Approaching the Potential of Cyber-Physical Systems to Tourism Projects

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Abstract

We are witnessing the need for a quick and intelligent reaction from organizations to the level and speed of change in business processes. This is often associated with the emerging of new information systems and technologies, bursting problems like the persistence of wrong information, systems not fully used and slow response. This requires two main actions: synchronizing people's visions and strategies within the organization and selecting the information which is relevant for the strategic goals. The main challenge of the proposed approach is to choose the information systems' portfolio management aligned with the enterprise architecture. This integration leads to modelling the process architecture of the company, which in turn serves as a reference for knowledge-base management to cope with business prospects. This kind of flexible framework can contribute to managing the potential adherence to new systems such as the mobile, cloud, big-data or IoT-based services that tend to proliferate especially in such areas as tourism and health.

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Introduction

Since the transition from the industrial society to the information society, it was necessary to organize and select data in enterprises. This organization gave rise to new values that are equal to or more important than the traditional ones, such as information and knowledge. Technology has brought so much change that its current association with the human capital has led to even greater potential of the information itself. Information technologies (IT) are the platform for the company's ability to develop information systems (IS) that meet the new management requirements. For example, an increasing ability to control large volumes of data in big databases, such as data warehouses using advanced tools for relating those data (data mining), responds to more selective and diverse costumers. Some changes require rethinking of the ways to present products and services and seeking for different dissemination channels. Therefore, companies should organize their IT/IS to be able to develop new solutions to maintain or enhance their competitive position in the market.

In current business scenarios information society and knowledge management play complementary roles. Connectivity, mobility, pervasiveness and real-time reaction are some of the keywords in today's vocabulary of enterprise information systems. The sustainability of competitive advantage is found in a company's ability to channel the critical information to generate business intelligence that enables it to constantly rethink its goals and methods to suit its needs in real time. Given the actual pace of change and business instability, companies have to manage real-time business events well. This requires adopting new attitudes and ways of managing business intelligence to address numerous emerging challenges.

Information Systems in Portugal

The Portuguese Economy

In Portugal, the companies (mostly small and medium-sized) invest little in R&D (research and development) due to their limited financial and organizational capacity. Therefore, information systems are an important resource for their business performance. In terms of most innovative sectors in the Portuguese economy, which according to Sarkar (2014) tend to be more supported by IT/IS, the Community Innovation Survey (CIS) provides useful information. The EU (European Union) employs this statistical instrument to monitor Europe's progress in the area of innovation, which is conducted by each EU nation's own statistical offices. In Portugal, following the methodological recommendations of Eurostat, the CIS aims

to directly collect information on innovation (product, process, marketing, and organizational) in companies. It explores how firms interrelate with their surrounding external environment in order to access information considered important for the development of new projects or the completion of existing ones. Firms may use external agents as information sources or engage in more formal cooperation activities, meaning their active participation with other enterprises or institutions relies on innovation.

The recent CIS (period 2010-2012) revealed that the main innovating sectors of the Portuguese economy are: research-based (computer, civil engineering, R&D), knowledge-based (insurance, health) or service-based (retail trade). The external sources/agents most commonly used by the research-based sector are universities, suppliers are most commonly used by the knowledge-based sector and firms' group is most commonly used by the service-based sector. Private customers are important sources for all types of sectors, which means that Portuguese firms generally use customers' information and relations for innovation purposes. These results are in line with the fact that Portuguese economy is mainly based on small and medium-sized firms (SME) that increasingly focus on services and knowledge provision. Customers' data allows to expand the knowledge base within the applied research and transform knowledge into goods and services (Sánchez-González & Herrera, 2014).

The IT/IS that Portuguese companies should bet on, especially those with a culture of customer service, are based on business intelligence tools such as CRM (Customer Relationship Management), ERP (Enterprise Resource Planning), big-data tools and analytics. These tools, complemented on well-planned platforms (even integrating data from social media) contribute towards the implementation of new ideas, design of new products and services, improvement of existing processes and creation of new ones. Given this enormous potential which may lead to a reconfiguration of the business model, managers should not only be familiar with these systems, but also get involved with their adoption from the beginning and cover all processes in the organization.

IT/IS Potential

Many Portuguese firms have been founded due to the development of financial systems which automatically process invoices and other reports from balance sheets. However, after analyzing the process of decision support, it became clear that managers make decisions based on many other documents and data in order to know which products they can offer, in which amount, and which is the best way for distribution, the best location for shopping, etc. In addition to that, the enormous amount of data that results from having a website, leads to the use of new database management tools (e.g. MySQL). An ERP can manage these issues by making it possible to integrate different business functions and documents to inform product traceability, i.e. from the order moment to knowing its stock level. Information flows became more rapid and complete by contributing to a better inventory management and a greater consistency with customer's needs (Vasilev and Georgiev, 2003).

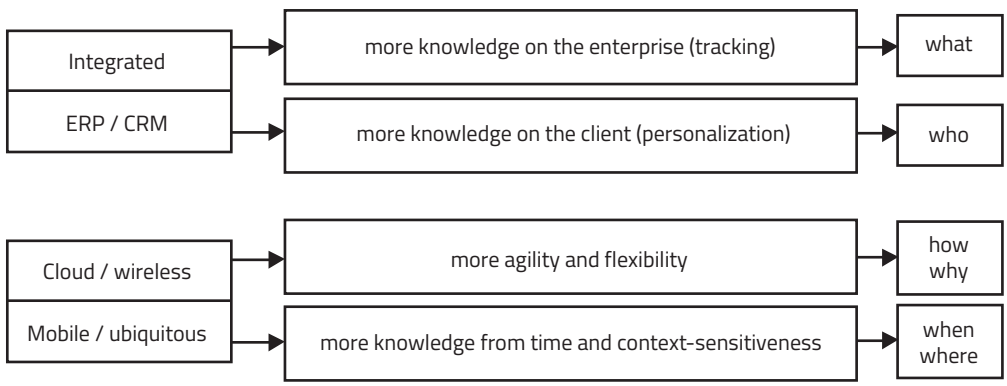
Companies can also implement ERP new modules tailored to their business reality (health, banking, commerce, etc.) to become more flexible. Unlike departmental systems, an ERP is multifunctional. It covers different levels or functions of an organization.

ERPs are integrated systems that make the information flow easily between different areas of an organization to be shared by different processes. The information is then accumulated in a single huge repository (a data warehouse), which is available to all business units at all functional levels. As a result of that, managers can receive a more accurate information about anything they need in real-time (Laudon and Laudon, 2004). This type of system answers to queries such as: inform customers if an ordered product is in stock; maintain customers informed of the whole processing course of their orders; easy communication between production and financial areas to define new production plans, etc. In contrast to that, departmental systems create more fragmentation of data which results in expensive and complex links that proliferate in companies, as these systems function separately. By consolidating the data, ERP systems help to eliminate unnecessary or redundant links having a positive impact on business efficiency and performance.

On the other hand, CRM tools consist of analytical functions to manage the relationship with clients, consolidate information from different sources or channels of communication (phone, email, web, wireless points) to answer queries such as: what is the value of a certain client for the company; which customers are the most loyal; which customers bring in the most profit, etc. Then companies can use the answers to these questions to acquire new customers; improve their products/services to further customize them according to customers' preferences; etc. CRM techniques are used to select and combine key information from different points of view to help companies create unique services or successful innovations. CRM processes can also (by means of advanced techniques like data mining) capture profiles, attitudes and behaviors that haven't been noticed before. These tools are effective in engaging a customer to the point of expecting the services s/he has previously outlined (Vasilev and Georgiev, 2003).

Besides being a key for business performance, these trends can be a way of knowledge-base enhancement (Gudas, 2008; Fernandes, 2013). Figure 1 illustrates this aspect through the main lines of information systems' support and the consequent enterprise knowledge expansion, as third and fourth blocks allow to answer questions like how/why and when/where.

Figure 1: Main Lines of Information Systems' Support and Knowledge-Base Enhancement
Source: Own Elaboration



Another relevant trend to mention is the widespread use of mobile platforms due to their ubiquity (the concept of being everywhere at the same time, related with pervasive devices – time and context-sensitive). These attributes have to do with the critical role that time and place play in today's communications. Facing the increasing geographical scope and time-sensitiveness of services (a real-time response), their development is making the difference. Under the provision of services, mobile systems have the potential to control the execution of activities by creating processes that may resolve many problems related to the on-time delivery in any requested place. Ubiquitous systems provide mechanisms for selection and alignment of processes that meet the aspects of a context and accurately reflect its constant changes. This pervasive nature, related with the capacity of different integrated devices functioning together, has changed the way of conducting activities and interacting with workers at various locations using different systems.

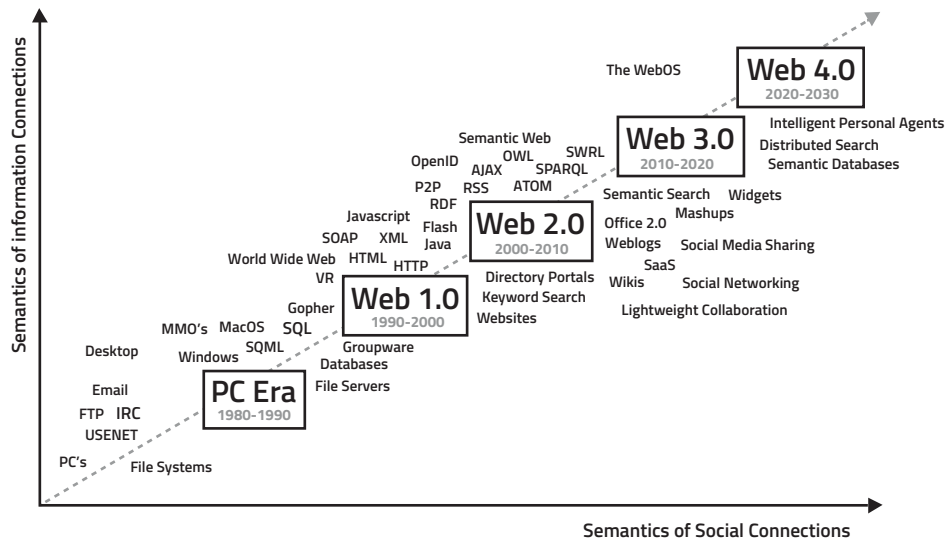
The Multiplying Effect of Internet

The Internet's expansion and the exponential number of customers and employees it has brought to companies to promote and sell their products, has led to a need for tools that can help to cope with this trend. The major challenge is keeping the same relationship patterns of interacting with more customers and stakeholders. The multiplying effect of this aspect, from a growing number of companies placed online, adds the need to compete more in real time. It justifies the increased adoption of the enterprise information systems mentioned above such as ERP, CRM, cloud, mobile, among others. Companies should therefore consider the implementation of these tools from a strategic perspective, to fully exploit their potential closely in line with their business needs for better business event monitoring.

As far as the Internet's potential is concerned, Figure 2 shows that there is an emergent trend brought by social networks. It is the semantic web (or intelligent web) related with semantic databases containing data from different sources (social networks, mobile apps, etc.).

Figure 2: The Generations of Web Are Coming

Source: http://www.novaspivack.com/articles



These sources and its interoperability are really important to be explored by enterprises and researchers because many sources are included in the Web 2.0 (blogs, wikis, video sharing, web services, apps, etc.), which is rapidly evolving to Web 3.0 (also known as 'intelligent web'). This level will enable the use of autonomous agents to perform tasks for the user. Thus, applications will become more and more approachable to the needs of the real world. An aim is to create a capability that anticipates user needs, easily integrates available information, and provides ubiquitous access and personalized content. Tags and keywords are ways to help organize and retrieve web resources (Borrero and Caballero, 2013).

Promising Business Models

The overwhelming potential of the internet requires companies to have more flexible information and process architectures. The main goal is to manage knowledge and adhere to new business models supported by mobile, cloud or big-data systems that tend to disrupt several areas such as tourism and health. Recent discussions about smart cities and regions (bridging the physical and digital) have touched upon those issues. For example, future European structural investment funds are based on developing and matching these research and innovation strengths to the business needs (European Commission, 2016).

Furthermore, a network of smart devices can be set up to enhance the work of any business and its services. For example, in tourism, there can be a better assistance to tourists through mobile apps for managing the experience of touring of a place by smart coordination of the objects

"This pervasive nature (...) has changed the way of conducting activities and interacting with workers at various locations using different systems."

at that place. This will enhance the overall experience of the tourist (information regarding the shortest route to reach there, traffic congestion in that route, alternate ways to reach the place). Mobile tours can be provided to tourists giving details of all the local attractions, restaurants, etc. and assisting them throughout their trip.

Mobile work empowerment is also possible, which is important for real-time or critical activities such as healthcare. Networked sensors, either worn on the body or embedded in one's living environments, make possible the gathering of rich information indicative of one's physical and mental health. Captured on a continual basis, aggregated and effectively mined, such information can bring about a positive transformative change in healthcare (Hassanalieragh et al., 2015; Tyagi et al., 2016). The combination of wearable technologies with related apps at a smartphone can serve to integrate and monitor patient information and sensing throughout healthcare records and systems (Niewolny, 2013). However, there are certain implications like concerns over privacy of personal data generated by smart devices due to over-tolerance in technology. These concerns need to be addressed (Kaur and Kaur, 2016).

Which Information System? Portfolio?

The issues raised by Figures 1 and 2 remind of the need of a good information systems's portfolio and its management. There is a common problem in companies which relates to an increasing amount of data ('big data') and of non-integrated information systems, affecting companies' performance and its relationships with customers and employees. Two main factors that lead to this problem are:

- The factor that there are many new information systems and technologies in organizations (such as ERP/CRM, clouds, sites, social networks, etc.) whose potential is far from being fully exploited, either in themselves or in integration with other existing systems;

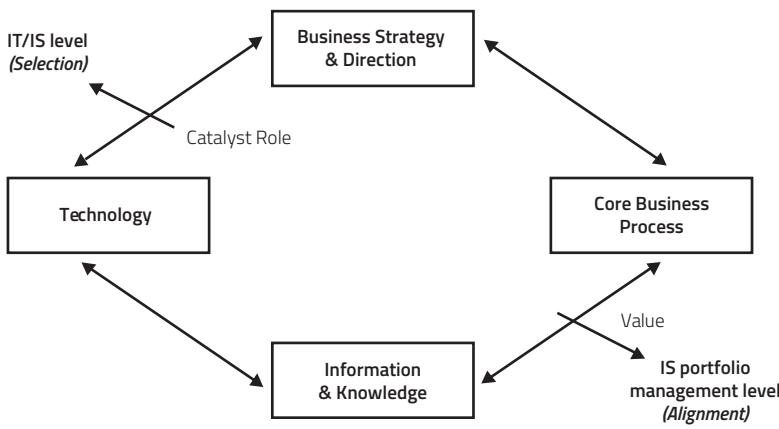
- The other factor is that people's work habits differ in terms of: training, willingness to work with technologies, willingness to cooperate with others, among other individual differences.

These factors raise the need for the information systems' portfolio management and a working architecture/culture in which people would synchronize their processes and visions within the organization, in accordance with the same mind-set targets. This leads to an exercise of collecting the relevant information (Robbins, 2006). For example, creative thinking makes people approach problems and solutions, in order to put existing ideas together in new combinations (Amabile, 1998).

The present work aims to develop an approach to these issues, which can be referred to as a portfolio approach to information systems management. It should be understood here, as information systems' portfolio the set of tools and methodologies for business intelligence (ERP/CRM, intranets, clouds, social networks, etc.). This approach aims to bring attention to the appropriate management of this portfolio, i.e., the selection and alignment with business goals (Figure 3).

Figure 3: Information Systems' Portfolio and Its Strategic Role

Source: Adapted From Kraft (2002)



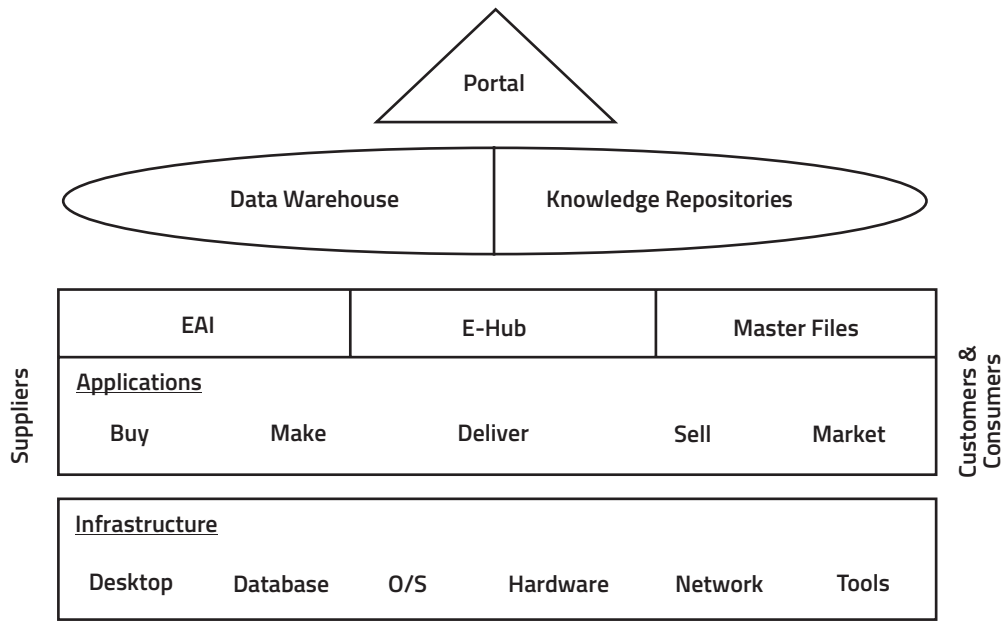
IT/IS Selection and Alignment

IT is playing an increasing role in almost every company's business development and innovation. In some industries IT has been a strategic differentiator for years. Then development of strategies, processes, products and services should consider technological opportunities and limitations (a catalyst role). Then an IS/IT portfolio which supports knowledge and intelligence for the core processes is crucial for a value-added business. A data warehouse is the most appropriate 'data center' or meta-knowledge support for it, because it normally keeps data from all departments and functions in the organization. The following case, at Kraft foods group (through Figures 4 and 5), illustrates an example of IS portfolio management and its IT support for a value-added business.

1) At the IT/IS level (*Selection*):

Figure 4: An IS Portfolio and Its IT Support (at Kraft Foods Group)

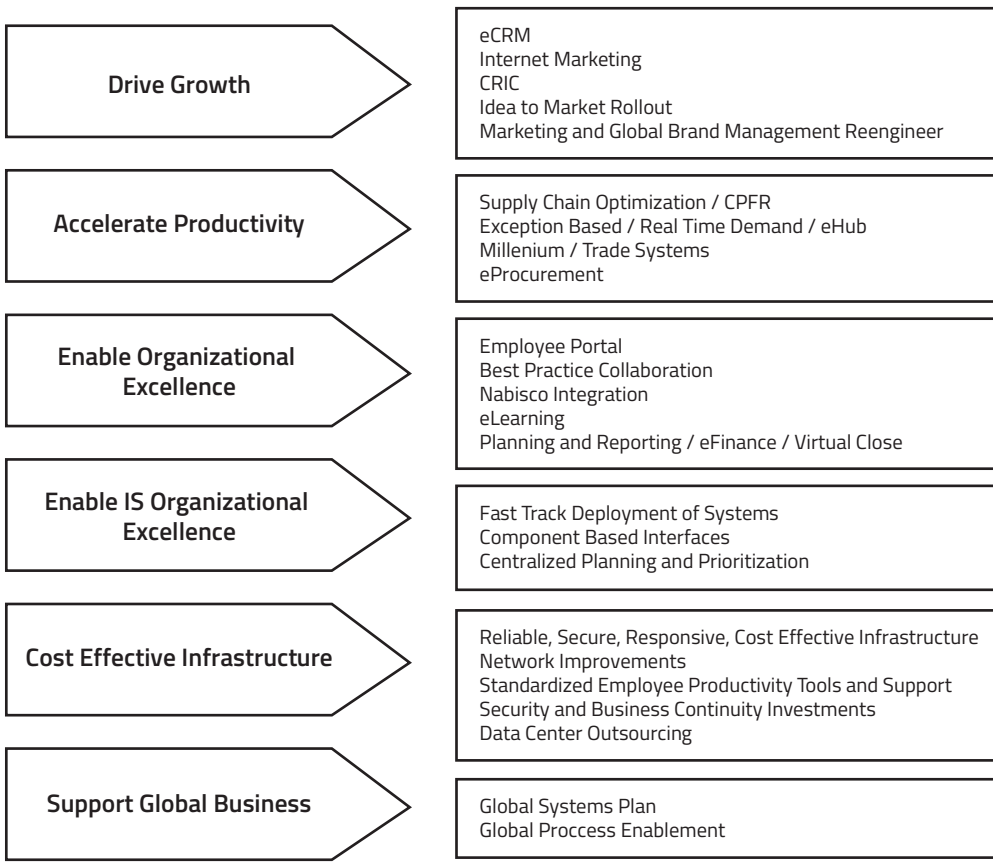
Source: Kraft (2002)



2) At the IS portfolio management level (*Alignment*):

Figure 5: Strategies and IS Support (at Kraft Foods Group)

Source: Kraft (2002)



It has become fashionable for companies to have data warehouse (DW), data mining (DM) and data analytics (DA), but often the expectations are higher than these data, tools and techniques can realistically give back. For example, data analyzes (DA) allow to identify competitive advantages, however some are not feasible to be implemented by the companies given the tremendous changes it entails (Ross et al., 2013). Companies should begin using these services realising how to use the data and tools they already have. In fact, there are few companies that take advantage of their existent data, either few or many, to make decisions. It requires having a day-to-day practice, throughout the organization, and a decision-making process culture which is based on data. Companies must begin to take advantage of their operational data and make daily decisions based on them.

A company that does the appropriate organizational and cultural change to its work processes:

- is more able to take advantage of its data;

- hardly goes back in its decisions;

- can reach a management level which is extremely difficult to replicate by its competitors.

Furthermore, it gives access to data to all its organizational levels in real time; defines procedures and reviews them on a regular basis considering the day-to-day events. Thus, decisions are based on the evidence of data (Ross et al., 2013). Such a company also empowers its employees, an aspect initiated by the most innovative firms. If each decision-maker uses his/her 'source of truth', then the organization loses energy discussing the truth and is not focused on decision, change, efficiency and improvement.

The Importance of Enterprise Arquitechture

Communication is desirable and necessary in transferring knowledge in an organization. One of the stages of knowledge creation model of Nonaka and Takeuchi (1995) is socialization, which arises from tacit knowledge exchange between individuals. The shared experiences and their articulation consolidate knowledge, creating shared mental models and forms of trust. Nonaka said that knowledge is created by individuals (an organization cannot create knowledge without individuals), and the organization has a role in expanding the knowledge created by its individuals and transforming it into organizational knowledge.

System analysts deal more with the need to synchronize views in having dialogues with the entities that request them for systems' development. In order to do this, they use models to represent the reality they need to appreciate, like a structured design or architecture, to quickly explore and find a solution (Ambler et al., 2005). Ontologies have been increasingly used as the models that represent a set of concepts within a domain and the relationships between them, in order to infer on the objects of that domain. Ontologies generally describe individuals, classes, attributes, relationships. They are used in artificial intelligence, web semantics, software engineering and information architecture, as forms of representing knowledge about an event.

New computing paradigms, given the speed of change they cause in business processes, should be increasingly addressed using the enterprise architecture approach (Spewak and Hill, 1992). Enterprise architecture (EA) consists of defining and understanding the different elements

that shape an organization and how those elements are inter-related (Sousa et al., 2006). In particular, EA provides a strategic context for the evolution of the IT system in response to the constantly changing needs of the business environment (Palli and Behara, 2014). It raises the importance of identifying and analysing enterprise processes. The next section concerns the contribution that process architecture can have to the issue under discussion. Information systems' portfolio management requires an increasing need of modeling data and process flows for better discerning and acting at its selection and alignment with business perspectives.

The Contribution of the Process Architecture

This concept reflects the concern on drawing or modeling organizational processes for a better adequation of IT/IS in supporting business needs. For example, Zachman's framework (Table 1) crosses the prospects of a company's management with the support given by the information systems. This approach has also served as internal IS creation. The resulting matrix of this crossing exercise has the following structure:

Table 1: Zachman's Framework (Ontology)

Source: Zachman (2008)

	What	*How*	*Where*	*Who*	*When*	*Why*
	Inventory	Process	Distribution	Responsibility	Timing	Motivation
Executive perspective (identification)	data types	procedures and changes	types of networks	organizational types	deadlines	motives
Business management perspective (definition)	business entities, relationships	business inputs/ outputs	locations and connections	roles, tasks	intervals, moments	means, business goals
Architecture perspective (representation) System	system entities, relationships	system inputs/ outputs	locations and system connections	roles, system tasks	intervals, moments	means, system goals
Engineer perspective (specification) Technology	technology entities, relationships	technology inputs/ outputs	locations and technology connections	roles, technology tasks	intervals, moments	means, technology goals
Technician perspective (configuration) Tool	tool entities, relationships	Tool inputs/ outputs	locations and connections	roles, tool tasks	intervals, moments	Tool, means, goals
Enterprise perspective (instantiation) Operation	operational entities, relationships	operational inputs/ outputs	locations and operational connections	roles, operational tasks	intervals, moments	means, operational goals

The Zachman Framework is typically depicted as a bounded 6x6 matrix with the communication interrogatives as columns and the reification transformations as rows. The Framework's classifications are represented by the cells, which are the intersection between the interrogatives and the transformations. This matrix constitutes the total set of descriptive representations that are relevant for describing an enterprise. This is a meta-model (ontology) which may serve for discussing the most adequate IS portfolio for a company. It can also help the IS portfolio management, through crossing the perspectives of business with the support from the IT/IS needed (Ross, 2013).

For this reason, the modern IS designing is more focused on processes – e.g. business process modeling (BPM). Besides the emerging problems, the cross-functional links (interactions) that perform a product or service entirely also emerge from this modelling. This structure can discuss questions like:

- Do you rework and use work-arounds because some information is missing or inaccurate?

- Do you have multiple ways of doing work where one process would be more efficient and cost-effective?

- Do you need to streamline your processes and reduce complexity?

- Is the market demanding that you cut costs and are more agile? (BPMessentials, 2015)

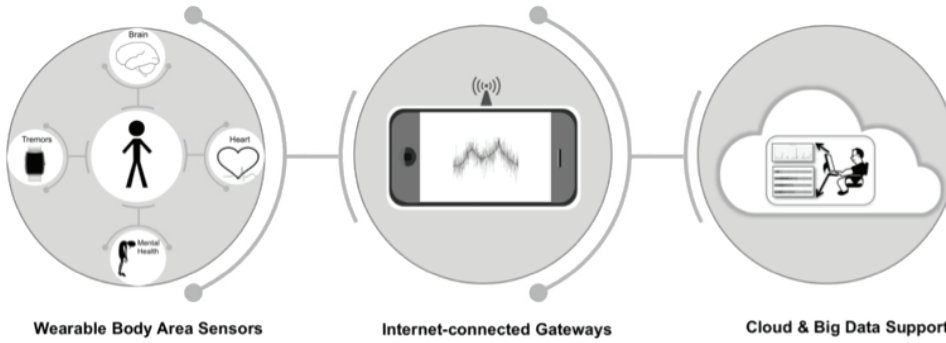
Process modeling can take up to 6 months. Then, the analysis can take another 6 months after that. But it doesn't have to. A structured approach, which is centered on process architecture, uses cross-functional team skills of subject matter experts, and the required techniques to analyze current process and build a more optimized process. To be fully effective, BPM must not be approached as an IT toolset only but rather as an environment where a business process-oriented view is the means of communicating business needs throughout an organization (iGrafx, 2016).

Cases From Process-Based System's Approach

Processes integrate the activities that really add value (receive inputs and turn them into results for the company). A decision-making culture based on processes helps to understand and define the different elements that shape an organization and how those elements inter-relate inside and outside of it (a holistic approach). This also helps to envison connecting devices in multiple industries such as health, automotive and consumer spaces. For each of them, the need for devices that can report or react to certain things provides a new level of convenience, efficiency and automation (see Figure 6). For instance, healthcare practitioners are closely watching the development of this trend to see if the Internet of Things (IoT) will be a part of their future. Some hospitals have begun implementing 'smart beds' that can detect when they are occupied and when a patient is attempting to get up. It can also adjust itself to ensure appropriate pressure and support is applied to the patient without manual interaction of nurses. Another area where smart technology can be an asset is coupled with home medication dispensers to automatically upload data to the cloud when medication is not taken or any other indicators for which the care team should be alerted (Chouffani, 2015).

Figure 6: Wearable Internet of Things[1]

Source: Niewolny (2013)



Also in tourism, IoT has the potential to transform the entire travel experience, and many hospitality companies are investing heavily in this technology, keeping the customer at the forefront. The first area of tourism is the marketing of the destinations, products and services. Selling tourism products and services online is not only price-conscious but also an inspiration for travelers throughout the world. Digital marketing, search engine marketing, mobile and location based marketing reach the potential traveler today within seconds. The second area is the infrastructure of the organization which determines the readiness to respond to customer requirements. Since more travelers expect personalized services, tourism businesses should have tools that can store and monitor information that meet the customers' needs (Prajapati, 2014). For example, mobile keys were already introduced this year by some hoteliers (Starwood, Hilton). Guests no longer need to wait in line at the front desk. A mobile app notifies guests when their room is ready. Once at the room, guests simply wave their phone in front of the lock to open the door. Mobile keys increase guest satisfaction and the likelihood of a customer booking a room through a hotel's app or a website. Each guest can then be monitored by room identity, which allows hotels to collect data about guests' preferences in order to offer them a more customized experience during their next stay (Lubetkin, 2016). IoT also makes it possible to perform preventive maintenance remotely. Malfunctioning equipment can be detected and analyzed long before it becomes a major issue.

Thus, these technologies create a smart tourism setting that supplies tourism consumers more relevant information, better decision support, greater mobility, and more enjoyable experiences (Gretzel, 2011; Sigala and Chalkiti, 2014). These smart systems can include a wide range of technologies such as decision support systems and the more recent context-aware systems, autonomous agents searching and mining web sources, ambient intelligence and augmented realities (Lamsfus et al., 2015). In smart tourism, technology is seen as an infrastructure, rather than as individual information systems and encompasses a variety of smart technologies that integrate hardware, software,

1 - http://www.ele.uri.edu/faculty/kunalm/491_591.xhtml

and apps to provide a real-time awareness of the real world and advanced analytics to help people make more intelligent decisions about alternatives, as well as actions that will optimize business processes (Washburn et al., 2010).

The New Paradigm: IoT and Industry

Trends in IoT

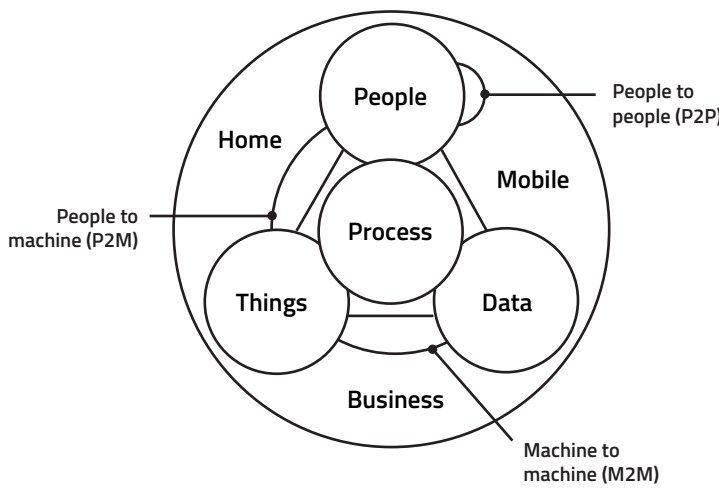
In Portugal, the companies (mostly SMEs) invest little in research and development due to their limited financial capacity. A recent CIS (Cis2012) revealed that main innovating sectors in the Portuguese economy are research-based, knowledge-based or service-based. Despite the industry being heavily dispersed in Portugal, it should follow emerging technological trends for greater innovation and service growth. A relevant trend to consider is the widespread use of mobile-online platforms. It has to do with the critical role that time and place play in modern services.

The internet expansion and the exponential number of customers it has brought to companies to promote and sell their products, has led to the need for tools that could help to cope with this trend. The overwhelming potential of internet requires a more flexible business process architecture. When internet penetrates all activities, many aspects of management and organizational structure will change. Rapid digital change in a society and economy mean more demand for digital skills and competences. Education and training must address this need, which requires investment in infrastructure (eg. broadband, digital devices), training for teachers, organisational change and the development of high-quality educational resources, including apps and software.

Figure 7 illustrates the wave of unstoppable growth of the Internet through IoT, which brings the confluence between people, processes, information and things.

Figure 7: Key Potentials of IoT

Source: RES (2013)



The five main factors that feed the IoT are:

- the use of assets (cost reduction);

- employee productivity (greater efficiency in tasks);

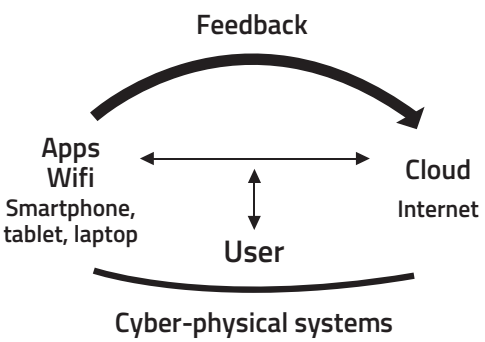
- supply chain and logistics (elimination of expenses);

- user experience (increase of customers);

- innovation ('time to market' reduced).

The technological trends including cloud, mobility, big data and increased processing capacity are driving the economy of IoT. This is creating an unprecedented opportunity to connect what was still disconnected among people, processes, information and things (RES, 2013). Then, a question is increasingly shaking enterprises and business models: how can they deal and profit from these opportunities? The information systems' portolio selection and alignment can help. Figure 8 shows these trends together with their potential scale and scope, reaching the need of effective interfaces for cyber-physical solutions.

Figure 8: Cyber-Physical Systems and Apps
Source: Own Elaboration



Enterprise and information architectures can play a very relevant role in dealing with the challenges of cyber-physical systems.

Open Architecture for Interface Design

There are many enterprise architecture models (EA), and each of them takes a slightly different approach. But in every model there is an explicit transition from business to IT - from goals and requirements to applications and systems. However, this transition or boundary can be less explicit due to abstract business process requirements and methods dictated by the new IT tools. User interface design and mobile connectivity are showing that the boundary between enterprise architecture model and development is softening to a zone rather than a line, and greater flexibility within this zone is essential to get more differentiating outcomes (Nolle, 2016).

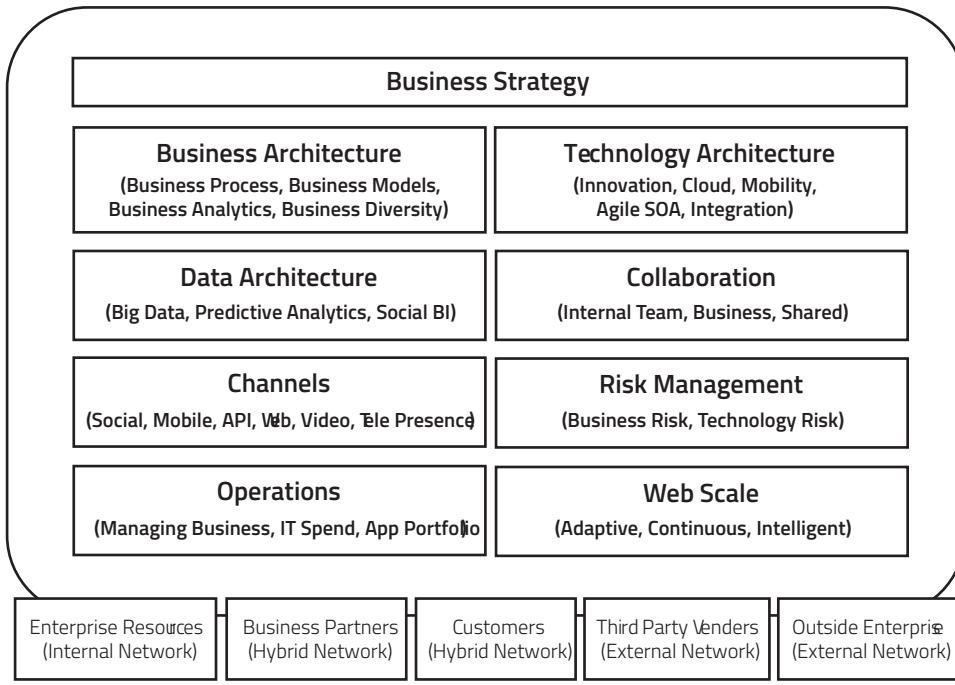
According to Palli and Behara (2014), unless there is an open EA, there will be gaps and architecture conflicts such as: lack of consistency due to an absence of standards; dissipation of critical information and knowledge about the deployed solutions; redundancy and a lack of flexibility in the deployed solutions; non-adoption of the next generation technologies; a lack of integration and interoperability between applications; fragile and costly interfaces within incongruent applications.

Traditional EA is a more framework-centered and tool-driven approach. Most of its function is technology-centric and defined as a one-time initiative. Application building principles are business-constrained before they are completed. The next generation EA (NGEA) is a business-centric, global, agile, continuous

and social digital network. Organizations adopt latest digital capabilities like social web, service-oriented architecture (SOA), big-data analytics, cloud computing, virtualization, IoT, etc. These technologies are interrelated and fit together to define NGEA for an organization (Palli and Behara, 2014).

A business model is shifting from a traditional EA to a digital architecture which addresses networked community capabilities (interacting with users and other agents through social media), globalization (borderless enterprise), product/service innovation (open and virtual innovation), collaboration (employees in decision-making, mobile work), flexibility (to choose technologies, infrastructure, applications). See Figure 9.

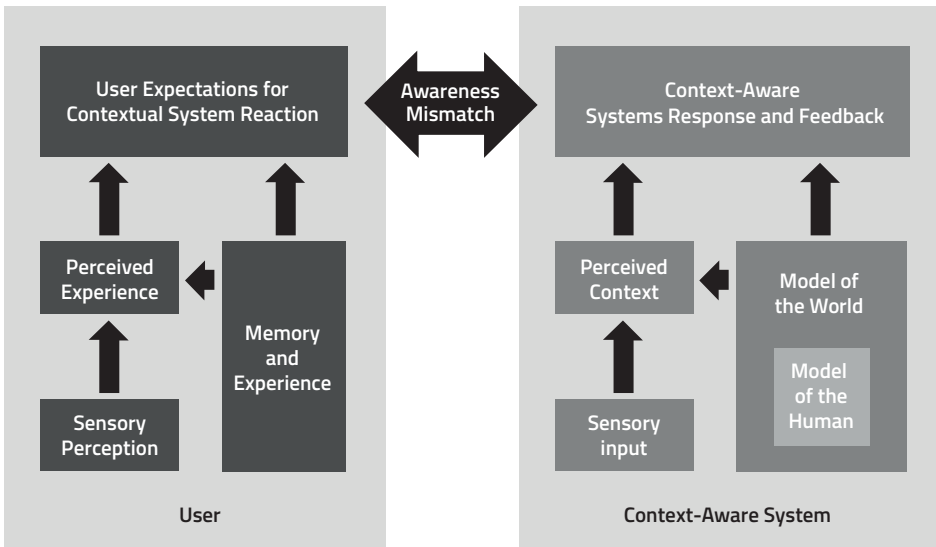
Figure 9: Next Generation EA Model



EA results should integrate with business planning and focus on business model architecture defining business outcome metrics. Also, EA program definition should not span for years. It should deliver business value in months or weeks.

Figure 10 illustrates the importance of NGEA for an awareness match: a user's perception and experience lead to the user's expectations that can be captured from the sensory input by an enterprise and its IT/IS, if they are context aware. Therefore, an open EA model should include a model of the user driving the enterprise systems' reaction (Schmidt, 2013).

Figure 10: Next Generation EA and Awareness Match



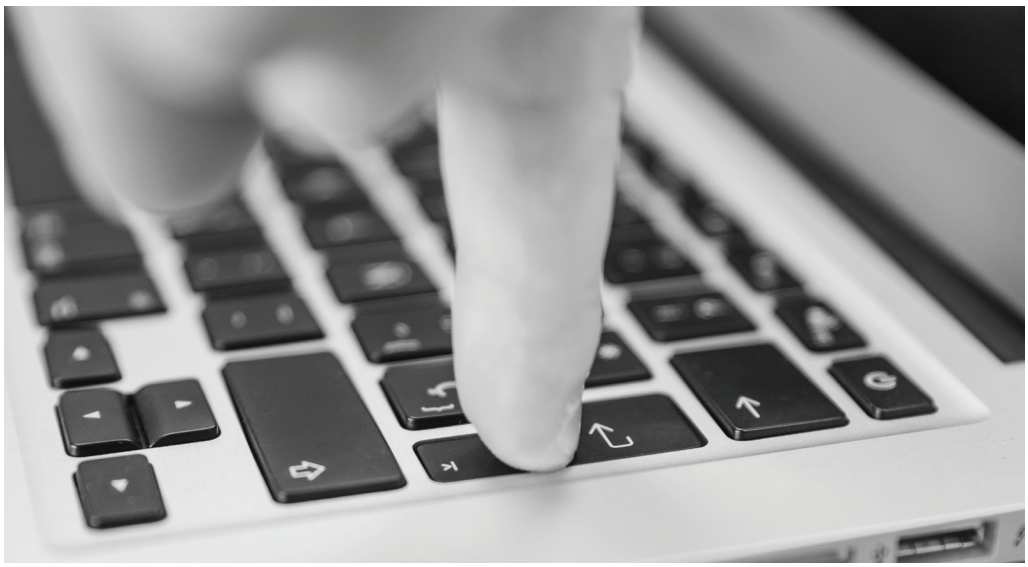
In current systems, a wide variety of sensors are used to acquire contextual information. Some examples of sensors used are: GPS (for location, speed), light and vision (to detect objects, activities), microphones (for data about noise, talking), gyroscopes (for movement, orientation), magnetic sensors (for compass to determine orientation), touch sensing (to detect user interaction), temperature sensors (to assess environments), etc. (Schmidt, 2013). Other sensors serve to detect the physiological context of a user, such as galvanic skin response. Its measures can be used to determine skin reactions (e.g. surprise or fear - lie detectors). All these types of sensors can be used to feed the enterprise systems with context information. The quality of the information obtained may be improved by using a set of sensors rather than just one set. It results into more advanced and effective user interfaces.

To match sensory information with the context, perception tasks are done by means of machine learning and data mining. It contributes to increasing of the system's understanding and interaction with its surrounding environment. This enables user interface design which challenges business models to become more flexible, innovative and agile. These IT - cloud, wireless, sensors, etc. create systems that can act differently in different contexts. If they are well designed, they match users' expectations in the context (an awareness match). It is also essential that users understand the varying behavior of the application and know how to link it to the situations they find themselves in.

Context-awareness is a very challenging area of human-computer interaction. This is very important for tourism projects and related business models, by the ability of clients to be providers in their own right. Also, by having access to every piece of information they need to make an informed choice about where they go and how they experience it. Airbnb, Uber and My Ticket are good examples (Tnooz, 2017).

These trends involve the new digital supply networks (DSN) that integrate information from many different sources and locations to drive physical acts of production and distribution. The result is a virtual world, which mirrors and informs the physical world. By leveraging both the traditional and the new, such as sensor-based data-sets (unstructured data), DSN enable integrated views of the supply network and create rapid responses to changing situations. It can then be potentially expanded by the capabilities of advanced physical technologies, such as robotics, drones, additive manufacturing and autonomous vehicles. It is relevant for connecting stakeholders, smart services, waste reduction, and process optimization.

"It is also essential that users understand the varying behavior of the application and know how to link it to the situations they find themselves in."



Conclusion and Future Research

The nature of business processes is changing, often due to the speed of emergence of new information technologies. It brings many challenges to organizations, which add up to those challenges that have not been fully resolved yet. It boils down to two main drivers of this paper's approach: there are so many systems and technologies that organizations are not going to make the best of them; moreover, people do not continuously tune their visions and processes at different levels of the organization, in order to obtain real-time relevant information. These two aspects lead to the necessity of a working model (architecture) to plan and facilitate the alignment throughout an entire organization, by iteratively selecting critical business information on time.

An easy to understand and communicate informational architecture of a company and its business can help identify the information, consistent with the company's mission, objectives and critical success factors. It is mainly modeled with objects such as: processes (functional and cross-functional, internal and external); resources (functional and cross-functional, internal and external) and outputs (internal and external). This supports information systems' portfolio management while it helps to identify the requirements for those systems in harmony with the company's business objectives.

However, given the heterogeneity of objects and data characterizing them, the conversion between structured and unstructured data is one of the most pressing issues. On this subject, the authors Carvalho and Ferreira (2001) carried out a survey for technological tools assessment, related with knowledge management and conversion between tacit and explicit knowledge. Some of these tools are: knowledge portals (corporate intranets and extranets); knowledge maps (lists of "who knows what": skills/profiles); EDM (Electronic Document Management: cataloging, indexing, etc.); OLAP (Online Analytical Processes for data normalization); data mining (advanced techniques to explore large amounts of data looking for consistent patterns); among others.

These tools within this digital transformation (IoT, cyber-physical and mobile systems) can contribute to achieving the higher levels of performance within the supply chain capabilities. These tools can also help to create new sources of revenue by providing new and faster access to markets, and supporting the production of smart products.

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References

Adams, H. (2015). Increase IT flexibility by adopting enterprise architecture and service oriented architecture. Acceded in 12th of January 2017, on the Web site of: https://www.linkedin.com/pulse/increase-flexibility-adopting-enterprise-architecture-hayden-adams.

Amabile, TM (1998).Amabile, T. (1998). How to Kill Creativity. *Harvard Business Review* .How to kill creativity. *Harvard Business Review*. 76(5): 76-87.

Ambler, S., Nalbone, J.Ambler, S., Nalbone, J. e Vizdos, M.and Vizdos, M. (2005). *Enterprise Unified Process: Extending the Rational Unified Process* (2005). *The enterprise unified process: Extending the rational unified process*, Prentice Hall. New Jersey.

Borrero, J. and Caballero, E. (2013). Crawling big data in a new frontier for socioeconomic research: Testing with social tagging. *Journal of Spatial and Organizational Dynamics*. 1(1): 3-24.

BPMessentials (2015). Analyzing and optimizing a BPM process. Acceded in 14th of June 2016, on the Web site of: http://www.bpmessentials.com/analysis-and-redesign/.

Carvalho, R e Ferreira, M. (2001), Using Information Technology to Support Knowledge Conversion Processes. *Information Research* .Carvalho, R and Ferreira, M. (2001). Using information technology to support knowledge conversion processes. *Information Research*. 7(1): 1-24.7(1): 1-24.

European Commission (2016). Smart regions conference. Acceded in 12th of October 2016, on the Web site of: http://ec.europa.eu/regional_policy/en/conferences/smart-regions/.

Fernandes, S. (2013). Aligning technology with business: A continuous effort. *CIEO Spatial and Organizational Dynamics Discussion Papers*. 12: 26-37.

Gretzel, U. (2011) Intelligent systems in tourism: A social science perspective. *Annals of Tourism Research.* 38(3): 757–779.

Gudas, S. (2008). Enterprise knowledge management aspects and layers. Paper presented at the 12th World Multi-Conference on Systemics, Cybernetics and Informatics. Florida.

Hassanalieragh, M. *et al.* (2015). Health monitoring and management using internet-of-things (IoT) sensing with cloud-based processing: Opportunities and challenges. Paper presented at the 12th IEEE International Conference on Services Computing, New York. USA.

Hustad, E. and Lange, C. (2014). Service-oriented architecture projects in practice: A study of a shared document service implementation. *Procedia Technology*. 16: 684-693. doi:10.1016/j.protcy.2014.10.017.

iGrafx (2016). Business process management. Acceded in 14th of June 2016, on the Web site of: http://www.igrafx.com/es/solutions/business-challenges/business-process-management.

i-Scoop (2017). Smart industry and smart manufacturing – industrial transformation. Acceded in 29th of January 2018, on the Web site of: https://www.i-scoop.eu/manufacturing-industry/#The_difference_and_similarities_between_smart_industry_and_smart_manufacturing

Kaur, K. and Kaur, R. (2016). Internet of things to promote tourism: An insight into smart tourism. *International Journal of Recent Trends in Engineering & Research*. 2(4): 357-361.

Kraft (2002). Information systems portfolio management. Acceded in 16th of February 2016, on the Web site of: http://www.kraftfoodsgroup.com/home/index.aspx.

Lamsfus, C., Wang, D., Alzua-Sorzabal, A. & Xiang, Z. (2015) Going Mobile Defining Context for On-the-Go Travelers. *Journal of Travel Research*. 54(6): 691-701.

Laudon, C.Laudon, C. e Laudon, J.and Laudon, J.(2004). *Management Information Systems: managing the Digital Firm* , 9ª Edição. Prentice Hall. (2004). *Management information systems: Managing the digital firm,* 9th edition, Prentice Hall. Boston.

Lubetkin, M. (2016) Tourism and the Internet of Things-IoT. Acceded in 31th of January 2017, on the Web site of: https://medium.com/3baysover-tourism-networking/tourism-and-the-internet-of-things-iot-e41b125e7ddd#.3prmu1rb8.

Niewolny, D. (2013). How the internet of things is revolutionizing healthcare, Freescale. Acceded in 4th of November 2016, on the Web site of: https://cache.freescale.com/files/corporate/doc/white_paper/IOTREVHEALCARWP.pdf.

Nolle, T. (2016). Enterprise architecture model helps to maximize mobile empowerment. Acceded in 10th of October 2016, on the Web site of: http://searchsoa.techtarget.com/tip/Enterprise-architecture-model-helps-to-maximize-mobile-empowerment?utm_medium=EM&asrc=EM_NLN_65809390&utm_campaign=20161007_Enterprise%20architecture%20holds%20the%20secret%20to%20mobile_fchurchville&utm_source=NLN&track=NL-1806&ad=910397&src=910397.

Nonaka, I.Nonaka, I. e Takeuchi, H.(1995). *The Knowledge-Creating Company.* Oxford Press. and Takeuchi, H. (1995). *The knowledge-creating company,* Oxford Press. New York.

Palli, P. and Behara, G. (2014). Enterprise architecture: A practitioner view. Acceded in 2nd of January 2017, on the Web site of: https://blog.opengroup.org/2014/09/17/enterprise-architecture-a-practitioner-view/.

Prajapati, V. (2014) Mobile technology advancements speed up the growth of tourism worldwide. Acceded in 31th of January 2017, on the Web site of: http://www.techprevue.com/mobile-technology-advancements-speed-up-the-growth-of-tourism/.

RES (2013). 6 claves que debes conocer sobre internet de las cosas. Acceded in 2nd of February 2017, on the Web site of: http://www.ecointeligencia.com/2013/09/6-claves-internet-de-las-cosas-iot/.

Robbins, SP (2006). *Comportamento Organizacional* .Robbins, S. (2006). *Organizational behavior*. 10ª Edição.10th Edition, Prentice Hall. Canada.

Ross, J. (2013). Jeanne Ross of MIT CISR on enterprise architecture. Acceded in 17th of February 2016, on the Web site of: http://www.youtube.com/watch?v=fel6_-v10Dk.

Ross, J., Beath, C. and Quaadgras, A. (2013). You may not need big data after all. Acceded in 17th of February 2016, on the Web site of: https://hbr.org/2013/12/you-may-not-need-big-data-after-all.

Sánchez-González, G. and Herrera, L. (2014). Effects of customer cooperation on knowledge generation activities and innovation results of firms. *Business Research Quarterly*. 17(4): 292-302.

Sarkar, S. (2014). *Entrepreneurship and innovation*, Escolar Editora. Portugal.

Schmidt (2013). Context-aware computing. Retrieved from https://www.interaction-design.org/literature/book/the-encyclopedia-of-human-computer-interaction-2nd-ed/context-aware-computing-context-awareness-context-aware-user-interfaces-and-implicit-interaction.

Sigala, M. & Chalkiti, K. (2014) Investigating the exploitation of web 2.0 for knowledge management in the Greek tourism industry: An utilisation–importance analysis. *Computers in Human Behavior*. 30: 800-812.

Sousa, P., Caetano, A., Vasconcelos, A., Pereira, C. and Tribolet, J. (2006). Enterprise architecture modeling with the unified modeling language. In: P. Ritten (ed.), *Enterprise modelling and computing with UML*. IRM Press. Hershey.

Spewak,S.Spewak, S. e Hill, Sand Hill, S.(1992). *Enterprise Architecture Planning: Developing a Blueprint for Data, Apllications and Technology* . (1992). *Enterprise architecture planning: Developing a blueprint for data, applications and technology,* John Wiley & Sons. New Jersey.

Tnooz (2017). Travel and the fourth industrial revolution. Acceded in 14th of May 2018, on the Web site of: https://www.tnooz.com/article/travel-fourth-industrial-revolution/

Tyagi, S., Agarwal, A. and Maheshwari, P. (2016). A conceptual framework for IoT-based healthcare system using cloud computing. Paper presented at the 6th International Conference on Cloud System and Big Data Engineering, Noida. India.

Vasilev, J.Vasilev, J. e Georgiev, G. (2003and Georgiev, G. (2003). Tendencies in the Development of ERP Systems. Tendencies in the development of ERP systems. Paper presented at the International Conference on Computer Systems and Technologies. Economical University of VarnaPaper presented at the International Conference on Computer Systems and Technologies, Economical University of Varna.Bulgária. Bulgaria.

Washburn, D., Sindhu, U., Balaouras, S., Dines, R. A., Hayes, N. & Nelson, L. E. (2010) Helping CIOs understand "smart city" initiatives. Acceded in 1st of March 2015, on the Web site of: http://www.uwforum.org/upload/board/forrester_help_cios_smart_city.pdf.

Zachman, J. (2008) Concise definition of the Zachman framework. Acceded in 17th of February 2016, on the Web site of: https://www.zachman.com/about-the-zachman-framework.