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Towards an Agile Information Systems Development Process Model

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Abstract

Process models are fundamental for structuring Information Systems Development (ISD) endeavors and contribute significantly to ISD projects' efficiency and effectiveness. On the one hand, agile process models have been increasingly adopted in software development. In general, the agile approach emerged to overcome the limitations of the classical models, such as the late delivery of products or the lack of response to changes. On the other hand, regarding ISD, as far as we know, there are no specific proposals for agile processes. Considering the socio-technical nature of ISD, agile processes cannot be adopted in this context without being adequately tailored. This paper describes an ISD agile process model, underlying principles, and activities. It also discusses the model's practical feasibility, benefits, and limitations.

Keywords: Agile Approach; Agile Principles; Agile Process Model; Enterprise Information Systems; Information Systems Development.

1. INTRODUCTION

Several authors point out the impacts associated with the adoption of Information Technology (IT) by organizations (Agyei-Ababio et al., 2023; Julia et al., 2018; Pereira et al., 2022; Seclen-Luna et al., 2022), which can be organized into four main categories (Alavi & Yoo, 2015): efficiency improvement in processes and transactions (Seclen-Luna et al., 2022); communication improvement and centralized access to information, making the decision-making process easier (Escobar et al., 2023); modification of the competition basis and industry structure, which leads to obtaining competitive advantages (Hunady et al., 2022); and exploitation of new business models (Kääriäinen, Kuusisto, et al., 2020).

Given the high diversity of existing IT and possible impacts, it is not always easy for organizations to determine which ones are the most suitable to adopt to improve their Information Systems (IS) in a specific organizational context, nor how these can be operated (Dasgupta et al., 1999). This is usually done through the implementation of Information Systems Development (ISD) projects, which in some cases can also be named digital transformation projects (Kääriäinen et al., 2023; Varajão, Lourenço, et al., 2022) and are carried out, for example, to improve business models, products, services, processes, communication channels (Agyei-Ababio et al., 2023; Haffke et al.,

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2016; Kääriäinen, Pussinen, et al., 2020) or to develop the relationship with the clients or suppliers (Bharadwaj et al., 2013; Brosig et al., 2022).

ISD projects can be structured in different ways. For several decades, the primary way of organization has involved classic methodologies and, more specifically, the waterfall model. Despite providing a clear structure for the ISD process, this model presents some limitations, such as the late delivery of the products resulting from projects and the risk of not including the modifications that take place during the projects (Fitzgerald et al., 2006; Lagstedt, 2019).

Agile models have emerged in software development to overcome the limitations of classical models, showing several advantages, such as a more effective response to customer needs (Lagstedt, 2019; Tam et al., 2020) or more team autonomy (Gustavsson et al., 2022). However, despite the good results of agile models in software development, these models have not yet been fully transposed into the ISD domain, and further research is needed (Meneses & Varajão, 2022). This article contributes to overcoming this limitation by identifying the required characteristics of agile ISD and describing AgilIS (Varajão, 2018a, 2018b), an agile ISD process model. It contributes to the theory and practice by detailing an agile process tailored for ISD.

The article is structured as follows: Section 2 presents the background; Section 3 discusses the research method; Section 4 presents relevant principles and activities of an agile process model; Section 5 describes an agile ISD process model; and finally, the last section presents the conclusions, identifies the main contributions, limitations, and research opportunities.

2. BACKGROUND

ISD results from combining a major influx of activities, specifically the IS analysis, design, construction, and deployment (Hirschheim et al., 1996). Traditionally, IS have been conceived based on the application of classical tools, techniques, principles, and methods or methodologies (Iivari et al., 2000). However, after years of using these methodologies, several limitations are recognized, namely delays in implementation, high costs, low quality, and lack of capacity of the final products to meet customer needs (Fitzgerald et al., 2006).

Frank and Thong (2009) state that the classical methodologies consider the systems development process as an ordered, rational process, not reflecting what really happens. The rigid structure of classical methodologies is a known problem. As customers cannot specify the full range of requirements at the beginning of projects, it is necessary to refine them and review the specifications throughout the development process (Austin & Devin, 2009), but classical methodologies do not make this change easy. Agile methodologies for software development were proposed to tackle these challenges and solve common problems (such as scope or time non-compliance of projects (Varajão et al., 2014)).

Generically, agility involves concepts such as flexibility and speed. A possible definition for ISD agility is pointed out by Lee and Xia (2010), who define this concept as the ability of a development team to respond quickly and efficiently to changes in requirements during the life cycle of a project. Another definition is conceived by Conboy (2009), who describes agility as the continuous willingness to create, embrace, and learn from imposed changes, contributing to the value creation for the client.

As in the early years, the industry played a major role in the development of several of the existing agile methodologies (many times fostered by the industry itself), so they are mostly based on practical experience rather than on a conceptual basis (Conboy, 2009), which, for Dingsøyr et al. (2008), is a problem. Conboy (2009) states that although studies have been developed to answer different questions within the ISD, most of them are related to agile methodologies for software development, such as Scrum, Extreme Programming, Dynamic Systems Development Method (DSDM), and Crystal. These, in turn, tend to be applied in combination with other practices dictated by different methodologies, depending on the project and/or organization (Conboy, 2009; Fitzgerald et al., 2006; Theocharis et al., 2015).

Summing up, despite the wide variety of work on agile development, there is almost an exclusive focus on software development, and no specific agile process model for ISD has been identified in the scientific literature. An exception to this is the AgilIS model, proposed by Varajão (2018a). However, this model is currently only used in the teaching context; thus, to be transposed to other contexts, the model needs more detail and experimentation.

3. RESEARCH METHOD

Organizations need to develop their IS in order to evolve and meet new requirements imposed by rapidly changing environments. Agile methodologies have emerged to deal with the various challenges that arise and overcome the limitations of classical approaches (Highsmith, 2002). These methodologies promote faster development as well as better communication between the development team, customers, and the different business units (Anderson, 2003). Although it is possible to find several case studies referring to the adoption of agile methodologies, they are commonly related to software development; so, at present, studies regarding ISD agility are scarce. Seeking to overcome this gap, our article focuses on an agile process model for the ISD: AgilIS (Varajão, 2018a, 2018b). One of the limitations associated with this model is the lack of detail in its description, which makes it difficult to apply it outside the teaching context. Given its potential for the agile organization of the ISD, the study of this model was considered relevant.

Action Design Research (ADR) was proposed by Sein et al. (2011) to combine two types of research, namely, design research and action research. The first involves the creation of artifacts to solve a

previously identified organizational problem and subsequent application in an appropriate context (Hevner et al., 2004), while the second aims to intervene in a specific social situation, solving current practical problems and expanding scientific knowledge with the direct intervention of the researcher (Baskerville & Myers, 2004). ADR is a research methodology whose main objective is to generate prescriptive design knowledge by constructing and evaluating artifacts in an organizational environment (Sein et al., 2011). The same authors also highlight the main challenges this approach faces, namely: (1) to address a problematic situation found in an organizational environment by intervening and evaluating; (2) to build and evaluate an artifact that addresses the class of problems identified in the situation found.

This research has been carried out according to the four steps of the Action Design Research (ADR) methodology. Each step of the methodology is described next.

Step 1 – Problem Formulation: This step focuses on defining and understanding the problem based on the principles of research inspired by practice, as well as an artifact rooted in theory. Once identified, the problem serves as inspiration for research efforts. In this case, the problem was the lack of a detailed process model for the agile ISD. Although AgilIS (Varajão, 2018a, 2018b) already follows the principles of agile development, including a life cycle inspired by Scrum and DevOps, a limitation recognized by the model's author is the lack of detailed description and practical experimentation. These are the problems for which the present work sought solutions.

Reviewing the literature made it possible to clarify the relevant concepts and detail the components that compose the model. Regarding the literature review, the search was mainly based on two of the most recognized databases in the academic and scientific context, particularly Scopus and Web of Science, but other databases such as AIS eLibrary and Google Scholar were also used to get additional information. To carry out the research, the following combined expressions were considered: "implementation strategy*", "enterprise system implementation*"; "agile method*", "agile process*", "agile approach*", "agile life cycle*". It was not found any agile process specific for ISD besides AgilIS (Varajão, 2018a, 2018b).

Step 2 – Construction, Intervention, and Evaluation: Based on the knowledge obtained through the research carried out in the first stage, and iteratively, this stage included the construction of the artifact, the intervention in the organization, and its evaluation. Regarding the construction, this consisted in detailing several AgilIS aspects, including the life cycle and activities. In turn, an experimental intervention and an evaluation were subsequently carried out.

Step 3 – Reflection and Learning: Evolving in parallel with the first two steps, this phase consisted of applying the learning outcome to a wider class of problems. During this process, there was a continuous reflection on the results obtained in each of the previous stages, making it possible to restructure or adjust the AgilIS model to incorporate the relevant changes.

Step 4 – Formalization of Learning: This step was intended to formalize the learning obtained throughout the process and focus on generalizing results. In other words, the artifact developed through this methodology seeks to solve a specific problem, so the focal point of this step was to transform it into a more generic model, and the result is presented in the next chapter.

4. TOWARDS AN INFORMATION SYSTEMS DEVELOPMENT AGILE PROCESS MODEL – PRINCIPLES AND ACTIVITIES

From the literature review, it is evident that agile approaches to ISD are a necessity and that the proposals that describe the agile implementation of IS are scarce (Meneses & Varajão, 2022). In order to clarify the required characteristics of an agile ISD process model, this section details the main aspects that should be taken into account when creating it, namely the principles on which it should be based as well as involved activities.

4.1. Principles

Currently, agility is required in organizations. The increasing uncertainty and instability brought by new competitors and ways of doing business make it crucial for traditional companies to become more agile and able to act fast on consumer needs and expectations (Dias & Tenera, 2023). It is not only expected to have the capability to detect and respond to changes and business opportunities that may arise but also ensure that IS are developed incorporating these changes (Lyytinen & Rose, 2006). An underlying set of values and principles is required for a process model to be agile. To define and standardize them, the Agile Alliance developed the Agile Manifesto, which includes a set of four values and twelve principles that provide a structure to manage agile development projects, considering the dynamic nature of the project development (Beck et al., 2001; Serrador & Pinto, 2015). The values on which these projects should be based focus essentially on individuals and their interactions, collaboration with the customer, continuous and timely delivery of the solution, and the ability to adapt to changes that may arise in requirements (Beck et al., 2001). From these values, the following principles were derived: 1) Since the first stages of the project, the priority is to satisfy the customer through early and continuous deliveries; 2) Accept changes in requirements, even if these occur at a late stage in the development cycle; 3) Deliver working solutions frequently, giving preference to shorter periods of time; 4) The client and the development team should work together frequently throughout the project; 5) Projects should be developed based on motivated individuals, giving them the environment and support they need, and trusting that they will meet the defined objectives; 6) Communicate in a personal and direct way, as it is the most efficient and effective method of disseminating information; 7) The main measure of progress is the delivery of functional solutions; 8) Agile processes promote sustainable development and a constant pace should be maintained; 9) Continuous attention to technical excellence and good design enhances agility; 10) Simplicity – the art of minimizing the amount of work to be done – is essential;

11) The best architectures, requirements, and designs emerge from self-organizing teams; 12) The team regularly reflects on how to become more effective, and then makes the necessary adjustments and adaptations. These are principles that should be considered in an agile ISD process.

4.2. Activities

On the one hand, an agile ISD methodology is expected to enable iterative and incremental development and frequent delivery, but this is impossible without integration with operational activities. On the other hand, the ISD is not "isolated" in the organization, so it must be properly integrated with the other groups of activities of the IS function. The IS function can be viewed through four major groups of related activities (Varajão, 1998, 2002, 2005): Information Systems Planning (ISP), Information Systems Development (ISD), Information Systems Operation (ISO), and Information Systems Management (ISM). Additionally, it is useful to consider Information Systems Governance (ISG) explicitly (ISACA, 2019), given its role in the business and IT alignment. The IS function, bringing together these activities, can be considered a cyclical process that focuses on thinking, implementing, using, and managing all relevant aspects in the context of organizational IS (Varajão, 1998, 2002, 2005). Next, these activity groups are addressed.

Information Systems Governance (ISG): IT plays a crucial role in all organizational areas, more specifically, in the management, development, and communication of tangible and intangible assets, such as information and knowledge (Patel, 2004). As organizations have found that IT support sustainability and business growth (Law & Ngai, 2005; Qureshil et al., 2009), they become dependent on their use (Grembergen et al., 2004). This means that many organizations must implement ISG practices to continuously align IT and business (Haes & Van Grembergen, 2009). The IT Governance Institute (ITGI) states that ISG is the responsibility of executives and the board of directors and is an integral part of executive governance: it provides leadership, organizational structure, and guidance for the processes, to ensure that IT supports and disseminates the strategy, as well as the goals of the organization (and that the business strategy is defined considering the IT potential). Although they conceive this activity slightly differently, Weill and Ross (2004) focus on the same aspect as the previous definition (the link between business and IT), by stating that ISG consists of the specification of decision rights and the accountability structure, to encourage desirable behavior in using IT, meeting current and future demands from the business (internal focus) and its customers (external focus) (Peterson, 2003).

Information Systems Management (ISM): ISM is the management of the information resources as well as of all resources involved during the planning, development, and operation of the organizational IS (Amaral & Varajão, 2007). According to Laudon and Laudon (2017), ISM has a broad knowledge of IS, dealing with behavioral and technical aspects covering the development, use, and impact of IS in an organization. This activity can be seen as a continuous process

responsible for managing all activities within the IS function, including its planning, structuring, and control (Varajão, 2002).

Information Systems Planning (ISP): According to Lederer and Sethi (1988), ISP can be defined as the process of identifying a portfolio of IT-based applications that will help an organization define and execute its business plan as well as achieve its objectives. Thus, they should be concerned with setting their goals, objectives, and priorities, with the latter two being the main elements of planning (Lederer & Mendelow, 1993). This activity also allows an organization to define the desired future for its IS, how it should support it, and how to achieve that support (Amaral & Varajão, 2007). In general, ISP can help define new business strategies, technological policies, and architectures (Amaral & Varajão, 2007). Furthermore, it allows an organization to use its IS to influence and execute existing business strategies (Hartog & Herbert, 1986), as well as help IT/business alignment (King, 1988). However, effectively planning a path to achieve business objectives with the help of IS can be challenging, as business strategies and IT can change very quickly (Remenyi et al., 1994).

Information Systems Development (ISD): Once the desired future for the IS within the ISP has been defined, it becomes necessary to bring about this planned change through interventions at the ISD level. For this reason, ISD activity is fundamentally characterized as a process of change intended to improve the performance of the IS (Amaral & Varajão, 2007). For Avison and Fitzgerald (1995), ISD is defined as the activity of building the supports (applications and services) that the IS provides to the organization's processes. For Laudon and Laudon (2007), ISD is characterized by the activities involved in producing IS, such as Analysis, Design, Construction, Implementation, and Maintenance. Varajão (2002) states that the ISD should be viewed as a continuous process, where each activity should be considered and integrated with planning and operation activities. It should be noted that ISD involves a long spectrum of situations, from developing tailor-made computer applications to implementing commercial-of-the-shelf application packages.

Information Systems Operation (ISO): IS are vital to business operation and management (Ragowsky et al., 2000). More specifically, the effective use of IS makes it possible to organize, visualize, and analyze information to support and improve decision-making (Laudon & Laudon, 2007). After the development activities, the IS should be used for effective support of the organizational processes (Varajão, 2002). Thus, to ensure that the expected benefits are achieved, and that IS remain adequate to the needs of the organization over time, the ISO becomes relevant. This activity will ensure the proper functioning of the IS by enhancing the efficient and effective use of the organization's informational resources and play a major role both in the exploitation of existing systems and in the definition of future strategies (Varajão, 2002). Varajão (2005) states that the quality of IS operation strongly influences the success of IS planning or IS development since it is in its scope that the IS impact can be evaluated.

5. AGILIS – A PROCESS MODEL FOR AGILE ISD

According to Van de Ven (1992), a process can be defined as: (i) a sequence of events that describe the evolution over time; (ii) a category of concepts or variables related to actions of individuals or organizations; (iii) a logic that explains a causal relationship between variables, dependent or independent. Therefore, process models are defined to sequence events or steps to obtain an outcome (Mohr, 1982), clarifying how and why a process evolves in a certain way instead of another and how to achieve certain results (Cule & Robey, 2004; Langley, 1999; Mohr, 1982; Newman & Robey, 1992; Van de Ven & Poole, 1995). Becker et al. (1997) conceive process models as immaterial images of functions (logical and temporal order) executed in a process object, being the basis for operationalizing process-oriented approaches. Generally, process models detail the conditions that precede a sequence of events, as well as specify the events in the process itself and relate them to the results obtained (Robey & Newman, 1996).

Based on the presented principles and activities, AgilIS is proposed by Varajão (2018a) as an agile process model, aiming to expand the current perspectives on ISD. An ISD model that supports the agility principles should consider a clear link of ISD with the IS planning and IS operation, with proper coordination of IS governance and IS management. In other words, agility must manifest itself at various levels, not only at the "local" level of the IS design and construction. So, an ISD agile process model will have to consider the aspects related to the integration activities and, at the same time, support agility.

Given the importance of an interconnection between the various activities that directly influence the success of ISD, AgilIS combines the activities of planning, development, operation, management, and governance of IS. In the scientific literature, there seems to be a gap regarding the integration of these activities, which tend to be studied individually. For example, for IS planning, there are several proposals and methods that can be used in this activity, such as IBM's Business Systems Planning (BSP). Although BSP is concerned about articulating IS with strategic aspects, it does not provide guidelines on how to proceed when developing and exploiting IS. In turn, as for the development of IS, some methods support this activity. However, typically, the effort to align the business with the strategic aspects or link the development with the subsequent operation is out of scope. Additionally, the ISD methodologies still denote a waterfall perspective, which may imply that the design, acquisition/construction, and implementation are carried out solely once and sequentially, not following the agility principles. Regarding the IS operation, several frameworks can be used. Still, once again, the concern is limited to what occurs in this activity without a clear connection with the ISP and/or ISD.

AgilIS seeks to contribute with an integrated perspective of these activities considering the agility features. Hence, it is useful not only to help understand the relevant aspects in a teaching context but

also has the potential to be applied in practice. As can be seen in Fig. 1, at the AgilIS top level are the activities of IS governance and IS management, which are closely related. ISG is primarily concerned with the alignment between the IS and business; ISM, following the guidelines and policies defined in ISG, not only structures the IS function but also works towards that alignment. In articulation with the ISG and ISM, the ISP, following the defined policies and guidelines, identifies the short and long-term needs of the IS that will later be converted into projects; these, in turn, will be incorporated into the portfolio backlog. Thus, ISP allows for identifying and defining the needed projects but also ensures that the IS architecture remains coherent and aligned with the organization's needs. So, whenever new projects emerge, they must be properly integrated to avoid the creation of technological islands or breakdowns. As it is possible to notice, agility will manifest itself not simply in the ISD activity and the integration of its results in operations but in IS planning, management, and governance as well.

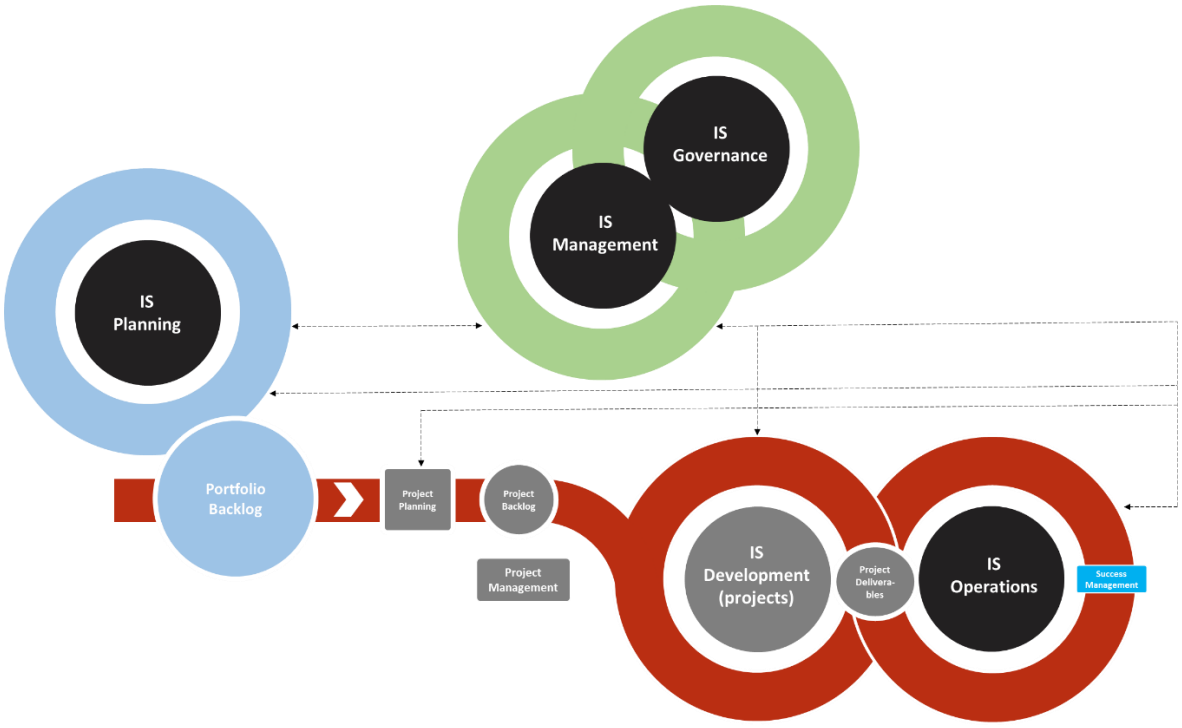

Figure 1 – AgilIS: Information Systems Development Agile Process Model (Varajão, 2018a, 2018b).

It is during the development of the IS that the projects are executed, which may run sequentially or simultaneously. Once the type of execution of a project has been decided, the next step is doing its planning (at the project level), and all the required functionalities for the project are detailed, which are then incorporated into the project backlog.

Contrary to what occurs in waterfall development, in AgilIS, the execution of the project follows an agile orientation. The underlying framework is Scrum since it is an approach that was developed in order to manage the development process of complex systems iteratively and incrementally,

considering the concepts of flexibility, adaptability, and productivity (Schwaber & Beedle, 2002). An agile orientation foresees the development of a project through iterations. Thus, in agilIS, several iterations are defined for a project according to the priorities, resources, and time available. Each iteration will result in a project increment according to what is defined in the project backlog.

Once developed, the increments will have to be properly integrated into the organization, so they will have to be articulated with the operation activity. In this case, the underlying framework is DevOps. Consisting of the combination of development (Dev) and operations (Ops), DevOps has the purpose of addressing the gaps that exist between the teams in these areas, one of which is related to the fact that the development team is focused on making changes so that the goals set can be achieved, while the operation team sees these changes as something that can affect the stability of the system and, therefore, tend to avoid them (Hussaini, 2015). The DevOps culture wishes to improve collaboration, communication, and integration between these two teams, as well as other parties involved in the development process and the output delivery to the customer, through a set of principles and/or practices (Zhu et al., 2015). Therefore, over time, and from iteration to iteration, the various increments are produced up to the moment the project's integral product is completed. Simultaneously, it occurs the transformation of the organization due to the incorporation of IT, but also, in an iterative way, the development of operations, which ensures the alignment between the solutions that the organization already uses and what is being developed. When finished, the project is removed from the portfolio backlog, and the resulting products/services are included in the IS portfolio. The entire process will be repeated for the remaining projects identified. In this manner, the organization not only becomes agile in the ISD but optimizes the entire IS function, which will have a permanent level of attention to the business needs and its translation into ISD initiatives.

6. CONCLUSIONS

In a rapidly changing business and technological environment, improving IS is an important aspect that can differentiate organizations from each other (Varajão, Trigo, et al., 2022). Moreover, digital transformation appears inevitable for most enterprises to maintain their competitiveness in a global market and digital economy (Hunady et al., 2022). ISD occurs in an increasingly dynamic, competitive, global, and customer-oriented business environment. For this reason, ISD processes should be able to respond to shifting market circumstances (Sándor & Gubán, 2022) and incorporate the changes that are requested by customers while dealing with technological innovations (Sarker et al., 2009). The success of projects is critical for the sustainability and development of virtually any human organization (Santos & Varajão, 2015; Varajão, Magalhães, et al., 2022), and this is particularly true in the case of ISD.

Through the literature review, it was possible to confirm the importance of adopting agile approaches, but also the need for further research since the adoption is not free of challenges (Durbin

& Niederman, 2021), and there is a lack of information on how to use it in the context of ISD. On the one hand, agile principles require, for example, that IS incorporate the changes imposed by the business, as well as enable the development and delivery of the resulting products in an iterative and incremental manner. On the other hand, such cannot be ensured without properly articulating all the activities involved in the ISD process. An ISD agile process model must consider the integration of activities and simultaneously support the agility required in each.

AgilIS combines IS planning, development, operation, management, and governance activities in an integrated manner, and it was developed based on agile principles. This leads to constant attention to the business needs, which will later be transformed into ISD initiatives adequately articulated with the operations. Aiming to ensure its proper functioning, these activities should be supported by IS standards (e.g., COBIT (ISACA, 2019)) since these already include a wide range of good practices.

Besides identifying and detailing the main aspects to consider when defining an ISD agile process model, this article also describes an agile process model. The main limitation of this work is the experimentation of the model in only one case of small dimension and complexity, which was not described in this paper due to space limitations. So, as future work, it is suggested to provide a detailed description of its implementation in practice and apply it in new cases to enrich the body of knowledge and make the model evolve.

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REFERENCES

Agyei-Ababio, N., Ansong, E., & Assa-Agyei, K. (2023). Digitalization of revenue mobilization in an emerging economy: the new Institutional Theory perspective. *International Journal of Information Systems and Project Management*, *11*(2), 5-22. Doi: 10.12821/ijispm110201

Alavi, M., & Yoo, Y. (2015). Use Information Technology for Organizational Change. In *Handbook of Principles of Organizational Behavior*, Wiley, 595-614.

Amaral, L., & Varajão, J. (2007). *Information Systems Planning, Planeamento de Sistemas de Informação)* (4th ed.), FCA-Editora, Lisboa.

Anderson, D. J. (2003). *Agile management for software engineering, applying the theory and constraints for business results* (1st ed.), Prentice Hall, Upper Saddle River, NJ.

Austin, R. D., & Devin, L. (2009). Research Commentary—Weighing the Benefits and Costs of Flexibility in Making Software: Toward a Contingency Theory of the Determinants of Development Process Design. *Information Systems Research*, *20*(3), 462–477.

Avison, D. E., & Fitzgerald, G. (1995). *Information Systems Development: Methodologies, Techniques and Tools* (2nd ed.), McGraw-Hill Education.

Baskerville, R., & Myers, M. D. (2004). Special issue on action research in Information Systems: making is research relevant to practice – foreword. *MIS Quarterly*, *28*(3), 329–335.

Beck, K., Beedle, M., van Bennekum, A., Cockburn, A., Cunningham, W., Fowler, M., Martin, R. C., Mellor, S., Thomas, D., Grenning, J., Highsmith, J., Hunt, A., Jeffries, R., Kern, J., Marick, B., Schwaber, K., & Sutherland, J. (2001). *Manifesto for Agile Software Development*. https://www.agilealliance.org/

Becker, J., Schütte, R., & Rosemann, M. (1997). Business-to-business process integration: Functions and methods. *Proceedings of the 5th European Conference on Information Systems*, *2*, 816-827.

Bharadwaj, A., El Sawy, O. A., Pavlou, P. A., & Venkatraman, N. (2013). Digital business strategy: Toward a next generation of insights. *MIS Quarterly*, *37*(2), 471–482.

Brosig, C., Strahringer, S., & Westner, M. (2022). From selling machinery to hybrid offerings – organizational impact of digital servitization on manufacturing firms. *International Journal of Information Systems and Project Management*, *10*(3), 5-27. Doi: 10.12821/ijispm100301

Conboy, K. (2009). Agility from First Principles: Reconstructing the Concept of Agility in Information Systems Development. *Information Systems Research*, *20*(3), 329–354.

Cule, P. E., & Robey, D. (2004). A dual-motor, constructive process model of organizational transition. *Organization Studies*, *25*(2), 229-260.

Dasgupta, S., Agarwal, D., Ioannidis, A., & Gopalakrishnan, S. (1999). Determinants of information technology adoption: an extension of existing models to firms in a developing country. *Journal of Global Information Management*, *7*(3), 30-40.

Dias, V. F., & Tenera, A. B. (2023). An agile portfolio management model for the insurance sector: the APMI model. *International Journal of Information Systems and Project Management*, *11*(2), 81-99. Doi: 10.12821/ijispm110204

Dingsøyr, T., Dybå, T., & Abrahamsson, P. (2008). A Preliminary Roadmap for Empirical Research on Agile Software Development. Agile 2008 Conference, Toronto, ON, Canada.

Durbin, M., & Niederman, F. (2021). Bringing templates to life: overcoming obstacles to the organizational implementation of Agile methods. *International Journal of Information Systems and Project Management*, *9*(3), 1-18. Doi: 10.12821/ijispm090301

Escobar, F., Almeida, W. H. C., & Varajão, J. (2023). Digital transformation success in the public sector: A systematic literature review of cases, processes, and success factors. *Information Polity*, *28*(1), 61-81. Doi: 10.3233/IP-211518

Fitzgerald, B., Hartnett, G., & Conboy, K. (2006). Customising agile methods to software practices at Intel Shannon. *European Journal of Information Systems 15*(2), 200–213.

Frank, K. K. Y., & Thong, J. Y. L. (2009). Acceptance of agile methodologies: A critical review and conceptual framework. *Decision Support Systems*, *46*(4), 803–814.

Grembergen, W., Haes, S., & Guldentops, E. (2004). Structures, Processes and Relational Mechanisms for IT Governance. In W. Grembergen (Ed.), *Strategies for Information Technology Governance*, Hershey, 1-36.

Gustavsson, T., Berntzen, M., & Stray, V. (2022). Changes to team autonomy in large-scale software development: a multiple case study of Scaled Agile Framework (SAFe) implementations. *International Journal of Information Systems and Project Management*, *10*(1), 29-46. Doi: 10.12821/ijispm100102

Haes, S., & Van Grembergen, W. (2009). An Exploratory Study into IT Governance Implementations and its Impact on Business/IT Alignment. *Information Systems Management*, *26*(2), 123–137.

Haffke, I., Kalgovas, B., & Benlian, A. (2016). The Role of the CIO and the CDO in an Organization's Digital Transformation. Thirty Seventh International Conference on Information Systems, Dublin, Ireland.

Hartog, C., & Herbert, M. (1986). 1985 Opinion Survey of MIS Managers: Key Issues. *MIS Quarterly*, *10*(4), 351-361.

Hevner, A. R., Park, J., March, S. T., & Ram, S. (2004). Design Science in Information Systems Research. *MIS Quarterly*, *28*, 75-105.

Hirschheim, R., Klein, H. K., & Lyytinen, K. (1996). Exploring the Intellectual Structures of Information Systems Development: Action Theoretic Analysis. *Accounting, Management and Information Technologies*, *6*(1-2), 1-64.

Hunady, J., Pisár, P., Vugec, D. S., & Bach, M. P. (2022). Digital Transformation in European Union: North is leading, and South is lagging behind. *International Journal of Information Systems and Project Management*, *10*(4), 39-56. Doi: 10.12821/ijispm100403

Hussaini, S. W. (2015). A Systemic Approach to Re-inforce Development and Operations Functions in Delivering an Organizational Program. *Procedia Computer Science*, *61*(1), 261–266.

Iivari, J., Hirschheim, R., & Klein, H. K. (2000). A Dynamic Framework for Classifying Information Systems Development Methodologies and Approaches. *Journal of Management Information Systems*, *17*(3), 179-218.

ISACA. (2019). *COBIT 2019 Framework: Introduction and Methodology*. ISACA.

Julia, K., Kurt, S., & Ulf, S. (2018). How digital transformation affects enterprise architecture management – A case study. *International Journal of Information Systems and Project Management*, *6*(3), 5-18. Doi: 10.12821/ijispm060301

Kääriäinen, J., Kuusisto, O., Pussinen, P., Saarela, M., Saari, L., & Hänninen, K. (2020). Applying the positioning phase of the digital transformation model in practice for smes: Toward systematic development of digitalization. *International Journal of Information Systems and Project Management*, *8*(4), 24-43. Doi: 10.12821/ijispm080402

Kääriäinen, J., Perätalo, S., Saari, L., Koivumäki, T., & Tihinen, M. (2023). Supporting the digital transformation of SMEs — trained digital evangelists facilitating the positioning phase. *International Journal of Information Systems and Project Management*, *11*(1), 5-27. Doi: 10.12821/ijispm110101

Kääriäinen, J., Pussinen, P., Saari, L., Kuusisto, O., Saarela, M., & Hänninen, K. (2020). Applying the positioning phase of the digital transformation model in practice for SMEs: toward systematic development of digitalization. *International Journal of Information Systems and Project Managemen*, *8*(4), 24-43. Doi: 10.12821/ijispm080402

King, W. R. (1988). How effective is your Information Systems planning? *Long Range Planning*, *21*(5), 103-112.

Lagstedt, A. (2019). *Selecting the right method for the right project* PhD Thesis, University of Turku.

Langley, A. (1999). Strategies for theorizing from process data. *Academy of Management Review*, *24*(4), 691-710.

Laudon, K. C., & Laudon, J. P. (2007). *Management Information Systems: Managing the Digital Firm* (10th ed.). Pearson Prentice-Hall, Upper Saddle River, NJ.

Laudon, K. C., & Laudon, J. P. (2017). *Management Information Systems: Managing the Digital Firm* (15th ed.). Pearson Prentice-Hall, Upper Saddle River, NJ.

Law, C. C., & Ngai, E. W. (2005). IT Business Value Research: A Critical Review and Research Agenda. *International Journal of Enterprise Information Systems*, *1*(3), 35–55.

Lederer, A. L., & Mendelow, A. L. (1993). Information systems planning and the challenge of shifting priorities. *Information & Management*, *24*(6), 319–328.

Lederer, A. L., & Sethi, V. (1988). The implementation of strategic information systems planning methodologies. *MIS Quarterly*, *12*(3), 445-461.

Lee, G., & Xia, W. (2010). Toward Agile: An Integrated Analysis of Quantitative and Qualitative Field Data On Software Development Agility. *MIS Quarterly*, *34*(1), 87-114.

Lyytinen, K., & Rose, G. M. (2006). Information system development agility as organizational learning. *European Journal of Information Systems*, *15*(2), 183–199.

Meneses, B., & Varajão, J. (2022). A Framework of Information Systems Development Concepts. *Business Systems Research*, *13*(1), 84-103. Doi: 10.2478/bsrj-2022-0006

Mohr, L. B. (1982). *Explaining organizational behavior* (1st ed.). Jossey-Bass.

Newman, M., & Robey, D. (1992). A social process model of user-analyst relationships. *MIS Quarterly*, *16*(2), 249-266.

Patel, N. V. (2004). An Emerging Strategy for E-Business IT Governance. In W. Grembergen (Ed.), *Strategies for Information Technology Governance* (pp. 81-97). Hershey.

Pereira, J., Varajão, J., & Takagi, N. (2022). Evaluation of Information Systems Project Success–Insights from Practitioners. *Information Systems Management*, *39*(2), 138-155. Doi: 10.1080/10580530.2021.1887982

Peterson, R. R. (2003). Information Strategies and Tactics for Information Technology Governance. In W. Grembergen (Ed.), *Strategies for Information Technology Governance*. Hershey.

Qureshil, S., Kamal, M., & Wolcott, P. (2009). Information Technology Interventions for Growth and Competitiveness in Micro-Enterprises. *International Journal of Enterprise Information Systems*, *5*(2), 71–95.

Ragowsky, A., Ahituv, N., & Neumann, S. (2000). The benefits of using information systems. *Communications of the ACM*, *43*(11), 303-311.

Remenyi, D. S. J., Money, A., & Twite, A. (1994). *A Guide to Measuring and Managing IT Benefits* (Vol. 2nd). Blackwell Publishers.

Robey, D., & Newman, M. (1996). Sequential Patterns in Information Systems Development: An Application of a Social Process Model. *Transactions on Information Systems*, *14*(1), 30-63.

Sándor, Á., & Gubán, Á. (2022). A multi-dimensional model to the digital maturity life-cycle for SMEs. *International Journal of Information Systems and Project Management*, *10*(3), 58-81. Doi: 10.12821/ijispm100303

Santos, V., & Varajão, J. (2015). PMO as a Key Ingredient of Public Sector Projects' Success - Position Paper. *Procedia Computer Science*, *64*, 1190-1199. Doi: 10.1016/j.procs.2015.08.546

Sarker, S., Munson, C. L., Sarker, S., & Chakraborty, S. (2009). Assessing the relative contribution of the facets of agility to distributed systems development success: an Analytic Hierarchy Process approach. *European Journal of Information Systems*, *18*(4), 285–299.

Schwaber, K., & Beedle, M. (2002). *Agile Software Development With Scrum* (1st ed.). Prentice-Hall.

Seclen-Luna, J. P., Castro Vergara, R. I., & Lopez Valladares, H. (2022). Effects of the use of digital technologies on the performance of firms in a developing country: are there differences between creative and manufacturing industries? *International Journal of Information Systems and Project Management*, *10*(1), 73-91. Doi: 10.12821/ijispm100104

Sein, M. K., Henfridsson, O., Purao, S., Rossi, M., & Lindgren, R. (2011). Action Design Research. *MIS Quarterly*, *35*(1), 37-56.

Serrador, P., & Pinto, J. K. (2015). Does Agile work? — A quantitative analysis of agile project success. *International Journal of Project Management*, *33*(5), 1040–1051.

Tam, C., Moura, E., Oliveira, T., & Varajão, J. (2020). The factors influencing the success of on-going agile software development projects. *International Journal of Project Management*, *38*(2020), 165–176.

Theocharis, G., Kuhrmann, M., Münch, J., & Diebold, P. (2015). Is WaterScrum-Fall Reality? On the Use of Agile and Traditional Development Practices. In L. C. P. Abrahamsson, M. Oivo, B. Russo (Ed.), *Product-Focused Software Process Improvement* (Vol. 9459), Springer, Cham, 149-166.

Van de Ven, A. H. (1992). Suggestions for studying process: A research note. *Strategic Management Journal*, *13*(1), 169-188.

Van de Ven, A. H., & Poole, M. S. (1995). Explaining development and change in organizations. *Academy of Management Review*, *20*(3), 510–540.

Varajão, J. (1998). *The Information Systems Management Architecture (A Arquitetura da Gestão de Sistemas de Informação)* (1st ed.). FCA-Editora, Lisboa.

Varajão, J. (2002). *Information Systems Function: Contributions to the successful adoption of information technologies and development of information systems in organizations (Função de Sistemas de Informação: contributos para a melhoria do sucesso da adopção de tecnologias de informação e desenvolvimento de sistemas de informação nas organizações)* PhD Thesis, University of Minho.

Varajão, J. (2005). *The Information Systems Management Architecture (A Arquitetura da Gestão de Sistemas de Informação)* (3rd ed.). FCA-Editora, Lisboa.

Varajão, J. (2018a). agilIS - agile Information Systems. In: DASI project, Information Systems Department, University of Minho.

Varajão, J. (2018b). agilIS - agile Information Systems (Zenodo). *Zenodo*. Doi: 10.5281/zenodo.8218749

Varajão, J., Domingues, C. E., Ribeiro, P. A., & De Paiva, A. C. (2014). Failures in software project management - are we alone? A comparison with construction industry. *Journal of Modern Project Management*, *2*(1), 22-27.

Varajão, J., Lourenço, J. C., & Gomes, J. (2022). Models and methods for information systems project success evaluation – A review and directions for research. *Heliyon*, *8*(12), Article e11977. Doi: 10.1016/j.heliyon.2022.e11977

Varajão, J., Magalhães, L., Freitas, L., & Rocha, P. (2022). Success Management – From theory to practice. *International Journal of Project Management*, *40*(5), 481-498. Doi: 10.1016/j.ijproman.2022.04.002

Varajão, J., Trigo, A., Pereira, J. L., & Moura, I. (2022). Information systems project management success. *International Journal of Information Systems and Project Management*, *9*(4), 62-74. Doi: 10.12821/ijispm090404

Weill, P., & Ross, J. (2004). *IT Governance: How Top Performers Manage IT Decision Rights for Superior Results* (1st ed.). Harvard Business Review Press.

Zhu, L., Weber, I., & Bass, L. (2015). *DevOps A Software Architects Perspective* (1st ed.). Addison-Wesley Professional.