maintenance models. Additionally, the description language of business-driven models are easier, friendly, better understood, used and manipulated by both IT and business specialists, which enables them greater freedom of action and participation in the business process modeling.

### 4.2 Searching for application integration

The concept of application integration architecture emerged with systems such as “Client-Server” in the second half of the 1990s. Its history is marked by the use of proprietary software and interfaces, generating interconnection and interoperability problems, such as those that occurred with the Enterprise Architecture Integration (EIA). Such problems are due to the fact that, with the use of proprietary technologies, for each new application to be integrated in the BPMS, is necessary to develop or install a specific interface, which consumes a lot of time and resources away from the company’s online and real-time concept. The solution was to use the opened architecture with standards interfaces to facilitate the interconnection and interoperability of the different systems and applications required to run the company [22] [23].

The EAI first model arose in 1996. Then came the Web Services architecture introducing several improvements. It should be noted that, in Figure 1, the reference to each model appearance year was estimated based on literature, since these dates do not have absolute precision.

![Fig. 1. The architectural models evolution](image-url)
Currently, the most widely used technologies in the implementation of application integration architecture is offered by WS, with some SOA concepts [23]. In other words, the most current integration solution includes features and capabilities of both architectures, WS and SOA, but has not solved the problems described before.

The Enterprise Service Bus (ESB), an evolution of WS and SOA, promises to solve the described problems. ESB concept is the next generation of integration architecture that can be applied to a very broad-spectrum integration project [22]. However, the ESB is still in the maturing process, such as occurs with the SOA, so some of its facilities have been used in addition to the services offered by previous architectures. Figure 2 shows a basic SOA conceptual model, serving as a means of integration between the various business processes and the BPMS.

![SOA conceptual model](image)

Although Web tools are still in its infancy with many of them lacking features desired by users, it should not be forgotten that each technology generation brings resources to the creation of the next step, and successive generations take place accelerating the pace, where new technologies incorporate best practices of their predecessors [24]. In BPMS case, each component (EIA, BPM, SOA, Web Services, etc.) provides facilities and benefits that complement each other, and “these technologies integration is one of the trends of the next years” [25].

5. Modeling techniques and the models construction

The models of Figure 3 are based on theoretical reference and aims to present a modeling based on three dimensions easily identified in any organization: the strategic dimension, the business size dimension, and the technique dimension [26] [27].

The first two models, designed by business professionals (middle management specialists and senior management specialists), build logical structures. The last model is a physical structure that combined with the first two models form the business support architecture. Corporation strategic objectives and business design are inputs to the business model.
Questions such as “what to do in the long term?” and “what products or services offer?” help define the business scope. The inputs of the strategy model are business strategies. Questions as “how to achieve those goals?” and “what are the alternatives?” contribute to forming the business strategies. In the case of the technological model, the inputs are the software and equipment that will shape the IT infrastructure. The work of model construction requires a specific type of modeling for each of these dimensions [28] [29]. Generally, the first two modeling types are business people responsibilities, and the last is up to IT people, although the job requires collaboration and joint participation of both parties. The modeling result (output) will be used in the development and implementation of the application integration architecture models (EIA, WS, SOA and ESB) discussed earlier. According to Balloni [30], this is the “IT infrastructure, a platform on which organizations constructs the Information Systems”. It deals with the particular project that IT adopts in a specific organization (Information Integrated Systems).

The Figure 4 makes explicit that for an organization to have competitive advantage it is necessary to have its management tools – SCM (Supply Chain Management), CRM (Customer Relationship Management) and KM – integrated. This integration necessarily exceeds the organization boundaries, forming for each organization a unique cross-organizational system, with its automation. This business processes automation is related to specific interest of each enterprise, which transposes multiple organizational functions and levels as well the systems of SCM, CRM, KM and BAM (Business Active Monitoring) [30].

Business activity monitoring (BAM) is what aids in monitoring of business activities, as these activities are implemented in computer systems. The term refers to the aggregation, analysis, and presentation of real-time information about activities within organizations and involved customers and partners. A business activity can either be a business process that is orchestrated by business process management software (BPMS), or a business process that is a series of activities spanning multiple systems and applications. BAM is an enterprise solution primarily intended to provide a real-time summary of business activities to operations managers and upper management [30].
5.1 **Strategy modeling**

This modeling, delegated to the senior management, focuses on corporate strategy, vision, mission, goals, and business capacity of the organization, which are the elements commonly reviewed in organization strategic planning cycles. Having these elements as input, then it's time to describe business policies and its macro-processes, as shown in Figure 5. The generated output will be the strategy model, which guides the business conduct.
5.2 Business modeling

In business modeling, the staff focuses on the details of "how the business should work", in terms of projects, processes, data, and rules that govern organizational activities. The biggest concern at this stage is the complete workflow, where critical activities and their interrelationships are driven by events that occur inside and outside the organizational environment. The business objectives, its detailed rules, and all organizational activities, are the inputs of this phase. The output is the construction of business process models, as shown in Figure 6.

![Business Modeling Diagram](image)

Fig. 6. Business modeling [26] [27]

5.3 Technical modeling

The technical modeling takes care of technological artifacts definition and specification, responsible for the company operation. This is the selection and "implementation" of its components (hardware and software) for mounting the services platform, under which will be integrated the business processes and its operational procedures. The objective of this modeling is to create the infrastructure support in a way that the organization is able to work in service-oriented mode. Thus, the less dependent on manufacturers and suppliers is the service platform to be implemented, the greater its ability to connectivity, integration and operability with software and hardware from different manufacturers. For example, in such architecture (open), the database management system from a vendor can interact and exchange information freely with the databases from any other vendor. So, the ideal is to assemble an opened architecture model permitting integration and interoperability between IT heterogeneous components (from different manufacturers, types and models), as shown in Figure 7.
6. Consolidation of the proposed framework

The final phase of models construction refers to the consolidation in which all built models, Web Services, EAI, Data Warehouse and BPMS integrated on a single platform, are all managed by a control panel (dashboards) to monitor business operating environment. Figure 8 represents a possible framework geared toward making the online real time business environment framework.
7. Trends and future perspectives

Conceptually, the business models are more advanced and developed than the technological tools that give support for management systems development. Such models are usually included in BPM, which is a philosophy or discipline of understanding of these models [28].

Two trends are changing BPM research lines. One is the adoption of integration process-oriented applications concept, by most e-business solution vendors. And the other is the advancement of Web Services as a universal computing platform [19].

Process orientation is a new paradigm for integrating applications where a "workflow engine" is used as a hub or a clearing house, and a process template is used to direct the applications flow [20]. Web Services, together with workflow capabilities and computational grid, are being incorporated into existing application platforms, in order to solve the problems of applications integration [31] [32].

E-Business tools are in its initial stage of development: still missing embedded organizational structures, business objectives and processes performance indicators within the business process models.

There are still many problems and challenges to be overcome, such as how to find out the services efficiently, how to generate the service descriptions (language semantics of WS) in a intelligible way, how to automatically capture the relationships between services (interface configuration), etc [14].

Finally it is worth noting that, when dealing with services integration issue, arising from mergers and Division of companies, yet we lack appropriate solutions [13], and this deserving further studies and research.

8. Conclusions

This article concern was discussing the key technologies and problems of processes models and organizational modeling construction, presenting a proposal that emphasizes a new information architecture (Figure 4) proper for a globalised markets changes (even in the maturation process), and constituting one of the essential requirements for online information architecture.

The biggest concern of enterprise regards the difficulties in implementing a business model and an information architecture capable of: a) overcome the limitations of systems maintenance; b) enable business professionals to overcome the barriers currently imposed by technology towards the modeling of their own business processes; c) solve the problem of applications integration with the aim at creating an online information for communication, data and information exchange among inter-organizational enterprises, and facilitate joint work between the business staff and IT personnel to achieve synergy for a better BPMS performance.

The combination of BPM, SOA and WS technologies has been one of the used ways to try to overcome the problems, although they are still in the development process. Considering the increasing pace with which IT technologies are being developed and matured, we hope the new information architecture, as presented in this paper, is going to allow a solution within a few years.

References

[1] Davenport, T.H.: The Coming Commoditization of Processes. USA: Harvard Business Review; june (2005).
[2] Varajão, J. Amaral, L., Palacios, R.C., Gouveia, J.: A Framework for the Analysis of the Potential Performance of Chief Information Officers. International Conference – CENTERIS 2010. Viana do Castelo, Portugal, 2020. Communications in Computer and Information Science. Berlin Heidelberg New York: Springer (2010).
[3] Duque, J., Varajão, J., Filipe, V., Cruz-Cunha, M.M: Customer Relationship Management Systems – Reasons Why Many Municipalities do not have them. Enterprise Information Systems. International Conference – CENTERIS 2010. Viana do Castelo, Portugal, 2020. Communications in Computer and Information Science. Berlin Heidelberg NewYork: Springer (2010).
[4] Ballard, C., Farrel, D.M., Gupta, A., Mazuela, C., Vohnik, S.: Dimensional Modeling: in a business intelligende environment. IBM Redbooks (2006).
[5] Dreiling, A., Rosemann, M., Aalst, V.D., Sadiq, W.: From Conceptual Process Models to Running Systems: a holistic approach for the configuration of enterprise processes. ScienceDirect/Decision Support Systems 45, 189-207 (2008).
[6] Hammer, M., Chumpy, J.: Reengineering the Corporation. USA: Harper Business (1993)
[7] Hall, R.H.: Organizações: estruturas, processos e resultados. 8ª. Ed. São Paulo: Prentice Hall (2004).
[8] Smith, B.R., Ackerifi, C., Bradford, T.G., Chmura, A., Dumdum, U. R., Gopalan, P., James, J., Maynard, J., Abdulamir, M.: IBM e-Business: technology, solution and Design Overview. IBM/Redbooks (2004).

[9] Zhang, D.: Web Services Composition for Process Management in e-Business. Journal of Computer Systems. XLV (2), 83-91 (2005).

[10] Beck, K., Joseph, J., Golrizmzid, A.: Learn Business Process Modeling Basic for the Analyst. IBM Developerwork/Architecture (2005).

[11] Amsden, J.: Business Services Modeling: integrating WebSphere Business Modeler and Rational Software Modeler. IBM (2005).

[12] Nalbone, J., Amber, S.W., Vizdos, M.J.: The Enterprise Business Modeling Discipline. USA: Prentice Hall PTR (2005).

[13] Sun, S., Kumar, A., Yen, J.: Merging Workflows: a new perspective on connecting business processes. ScienceDirect/Decision Support Systems 42, 844-858 (2006).

[14] Chen, M., Zhang, D., Zhou, L.: Empowering Collaborative Commerce with Web Services enabled Business Process Management Systems. ScienceDirect/Decision Support Systems 43, 530-546. (2007).

[15] Garimella, K., Lees, M., Williams, B.: BPM Basics for Dummies. Indiana, EUA: Wilwy Publishing, Inc. (2008).

[16] Gregoriades, A., Sutcliffe, A.: A Social-Technical Approach to Business Process Simulation. ScienceDirect/Decision Support 45, 1017-1030 (2008).

[17] Shon, D.: Beyond the Stable State. New York: Norton Library, 1971.

[18] Cruz, T.: Sistemas, Métodos & Processos. São Paulo: Atlas, 2003.

[19] Zhao, J. L., Cheng, H.K.: Web Services and the Process Management: a union of convenience or a new area of research? USA/ELSEVIER: ScienceDirect/Decision Support 40, 1-8 (2005).

[20] Cruz-Cunha, M.M, Putnik, G.D.: Agile Virtual Enterprises: Implementation And Management Support. Polytechnic Institute of Cavado and Ave, and (University of Minho, Portugal. (2006).

[21] Debevoise, T.: Business process management with a business rules approach: implementing the service-oriented architecture. USA/Virginia: Business Knowledge Architect (2005).

[22] Chappell, D.: Enterprise service bus: theory in practice. USA: O’Reilly Media Inc. (2004).

[23] Delphi. G.: SOA: a business architecture for managing uncertainty. USA: Delphi Group, 2005.

[24] Martin, J.: Impactos dos avanços tecnológicos sobre os negócios. HSM Management 31, jul-ago., 2005.

[25] Newcomer, E., Lomow, G.: Understanding SOA with web services: independent technology guides. USA: Addison-Wesley Professional (2004).

[26] Proforma, E.: The business of SOA: evolving an agile enterprise with service-oriented architecture. USA: Proforma (2006). http://www.bpminstitute.org/resources/white-papers/business-soa-evolving-agile-enterprise-service-oriented-architecture

[27] Metastorm E.: The business of SOA: evolving an agile enterprise with Metastorm Enterprise. USA: Metastorm (2009). http://www.metastorm.com/solutions/solution_sheets/Metastorm_Whitepaper-The_Business_of_SOA.pdf

[28] Oliveira, S.B., Valle, R., Mahler, C.F., Peixoto, J.A., Mendes, O., Xavier, L., Cardoso, R.S., Neto, M.A.A., Santo, V. S.: Gestão por processos: fundamentos, técnicas e modelos de implementação. 2ª. Ed. Rio de Janeiro: Qualitymark (2008).

[29] Oliveira, S.B.: A gestão de processos de negócio e suas ferramentas de apoio. XIII SIMPEP; Bauru, SP, 6 a 9 de novembro de 2006.

[30] Balloni, A.J.: Por que GESITI: por que gestão em Sistemas e Tecnologias de Informação. São Paulo: Komedi, (2006).

[31] Ganesarajah, D., Lupo, E.: Workflow-bases composition of Web-services: a business model or a programming paradigm? VI Conferência Internacional de Empresas de Objetos Computacionais Distribuídos, USA: IEEE Press (2002).

[32] Stab, S., Alast, W.V.D., Benjamin, V.R., Sheth, A., Miller, J.A., Bussler, C.M.A., Fensel, D., Gannon, D.: Web-services: been there, done that? IEEE Intelligent Systems, 18 (1), (2003).