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JOSÉ EDUARDO RICCIARDI FAVARETTO

STAGE LEVEL MEASUREMENT OF INFORMATION SYSTEMS AND ANALYTICS DIFFUSION IN ORGANIZATIONS

SÃO PAULO
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Área de concentração: Administração, Análise e Tecnologia de Informação

Orientador: Prof. Dr. Fernando de Souza Meirelles

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Aos meus pais, Aldo e Yonne pelo amor e ensinamentos recebidos até suas partidas.

À Patricia e familiares queridos, pela compreensão de minha ausência.

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"Models are abstractions and simplifications of reality. Useful models capture the essence of reality in a way that enhances understanding of phenomena."

Frank M. Bass (1926–2006)

American academic (Business Administration)

RESUMO

A atual economia do conhecimento baseada em dados, na era do Big Data e da transformação digital dos negócios, tem afetado as organizações e requerido um melhor gerenciamento de suas iniciativas de Tecnologia da Informação e Comunicação / Sistemas de Informação (TIC/SI), combinadas com a análise de dados para tomada de decisão organizacional, além da busca contínua por Inovação como vantagem competitiva no mercado. Esta pesquisa foi estruturada conceitualmente baseada em três lentes teóricas: a teoria dos Estágios de Crescimento do campo de Administração de Sistemas de Informação (ADI), a teoria da Aprendizagem Organizacional, do campo de Estudos Organizacionais, a qual descreve duas formas distintas e complementares nas quais as organizações aprendem / inovam (e*xploration* e e*xploitation),* e a Teoria da Difusão de Inovação da área da Sociologia. Este estudo tem o objetivo de medir e explicar o Nível de Estágios das iniciativas da TIC/SI nas organizações e sua influência na Inovação organizacional (*exploration* e *exploitation*), quando também moderado pelo nível do '*data Analytics'* em uso nas organizações. Com base na abordagem metodológica quantitativa, utilizando a técnica estatística de Modelagem de Equações Estruturais de Mínimos Quadrados Parciais (PLS-SEM), uma amostra de 107 respondentes, representantes de organizações do Brasil e exterior, foram contatados com o uso da rede social do LinkedIn e participaram de uma survey disponibilizada on-line na Internet. Os achados apontam que no processo de crescimento de UC (*User Community*) é onde 55 organizações (51% da amostra) estão pior posicionadas (13 organizações no nível de 'Estágio I' e 42 organizações no nível de 'Estágio II'), e a utilização do 'data Analytics' pelas organizações que estão no nível de 'Estágio IV' em suas atividades de TIC/SI, aumenta em 55% a influência na inovação organizacional. Apenas 7,5% das empresas da amostra analisadas possuem o nível '6-Prescritivo' de uso do 'data Analytics' em suas estruturas, o que ocorre majoritariamente em empresas com faturamento ou orçamento anual acima de US$75 milhões. Implicações desta pesquisa ajudarão novas compreensões do paradigma da teoria de estágio de crescimento do campo de ADI, a disseminação de um modelo com rigor acadêmico que propõe mensurar o nível de estágio da TIC/SI, associados à influência da Inovação organizacional e ao nível de uso do '*data Analytics'* nas organizações, esclarecendo aspectos relativos a essa temática para acadêmicos e profissionais.

Palavras-chave: teoria de estágios, *exploration*, *exploitation*, teoria da difusão de inovação, estágios de crescimento, nível de estágio da TIC/SI organizacional, data Analytics

ABSTRACT

The current data-driven knowledge economy, in big data era and digital business transformation, have been affecting organizations and required a better management of their Information and Communication Technology / Information Systems (ICT/IS) initiatives, combined with data analysis as a valuable asset of the organization for decision-making, beyond the continuous search for Innovation as competitive advantage in the market. This research was conceptually structured based on three theoretical lenses: Stages of Growth Theory (SGT) from Management Information Systems (MIS) field, the theory of Organizational Learning which describes two distinct and complementary ways in which organizations learn / innovate (exploration and exploitation), from the Management field, and Innovation Diffusion Theory (IDT) from the Sociology field. This study has the objective to measure and explain the Stage Level of ICT/IS initiatives in organizations and their influence in organizational innovation (exploration and exploitation), while also moderated by the level of ‘data Analytics’ in use in Organizations. Based on quantitative methodological approach, using the statistical technique of Partial Least Squares Structural Equation Modeling (PLS-SEM), a sample of 107 respondents, representatives of organizations from Brazil and abroad, were contacted using the LinkedIn social network and participated in a survey made available online on the Internet. Findings indicate that in the growth process of UC (User Community) is where 55 organizations (51% of the sample) are worse positioned (13 organizations at the 'Stage I' level and 42 organizations at the 'Stage II' level), and the use of 'data Analytics' by organizations that are at the 'Stage IV' level in their ICT/IS activities, increases their influence on organizational innovation by 55%. Only 7.5% of the analyzed sample companies have the '6-Prescriptive' level of ‘data Analytics’ use in their structures, which occurs mostly in companies with annual revenue or budget above US$ 75 million. Implications of this research will help further understand the paradigm of stages of growth theory in the field of MIS, the dissemination of a model with academic rigor that proposes to measure the stage level of organizational ICT/IS initiatives, associated with the influence of organizational innovation and the level of ‘data Analytics’ use in organizations, clarifying aspects related to this thematic for academics and practitioners.

Keywords: stages theory, exploration, exploitation, innovation diffusion theory, stages of growth, organizational stage level of ICT/IS initiatives, data Analytics

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ADI – Administração de Sistemas de Informação

AI – Artificial Intelligence

ANPAD - Associação Nacional de Pós-Graduação e Pesquisa em Administração

AP – Information Systems Applications Portfolio Processes [of ICT/IS]

AVE – Average Variance Extracted

BDA – Big Data Analytics

CMB – Common Method Bias

CR – Composite Reliability

CVs – Control Variables

EG – Information Systems Emerging Processes [of ICT/IS]

ICT – Information and Communication Technology

ICT/IS – Information and Communication Technology / Information Systems

IDT – Innovation Diffusion Theory

IM – Information Systems Management Processes [of ICT/IS]

IoT – Internet of Things

IR – Information Systems Resource Processes [of ICT/IS]

IS – Information Systems

IT – Information Technology

LV – Latent Variable

MIS – Management Information Systems

MLMV – Measured Latent Marker Variable

NSGM – Nolan´s Stages of Growth Model

PIN – Personal Identification Number

PLS-SEM – Partial Least Squares Structural Equation Modeling

SEM – Structural Equation Modeling

SI – Sistemas de Informação

SGM – Stages of Growth Model(s)

SGT – Stages of Growth Theory

TIC – Tecnologia de Informação e Comunicação

UC – User Community Processes [of ICT]

SUMMARY

1 INTRODUCTION

The current data-driven knowledge economy in big data era (Agarwal & Dhar, 2014; Boyd & Crawford, 2012; Erevelles, Fukawa, & Swayne, 2016; Goes, 2014; Nolan, 2005; Nolan & Croson, 1995; Vassakis, Petrakis, & Kopanakis, 2018; Wang, White, & Chen, 2015) and digital business transformation (Chanias, Myers, & Hess, 2019; Ferreira, Fernandes, & Ferreira, 2018; Francisco, Kugler, & Larieira, 2017; Westerman, Bonnet, & McAfee, 2012, 2014) have been affecting organizations and required a better management of their Information and Communication Technology / Information Systems (ICT/IS) initiatives, combined with data analysis as a valuable asset of the organization for decision-making, beyond the continuous search for Innovation (Benitez, Llorens, & Braojos, 2018; Duan, Cao, & Edwards, 2018) as competitive advantage in the market.

The theoretical context that guides this research is based on seminal studies and subsequent contributions regarding three corpus of knowledge: Stages of Growth Theory (SGT) in Information Systems (Nolan, 1973, 1979), Innovation (exploration and exploitation) (Jansen, Bosch, & Volberda, 2006; March, 1991, 1995) and Diffusion of Innovation Theory (IDT) (Rogers, 2003).

This research wants to answer the following research questions:

1) How to measure and explain the Stage Level of ICT/IS initiatives in Organizations and its influence in Organizational Innovation (Exploration and Exploitation)?
2) How to measure and explain the moderation of this relation by the ‘data Analytics’ Level in use in Organizations?

The first justification for developing this research in the study field of Management Information Systems (MIS), concerning the measurement of the stage level of ICT/IS, is supported by the need to stimulate this research paradigm (Kuhn, 1970), mainly by searching for empirical validation of Nolan's work, which remains for more than 40 years without response.

Despite all scholars’ efforts to attempt of several scientific researches in the past (Benbasat, Dexter, Drury, & Goldstein, 1984; Drury, 1983; Huff, Munro, & Martin, 1988; Li, Rogers, & Chang, 1994) to explore this task, the academic literature does not inform recent studies that analyzed in depth and generates theoretical and empirical explanations to measure and explain the stages of growth about the organizational ICT/IS initiatives based on Nolan´s Stages of Growth Model (NSGM) (Nolan, 1973, 1975, 1979), and also specifically to seek its empirical

validation with the use of multivariate statistical techniques – this is a gap to be clarified in order to evolve new researches in this paradigm.

Although for decades researchers have insisted that the empirical foundations that supported Nolan's works are questioned, or the original model is very simplified or even implausible to be used (Leem, Kim, Yu, & Paek, 2008), there is a need for complementary efforts to refine the focus of the model, as well as to increase the use of variables that allow adjusting the measurement of the model (Damsgaard & Scheepers, 2000; Lyytinen, 1991; Mutsaers, Zee, & Giertz, 1998). Thus, it is clear that literature reiterates the need for the creation and development of a measurement scale that extends Nolan's research, to identify the stage of the initiatives of ICT/IS in an organization by combining variables and measurements that reflect the current moment that organizations experience.

The second justification for developing this research is that there are a variety of studies in the Management literature, which uses models of stages of growth in different thematic (Berghaus & Back, 2016; Boza, Llobregat, Cuenca, & Michaelides, 2017; Solli-Sæther & Gottschalk, 2015), recent studies address the issue as maturity models (Carvalho, Rocha, & Abreu, 2016, 2017; Carvalho, Rocha, van de Wetering, & Abreu, 2019; Carvalho, Rocha, & Vasconcelos, 2015), to the point that Portuguese researchers Carvalho et al. (2016) consider Richard Nolan as the leading architect of the ICT/IS maturity models with the approach by stages, originally studying its use in large organizations in the US, and having been recognized as a highly innovative. These researchers conducted continuous studies in recent years focused on the health sector and hospitals (Carvalho et al., 2017, 2019, 2015; Carvalho, Rocha, Vasconcelos, & Abreu, 2018a) using ICT/IS maturity models for this niche.

But none of these studies were concerned to return to the origins of this body of knowledge, which is Nolan's own model per se, before mentioning it in the references of the works and recognizing its theoretical importance, launching new efforts to validate it empirically and also broaden it theoretically.

In this way, the academy can also bring its contribution to the applied field of professional practices, proposing a way of generating value for the research respondents, through the generation of a diagnostic and report compiled at the end of their answers, regarding the ICT/IS initiatives of these participating organizations, adequately based on theoretical frameworks, using a scale and methodological procedures conducted with academic-scientific rigor.

The third justification for developing this research is, as a complementary contribution to the present times, when society experiences data-driven knowledge economy in big data era, it is important to propose a link between organizational ICT/IS initiatives, its capacity to be reinventing or constantly changed by efforts of Innovation, being this in exploration and exploitation (Jansen et al., 2006; March, 1991), and the influence in this process when moderated by a technological diffusion (Lechman, 2015; Mahler & Rogers, 1999; Rogers, 2003) like 'data Analytics' (Davenport, 2013; Deka, 2014; Delen & Zolbanin, 2018; Gandomi & Haider, 2015; Vassakis et al., 2018) in different levels of use by organizations.

Models for studying the level of 'data Analytics' (Carvalho, Rocha, Vasconcelos, & Abreu, 2018b; Carvalho et al., 2018a; Comuzzi & Patel, 2016), are also the target of recent research in the area of management.

It is also necessary to create and develop the theoretical basis of a scale for indicating the levels of 'data Analytics', starting with the integration of literatures that already substantiate this theme in part (Davenport, 2013; Deka, 2014; Delen & Zolbanin, 2018; Gandomi & Haider, 2015; Vassakis et al., 2018), in addition to verifying how the diffusion of this technology occurred in organizations (Lechman, 2015; Mahler & Rogers, 1999; Rogers, 2003), for the reason that 'the data' became a resource or an asset to the organizations, discussed so much in the academic literature (Carillo, 2017; Loebbecke & Picot, 2015; Newell & Marabelli, 2015; Nolan & Croson, 1995, p. 13), as well as by professional consultancies (Hagerty, 2016; International Business Machines, 2017; Logan, Edjlali, Herschel, & Judah, 2017), which highlight the importance of this to be increasingly exploited by organizations, with the aim of developing and obtaining analytical skills and competencies to revert to competitive advantage in modern society.

The focus of this research study was on organizations identified by the LinkedIn social network, represented by its leading professionals in the Technology departments or divisions, usually their Chief Information Officers (CIOs), Technology Directors or Technology Managers, not limited to just to these positions. In addition to being a form of transparency to find qualified respondents, because the organization is easily located via Internet, also allows the possibility of direct contact of the researcher with these leaders to send invitations directly via in-box or email. This context is justified by the academic literature, which brings studies that used the LinkedIn social network (Holt, Ramage, Kear, & Heap, 2015; Schmiedel, vom Brocke, & Recker, 2014; Tifferet & Vilnai-Yavetz, 2018), and identified as response-

facilitating conditions the response time, as well as the reduced cost of administering the research (Schmiedel et al., 2014).

The choice of the identification and invitation of individuals, through LinkedIn social network, was a way to obtain adequate profiles of qualified respondents, since such social network has a focus of use for professional and business activities, and their members are active and interested in connections that bring value to their organizations.

In addition, information is available to all who participate in this network, with free access, about the contact individuals, the position they occupy and also information about the organizations where they work. Additional considerations from researchers who made the dissemination of research via LinkedIn social network were to collect samples of their empirical research online on the Internet (Holt et al., 2015), and to maximize the geographical penetration of their researchs (Schmiedel et al., 2014).

The second justification for choosing the context of the study [that used the Linkedin social network] is to enable the participation of organizations (survey respondents) going beyond only Brazilian organizations installed locally. To study organizations of varying sizes (small, medium or large) that make use of ICT/IS initiatives and that adopt and use ‘data Analytics’ technology, not only in the territorial limits of Brazil – since the collection instrument (survey form) was created to meet two languages (Portuguese and English) – it is a way to validate the scale developed broadly and identify how the stage level of such ICT/IS initiatives are underway in organizations around the world.

Other two motivators were identified by the researcher to make this choice to use LinkedIn's social network: 1) the condition of ‘multiplying’ the dissemination of research to the network of prospects / respondents who could indicate participation or share the existence of the research among their friends, and 2) the condition of working simultaneously with Linkedin system and the administration of the research via an information system developed by him specifically to assist and integrate this task.

This 'set' of online systems (LinkedIn and the research administration system) allowed the verification of all potential respondents previously by the researcher, restricting the participation of only qualified leaders to respond to the survey, prior to the issuance and release of the exclusive personalized invitation of participation for respondents with appropriate profiles.

The provision of the generation of real-time Diagnostic and report about the organization's ICT/IS initiatives, shortly after the completion of the responses, motivated the participation of potential respondents (leaders who are not usually accessible to participate in surveys) and also suggested that the answers were more reliable about the reality of the participating organizations, and thus, the findings of the research still more coherent.

The most important contribution of this scientific research is to the MIS field, specifically to the paradigm of the stages of growth theory. From the use of the scale and the model generated and tested empirically in this work, it was possible to add as theoretical contribution in the SGT the possibility of now being able to measure the influences of each stage of the organizational ICT/IS in the relation of other organizational dependent variables – this research focused on the dependent variable of organizational Innovation (exploration and exploitation). As an applied contribution with this research, it also was possible to generate a diagnostic report to the respondents, taking this resource to managers as a tool to support management and understanding of what stages of ICT/IS initiatives need to be better managed to achieve organizational goals.
As a secondary contribution of this research, from the empirical measurement of innovation (exploration and exploitation) with the use of a scale made available by the literature (Jansen et al., 2006), it is also possible to identify how the stage level of ICT/IS initiatives can influence organizational innovation and additionally, clarified how this theoretical set can still be influenced by moderation with the level of use of ‘data Analytics’ technology, bringing its diffusion curve (Rogers, 2003) of the organizations that participated in the study.

This study has the objectives to measure and explain the Stage Level of Information and Communication Technology / Information Systems (ICT/IS) initiatives in organizations and their influence in organizational Innovation (exploration and exploitation), also moderated by the level of ‘data Analytics’ in use in organizations.

In the Chapter 2 (Literature Review), the author reviews and updates the discussion regarding Stages of Growth in Information Sytems, seeking the empirical validation of the scale created in his previous research. Innovation in organizations will be introduced and supported by the theoretical lens of exploration and exploitation (organizational learning). Also, diffusion of Innovation will be used to conduct the part of the research that has association with the

diffusion of technology of 'data Analytics', as a way to notice the presence (or absense) of ‘data Analytics’ in organizations, introducing levels about the influence of ‘data’ analysis as a strategic asset to be managed and explored.
In Appendix A is shown in detail all specifications about a bi-lingual scale for measuring the Stage Level of ICT/IS initiatives in Organizations (English and Portuguese), adapted from Favaretto (2015, p. 70).

Important: in order to clarify the reader of this work, it should also be mentioned that some parts or blocks of this research may contain materials and references also related to the previous study developed by Favaretto (2015), as a continuous sequence of his own studies derivated from his academic Master Dissertation.

2 LITERATURE REVIEW

The theoretical body that guide this research is based on seminal studies and subsequent contributions regarding three corpus of knowledge: Stages of Growth Theory in Management Information Systems (SGT/MIS) (Nolan, 1973, 1975, 1979), Organizational Innovation studies (exploration and exploitation) in Organizational Learning theory (Jansen et al., 2006; Jansen, Vera, & Crossan, 2009; March, 1991), and Diffusion of Innovation Theory (Mahler & Rogers, 1999; Rogers, 2003) in organizations. This chapter has been divided into subsequent sections for better understanding of the reader.

2.1 Richard L Nolan´s Stages of Growth Model (NSGM) and Organizational Learning about ICT/IS initiatives

A wide variety of growth phenomena in diverse study fields has been using Stages of Growth Theory (SGT) to describe their formative periods of knowledge, in galaxies growth, in biological growth, in studies regarding economic development of nations (Nolan, 1973, p. 399). King and Teo (1997, p. 279) stages of growth model are also used to explain product life cycle, organizational life cycle, assuming that exist predictable patterns that are conceptualized in terms of stages, and also: (1) have sequential nature, (2) have a certain progressive hierarchy that is not easily reversed, and (3) involve a broad set of activities and organizational structures (Lavoie & Culbert, 1978).

Seminal studies of the Stages of Growth Theory (SGT) in the academic field of Management Information Systems (MIS) back to the 1970s and is attributed to Professor Richard L. Nolan (Nolan, 1973). He is considered the first IS researcher that introduced a structured scheme for explaining the growth of computing in organizations (J. L. King & Kraemer, 1984, p. 474), making statements regarding technical and organizational consequences. Nolan´s theoretical framework of the development of MIS for the assimilation of Information Technology (IT) in business organizations (Nolan, 1973, 1979, 2001) was developed to help managers understand the role and evolution of computers in their organizations.

In the later version of the NSGM, preliminarily presented in 1975, the stage III was divided to include two other stages, thus totalizing six stages (Nolan, 1975, 1979): I-Initiation, II-Contagion (also known as 'Expansion'), III-Control (also known as 'Formalization'), IV-Integration, V-Data Administration, and VI-Maturity (Table 1), as has emerged the stages based on Organizational Learning, as shown by the Figure 1.

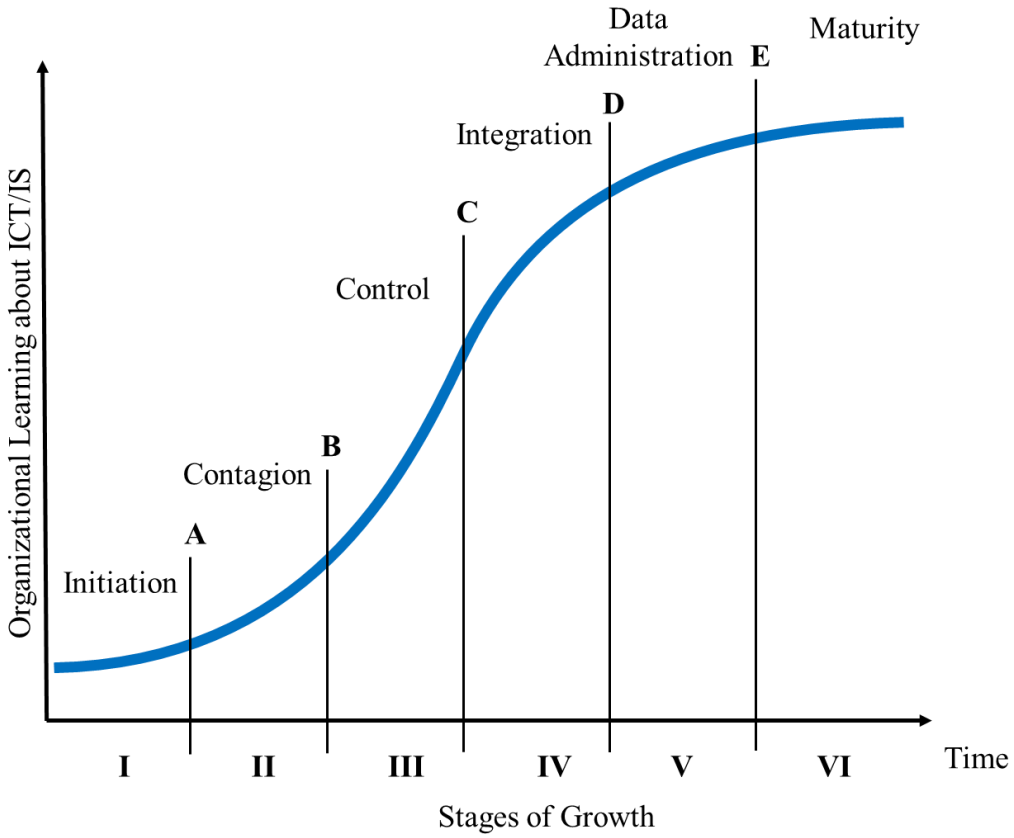

Figure 1 – A schematic representation of Nolan´s Stages of Growth Model with six stage levels
Source: Adapted by the Author based on Nolan (1979) and literature review

As organizations 'learn' how to utilize ICT/IS initiatives in their businesses, they spent more and more money developing this capability (Cash, Eccles, Nohria, & Nolan, 1994, p. 259). According to Nolan and his collaborators (Nolan, 2001; Nolan & Croson, 1995; Nolan, Croson, & Seger, 1993), this S-shaped curve reflects the 'Organizational Learning about Information Technology' that occurs when an organization uses technologies in their business operations and management.

The term 'Organizational Learning' (Bierly III, Kessler, & Christensen, 2000) became widespread commonly used to guide research about stages of growth and also suggesting links with organizational innovation (Christensen, 1997; March, 1991) or about the effects of technology on work and organizations (Cascio & Montealegre, 2016).

In a short way, to understand about the concept of 'Organizational Learning' a definition proposed by March, Sproull, and Tamuz (1991) explains: "how organizations learn from experience".

Specifically in this research, focusing on the field of Information Systems studies, the author considered the experience conducted by organizations in their ICT/IS activities, through the

five sets of growth processes (Table 2), such as how to classify this organizational learning by stage level (Table 1).

Table 2 shows the five growth processes described to allow the measurement of ICT/IS initiatives stage level. Accoding Nolan´s model (Nolan, 1979), four of them - Applications Portfolio (AP), ICT/IS Resources (IR), ICT/IS Management practices (IM) and User Community (UC) - were revisited and updated, and a new one, Emerging ICT/IS (EG), was created by studies of Favaretto (2015, pp. 35–36), based on academic literature review and the necessity to update the model to contemplate the present times.

Thus, the author from that point forward, briefly used the term 'ICT/IS initiatives' to integrate any other definition of these organizational practices.

Table 1 – Revisited and updated definitions of the six stage levels of Nolan´s Stages of Growth Model

Stage Number (segment)	Stage Name	Stage Definition
Stage I (origin–A)	Initiation	Characterized by limited investment and contained experimentation for proving the value of the technology in the organization. ICT/IS personnel are learning regarding the new technology. There is no clear direction for the organization's ICT/IS initiatives. The organization directs efforts to functional applications.
Stage II (A–B)	Contagion	Also known as "Expansion" stage. A period of high learning in the organization whereby the technology proliferated in a relatively uncontrolled manner. ICT/IS initiatives are increasingly considered to be an important component of the organization's business. With no proper planning, high slack and low control, the use of ICT/IS is growing rapidly, but in an inefficient manner. There is a lack of direction for ICT/IS development and implementation.
Stage III (B–C)	Control	Also known as "Formalization" stage. Management reacts to impose controls on the ICT/IS initiatives and to discipline related costs. Due to the growing use of automation activities, they are considered an important component of the organization's business. Uncontrolled growth eventually led to inefficiency, which created a demand for controls that slowed the growth to a more manageable rate. There is a clear direction for the development of ICT/IS initiatives within the organization. However, ICT/IS is still much too focused on technology-centric perspective and not influenced by business needs.
Stage IV (C–D)	Integration	There is a move towards integration and greater coordination between the ICT/IS processes and the organization's business processes. The accumulated learning allowed reaching a balance between managed controls and growth. Organizations dominate certain current technologies, providing a foundation to introduce the next order of magnitude of progress that would be the next S-curve Era seeking new improvements. ICT/IS adoption and development is becoming more business-focused.
Stage V (D–E)	Data Administration	ICT/IS initiatives focus to data administration to provide strategic benefits by building strategic systems. Integration between traditional business processes and activities and ICT/IS initiatives, creates seamless communication and flow of processes within the organization.
Stage VI (E–onwards)	Maturity	ICT/IS initiatives are deeply embedded throughout every aspect of the organization. There is a strong integration between the ICT/IS processes and business processes within the organization as well as with those of its suppliers and business partners. ICT/IS initiatives are aimed to create and maintain the organization's strategic advantage.

Source: Created by the Author based on literature review and Favaretto (2015, p. 32)

Table 2 – The five growth processes to the assessment of ICT/IS initiatives in each stage level

Growth Processes	Definitions
Applications Portfolio (AP)	The existing base of information systems that support the business functions and objectives. The set of applications of information systems that an organization has at its disposal and must support. For example: financial planning, order processing, on-line customer enquiries. This refers to the functional and technical quality of these systems and the level to which these systems support the current work processes.
ICT/IS Resources (IR)	The resources (personnel / staff and available technology) providing the organization with the ways (means) to use and apply ICT/IS initiatives in the business. Involves the position of the ICT/IS unit in the organizational chart, its areas of activities (technical services, database for queries, maintenance, etc.), the skills and relevant knowledge of the ICT personnel.
ICT/IS Management (IM)	The instruments, procedures and controls that management uses to facilitate effective and efficient use and provision of ICT/IS activities (i.e, its practices). For example: level of control, formalization of planning process, management of projects, and extent of strategic plans. The objective of management is to strike an appropriate balance between control and slack for each stage of ICT/IS assimilation.
User Community (UC)	The ability of users to effectively apply ICT/IS initiatives to their work. This process represents the amplitude to which users (people in the organization using ICT/IS; users skills) develop an understanding and awareness of the opportunities and limitations of ICT/IS initiatives. This concerns the level to which user management can indicate the contribution that ICT activity has to provide in the realization of the organizational objectives.
Emerging ICT/IS (EG)	New and emerging ICT/IS influencers that will introduce, induce and promote organizational discontinuity regarding the new ‘Big Data Era’. They stimulate the introduction of new technologies with high potential to be explored by the organization. Connection full time, instantaneous information, information transparency, on-line databases, real-time messaging and transactions services, data warehousing, Internet mass users/consumers, cloud computing services, mobile technologies, the power of the social media/network sites, Analytics and Data-driven, Artificial Inteligence (AI), Blockchain, Internet of Things (IoT), etc. influencing popular use of different technologies by organizations and its users.

Source: Created by the Author based on literature review and Favaretto (2015, pp. 35–36)

Using the five growth processes described in Table 2, managers can notice where their organizations stand in the evolutionary stage level process, described by those explanations of the six stages in Table 1 and Figure 2.

This type of structure reported in Figure 2, for the preliminary specification of studies of models of stages, brings in the first row and column respectively the variations of the 'stages' and the variations of 'factors' (or grouping of growth processes for the Nolan model), bringing

in the central part (other lines) the 'indicators' or the characteristics of variables for each respective set of 'stage + factor', is documented in the academic literature (Carvalho et al., 2015) as the framework for the creation of maturity models.

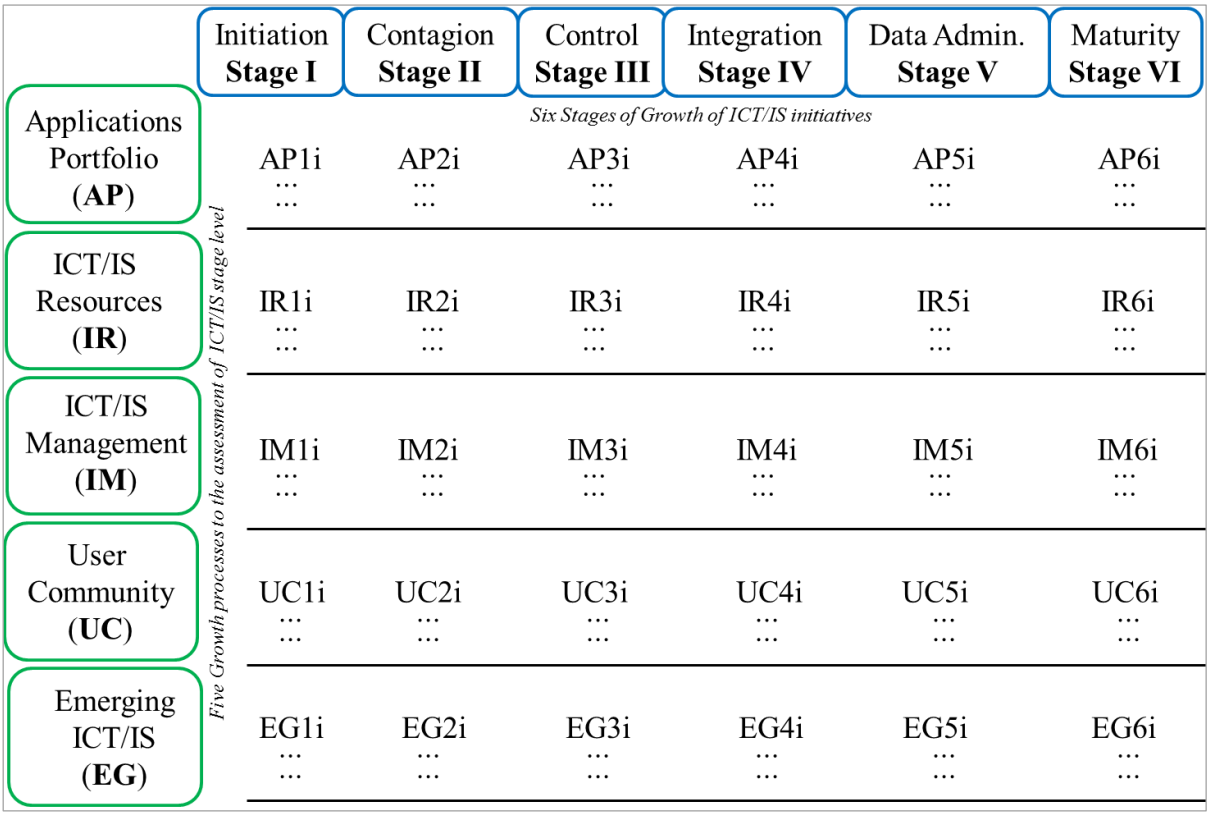

Figure 2 – Theoretical schematic representation about the Stages of Growth of ICT/IS initiatives
Source: Created by the Author

The theoretical schematic representation proposed in Figure 2 is a tentative to continue to adapt the theory of Stages of Growth to the current ICT/IS environment present in the organizational structures, and expect to be useful to academic and practitioner studies. This schematic representation indicates that the five Growth Processes – AP, IR, IM, UC e EG (independent variables) which are composed of a set of itens / indicators variable (eg AP1i ... ranging from AP11 to AP14; or EG61i ... ranging from EG61 to EG65; see additional details in the APPENDICES section – measurement scale for each of the six stages level (Stage I, II, III, IV, V and VI).

As initially presented in the international conference of SouthWest Decision Science Institute (SWDSI) in Houston, study of Favaretto and Meirelles (2015) proposed an extended theoretical schematic representation to the study of Stage of Growth of ICT/IS initiatives in

Organizations, in order to integrate new understandings obtained from the revisited academic literature and updated vision to research approaches.

By measuring the levels of each of the five Growth Processes, for each of the respective six Stages of Growth, the average value obtained from this (in the respective stage) is the appropriate measure of the level of the ICT/IS initiatives regarding that stage.

In other words, for example, to measure the level of Stage I, it will be necessary to obtain the sum of all the indicators related to Stage I and to extract the average, and then sum all these partial averages and divide by 5 (the number of processes used in the scale), ie: Stage I Level = (ΣAP1i/i + ΣIR1i/i + ΣIM1i/i + ΣUC1i/i + ΣEG1i/i)/5, where 'i' is the maximum number of indicators, which can vary from 3 to 5 (maximum), according to the specific Growth Process.

Measurements of stage levels may vary depending on the interest and focus of the research or even the researcher. Portuguese researchers who have acted in this paradigm with recent research (Carvalho et al., 2016) attribute the nomenclature of 'maturity models' – the way that stage level measurements are known to practitioners and firms - to be evaluated not only by the entire organization but also at the departmental level alone.

After Nolan´s studies, a variety of studies and researchers keep exploring this research paradigm of Stages of Growth Models (SGM) (Berghaus & Back, 2016; Boza et al., 2017; Carvalho et al., 2019, 2015; Duane & O'Reilly, 2016; Solli-Sæther & Gottschalk, 2010), focusing on a variety of approaches related to the areas of technology and management. Even during the last decade, academics has noticed the importance that the SGT represents to the MIS research field, and continued to study other themes, such as: IS Planning (Haghighi, Divandari, & Keimasi, 2010), data management (Mattia, 2011), ERP integration (Grant, Hwang, & Tu, 2013), E-government (de Brí & Bannister, 2015), Social Media adoption (Duane & O'Reilly, 2016), Digital Business Transformation (Berghaus & Back, 2016), and Healthcare (Carvalho et al., 2016) - Table 3 details a little more this last decade of published studies with the use of Stages of Growth Models.

Table 3 – Some thematic's studies covered by academic literature using Stages of Growth Models published in this decade

Publication Year	Thematic Studied	Number of Stages	Reference
2017	Technical Office IS	12	(Boza et al., 2017)
2016	Digital Business Transformation	5	(Berghaus & Back, 2016)
2016	Healthcare	vary from 3 up to 9	(Carvalho et al., 2016)
2016	Social Media adoption	5	(Duane & O'Reilly, 2016)
2015	E-government	8	(de Brí & Bannister, 2015)
2015	IT outsourcing	5	(Solli-Sæther & Gottschalk, 2015)
2014	Social Media Business Presence (SMBP)	5	(Duane & O'Reilly, 2014)
2013	ERP integration	6	(Grant et al., 2013)
2013	Social Media adoption	3	(Mergel & Bretschneider, 2013)
2012	Human Resource Information Systems (HRIS)	6	(Krishna & Barman, 2012)
2011	Data management	5	(Mattia, 2011)

Source: Compiled by the Author

Table 3 illustrates several thematic studies published in academic literature regarding Stages of Growth Model in this last decade, showing that this paradigm of study remains active and is of interest to academics

The scale of measuring the Stage Levels of ICT/IS initiatives in Organizations, created by the master´s dissertation of Favaretto (2015) based on seminal studies of Nolan (Nolan, 1973, 1979, 2001) was refined in this study with empirical and statistical methodological procedures validations, guided by the interest to measure and explain the Stage Level of ICT/IS initiatives in Organizations and its influence in Organizational Innovation, moderated by the 'data Analytics' level.

2.2 James G. March´ studies about Exploration and Exploitation

A theory of organizational learning which describes two distinct and complementary ways in which organizations ‘learn’, “Exploration" and "Exploitation", was propounded by March (1991, 1995). Thus, by when considering this theoretical body of knowledge, organizational learning is defined as a balanced combination of two learning types, exploration and exploitation.

“Exploration” is associated with activities that increase variation in organizational processes, functions and tasks, including, invention, relaxed control, risk-taking, in contrast of “Exploitation” that typically represents immediate targets and short-term objectives, reduced slack to increase accuracy and control over core activities and processes (Hunter, 2003, p. 3).

Normally, Exploratory innovations (or radical innovations) are those innovations focused on reaching emergent customers or markets, requesting new organizational knowledge, in contrast of Exploitative Innovation (or incremental innovations) are those innovations designed to meet the needs of existing customers, based on existing organizational knowledge (Benner & Tushman, 2003). Tecnological innovations can also be disruptive (Christensen, 1997, 2012).

Researchs demonstrated that firms tend to search more immediate and certain returns using the known solutions (exploitation), instead of having expenses to seek new solutions (exploration) (Denrell & March, 2001).

Innovation can contribute to the practice of management if receive a better understanding, introducting changes to organizations, helping to explore new opportunities or to exploit the existing ones (Damanpour & Wischnevsky, 2006).

Brazilian scholars also have explored in their researches the thematic of Exploration and Exploitation related on developing a scale for classifying organizations as explorers, exploiters or ambidextrous (Popadiuk, 2012) and related on organizational coordination mechanisms (Popadiuk & Bido, 2016).

This research made use of the scale for the empirical measurement of Innovation (exploration and exploration), already developed by Jansen et al. (2006), in the role of a second order dependent variable in the proposed model of the study, to identify the influence of the stage level of ICT/IS activities in organizational innovation.

2.3 Everett M. Rogers´ studies about Diffusion of Innovation

According to Lechman (2015, p. 29) the term "diffusion" originates from the Latin nouns "diffusio" and "diffusionis", and the verb "diffundere", referring to the process of spread, expansion, dissemination, propagation or generalization.

The Innovation Diffusion Theory (IDT) explains that diffusion is a process by which some innovation, according Rogers (2003), "is communicated through certain channels over time among the members of a social system" (p. 5) and can be associated by the curves of the Figure 3. IDT is commonly utilized to study and explain the diffusion of high-technology product (i.e, mobile phones, microcomputers, etc.), and also can be useful to explain the diffusion of information and communication technologies (i.e, data Analytics and Data-driven, Big Data Analytics (BDA), Artificial Inteligence (AI), Blockchain, Internet of Things (IoT), Cloud Computing, Cognitive Computing, etc.) in organizations.

As showed in Figure 3, and according Rogers (2003) "adopter distributions follow a bell-shaped curve over time and approach normality" (p. 275). The literature also consider that Laggards categorization it is not divided in 'Early' ou 'Late' Laggards, because empirical studies did not find significant differences on that.

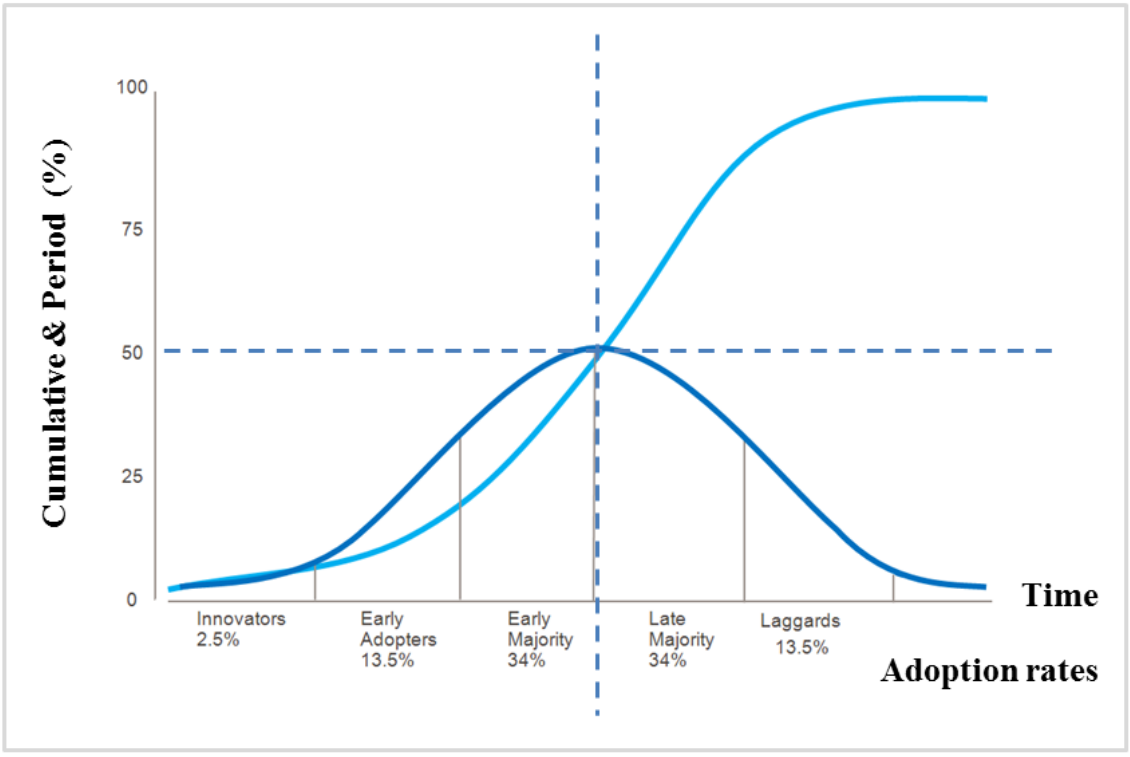

Figure 3 – S-curve with cumulative measurements and Bell curve with the rates of variation of this accumulation (overlapped)
Source: Created by the Author based on Rogers (2003, p. 281) and literature review

2.4 Information Systems Research – Technology Adoption and Diffusion

Following literature review based on Rogers' studies (2003) and other related studies about innovation technology diffusion process, it was possible to understand about additional contributions to IDT provided by IS researchers (R. B. Cooper & Zmud, 1990; Kwon & Zmud, 1987; Moore & Benbasat, 1991; Swanson, 1994), in order to create new frameworks, dimensions or variables to measure the process of diffusion / adoption of a new technology in organizations or their phases / stages to propagation. But, there is no consensus on explaining how to handle a diffusion technology when considering the diffusion / adoption by organizations (firms) instead of by individuals (users) - Table 4 shows the integration of this different theoretical lens.

Table 4 – Theories used to individual or organizational analysis technology adoption / diffusion in IS research

Innitial Year	**Theory name / abbreviation**	**Field of origin**	**Publication Type**	**Level of analysis**[a]	**Seminal References**
1962	Innovation Diffusion Theory (IDT)	Sociology	Book	I/O	(Rogers, 1962)
1975	Theory of Reasoned Action (TRA)	Social Psychology	Book	I	(Fishbein & Ajzen, 1975)
1985	Theory of Planned Behavior (TPB)	Social Psychology	Book	I	(Ajzen, 1985)
1987	Diffusion/Implementation Model (DI-IT)	Information Systems	Book Chapter	O	(Kwon & Zmud, 1987)
1989	Technology Acceptance Model (TAM)	Information Systems	Paper	I	(Davis, 1989)
1991	Perceived Characteristicas of Innovation (IDT-IT)	Information Systems	Paper	I	(Moore & Benbasat, 1991)
1994	Tri-Core Model (TCM)	Information Systems	Paper	O	(Swanson, 1994)
2000	Technology Acceptance Model 2 (TAM-2)	Information Systems	Paper	I	(Venkatesh & Davis, 2000)
2003	Unified Theory of Acceptance and Use of Technology (UTAUT)	Information Systems	Paper	I	(Venkatesh, Morris, Davis, & Davis, 2003)
2008	Technology Acceptance	Information	Paper	I	(Venkatesh &

	Model 3 (TAM-3)	Systems			Bala, 2008)
2012	Unified Theory of Acceptance and Use of Technology 2 (UTAUT-2)	Information Systems	Paper	I/O[b]	(Venkatesh, Thong, & Xu, 2012)

Source: Elaborated by the Author based on literature review

Note: Level of analysis[a] represents 'I' to individual, 'O' to Organizations and 'O[b]' also to Organizations, specifically when research has applied UTAUT2 with other theories, or extended it to study a variety of technologies in organizational settings, as synthesized in Venkatesh, Thong, & Xu (2016).

A study of technology diffusion considers the set of the four elements delineate by the IDT – the innovation ('data Analytics' technology in this case), in the communication channels, over time, among the members of a social system (Rogers, 2003, p. 11). A recent work of bibliometric review of the innovation adoption literature (van Oorschot, Hofman, & Halman, 2018), demonstrates that the theme has several ways of being studied, according to research interests.

For the understanding of the process of adopting a technology innovation in organizations (specifically in this research, the organization's current "data analysis" level), it must be understood that adoption happens when the organization seeks knowledge about that innovation until the acquisition of its technology (Hameed, Counsell, & Swift, 2012), which differs when the unit of analysis of the research is the individual, due to the existence of different theories to explain this procedure (Table 4).

By choice and decision of the researcher, in order to contemplate this part of this research, related to the adoption and diffusion of technology in organizations, the IDT theory (Rogers, 2003) was used to analyze the diffusion of 'data Analytics' technology by identifying in the participating research organizations the year that each company chose to adopt this technology and began its use.

Thus, this research was limited to asking each of the respondents of the organizations if they had adopted the technology of 'data Analytics', and what had been the initial year of adoption. By integrating all the responses of the participating organizations, it was possible to graphically generate the diffusion process that occurred in the sample studied.

The graphical form of this distribution, according to Rogers, must be similar a curve with normality approach (a histogram can almost show that) and when accumulated, should be approximated an S-curve, as shown in Figure 3.

2.5 Analytics Level, Adoption and Diffusion in Big Data Era

Managing ‘data’ as a resource (Nolan & Croson, 1995, p. 13) as a subject that corporations are placing increasing emphasis for decades (Aiken, Gillenson, Zhang, & Rafner, 2011; Gillenson, 1985; Goodhue, Quillard, & Rockart, 1988).

The explosion of generation and access to an increasing volume of data and information in the Big Data Era (Chen, Chiang, & Storey, 2012, p. 1168; Gerry George, Haas, & Pentland, 2014; Goes, 2014; Vassakis et al., 2018), has been impacting organizations and society (Boyd & Crawford, 2012; Loebbecke & Picot, 2015; Schildt, 2017).

Academic research regarding Information Systems, Analytics and Big Data has been getting attention of IS community (Gunasekaran, Kumar Tiwari, Dubey, & Fosso Wamba, 2016; Lu, Gupta, Ketter, & Heck, 2016; Shmueli & Koppius, 2011), resulting in discussions about the ‘datification’ or ‘datafication’ of the society (Lycett, 2013; Newell & Marabelli, 2015), and regarding how to become a ‘data-driven company’ (Delen & Zolbanin, 2018; McAfee & Brynjolfsson, 2012; Sorescu, 2017; Vassakis et al., 2018).

As for the creation of capital, for the modern organization the creation of knowledge that enhances the decision-making process is vital. The knowledge-creation process can be understood as a set of hierarchical processes, each one attending different levels, starting from lower levels, reaching higher levels. For example, Nolan and Croson (1995, p. 13), define that at least three steps need to be followed, starting from the level of ‘Events’, to reach the level of ‘Knowledge’. In their understanding, there are phases of transformation from one level to another, which are: observations (‘Events’ -> to Data), analysis (‘Data’ -> to Information), and learning (‘Information’ -> to Knowledge). Explicitly, when we make 'observations', we make the description of ‘Events’ and convert (such descriptions) into ‘Data’. From the 'analysis' of these ‘Data’, focusing on the application for decision making, we generate ‘Information’. And from 'learning', by integrating this ‘Information’ into strategic actions through experience, we generate ‘Knowledge’.

The academic field of information systems studies has moved along this hierarchy (Data -> Information -> Knowledge -> Intelligence), and stimulates research that drives ‘data Analytics’ technology, to support objectives and organizational decision-making (Goes, 2014, p. vi).

A group of researchers associate Figure 4 with a sequence of letters, with a label representing the first letters ‘DIKW’ of each words (Data, Information, Knowledge and Wisdow) (Bierly III et al., 2000; Frické, 2009; Rowley, 2007; Rowley & Slack, 2009). The current times and new Big Data Era, suggest to ‘re-think’ this ‘DIKW’ model to a new one, adding as a first level 'Event', to precede the traditional level 'Data', and replace the designation of the level 'Knowledge', now as a level called 'Descriptive'. The traditional ‘DIKW’ model would also be further expanded in its latest level, from the current 'Wisdom' or 'Intelligence', now being replaced by two other levels: 'Predictive' and 'Prescriptive' – Table 5 and Figure 4.

Big Data Analytics and Data Science thinking are 'connected' with the traditional DIKW model, considering technology and ‘data Analytics’ as new ‘drivers’ for the development of this paradigm in the field of Information Systems studies (Aven, 2013; Benjamins, 2013; Braganza, 2004; Jifa, 2013; Jifa & Lingling, 2014), that can be associated with organizational learning to modern organizations, adding Big Data 5 Vs and the importance of data science (Francisco, 2014, 2017; Song & Zhu, 2015) to the ROI of the organizations (Shim, French, Guo, & Jablonski, 2015).

Table 5 – The revisited data-information-knowledge-wisdom (DIKW) hierarchy by examining the articulations associated to data-driven Analytics procedure in Management Information Systems field

Data Analytics Level	Level Name	Level Definition	References
Level 1	Event	Also known as facts, isolated signs or noises, is the most primitive available form of contents to be collected and used in the data driven Analytics procedure. Any kind of unstructured content, for example: file folder contents without any structuring, social media or on-line forum comments, content obtained from browsing the Internet, etc.	(Liew, 2013; Nolan & Croson, 1995, p. 13)
Level 2	Data	Are sets of characters, signs and symbols that represent properties of facts or events in raw form. It does not have meaning of itself. For example: when a person fills in a form giving their full name, home address, age, zip code, social security number - these contents are Data. This level forms the basis for initiating any data-driven Analytics procedure.	(Ackoff, 1989; Bierly III et al., 2000; Frické, 2009; Goes, 2014; Hoppe, Seising, Nürnberger, & Wenzel, 2011; Jifa & Lingling, 2014)
Level 3	Information	Is related to give or to provide meaning by way of relational connection. As Data ‘in’ ”formation”, in other words, Information can be generated or inferred from Data after receiving meaning through relational	(Ackoff, 1989; P. Cooper, 2017; Frické, 2009; Hoppe et al., 2011; Jifa & Lingling, 2014; Liew,

		connection or understanding relations. For example: A baking recipe with its ingredients. This "meaning" or "understanding" relations is the third level of a data driven Analytics procedure.	2013; Rowley, 2007, p. 168; Zeleny, 2002, p. 185)
Level 4	Descriptive	Is Information transformed by the understanding of patterns. Descriptive (or Knowledge level) is associated with acquired experience. The focus of the Descriptive level is to consider improving the decisions made by looking at historical information and lessons learned in the past, and tries to answer the question of 'what has happened?'. It is commonly served with a business intelligence tool and data mining. For example: sequential pattern discovery is used extensively on e-commerce websites, which can "recommend" items to the consumer, based on past purchase history data. Some common examples of Descriptive Analytics include: graphs and analyzes that present the usual metrics of an organization (sales orders, financial performance, etc.), data visualization, generic reports, etc.	(Brodie & Brodie, 2009; P. Cooper, 2017; Deka, 2014; Delen & Zolbanin, 2018; Rowley, 2007; Vassakis et al., 2018; Zeleny, 2002, p. 185)
Level 5	Predictive	It uses statistical models based on current and historical data to predict the future (trends and probabilities). Understanding a variety of techniques that predict future results, Predictive Analytics is able to discover patterns and identify relationships in data - not 'visible' with conventional analysis - which can be used for forecasting. This type of Analytics level expect to answer the question of 'what could happen?'. Examples of Predictive Analytics include, financial assessment to avoid financial credit risk, predicting consumer behavior, etc.	(Davenport, 2013; Deka, 2014; Delen & Zolbanin, 2018; Gandomi & Haider, 2015; Vassakis et al., 2018)
Level 6	Prescriptive	The highest level of data-driven Analytics. It uses models of optimization and simulation, and involves a set of mathematical techniques, to find and suggest the best direction of action or decision, under certain circumstances, requirements and restrictions, with the purpose of improving the performance of the business, taking advantage of a future opportunity or minimize future risk. This type of Analytics level expect to answer the question of 'what should happen?'.	(Davenport, 2013; Deka, 2014; Delen & Zolbanin, 2018; Vassakis et al., 2018)

Source: Elaborated by the Author based on literature review

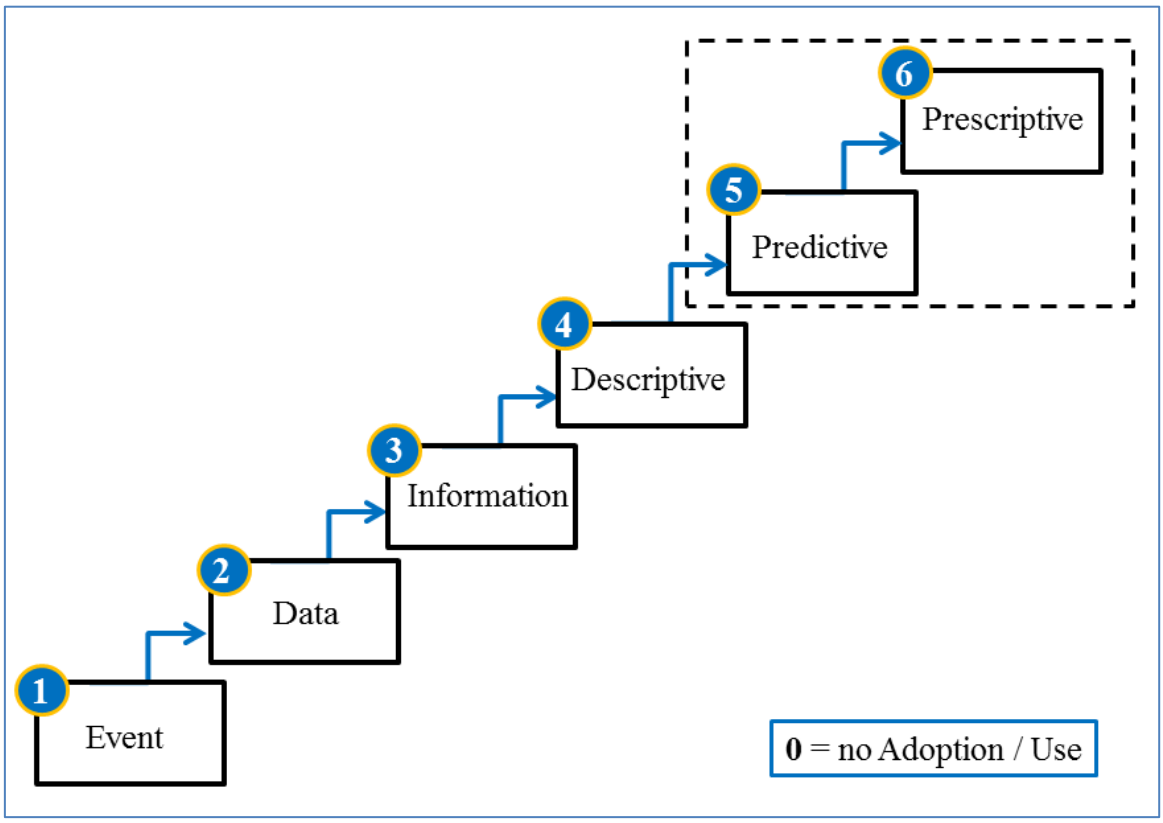

Figure 4 – Data Analytics Levels of the hierarchy for the transformation of generic content (level '1-Event') to its strategic use by the Organization, associated with processes of data-driven Analytics (level '5-Predictive' and level '6-Prescriptive')
Source: Created by the Author based on literature review

Figure 4 is based on the academic literature reported in Table 4, after extensive research work on concept review and content integration to complement this section of the study.

When an organization does not use Data Analytics technology in its initiatives, it is conceptualized that this organization is at the zero (0) level of Data Analytics, for comparison purposes with the levels declared in the hierarchy for the transformation of generic content ('Event', level 1, minimum) to strategic use by the organization ('Prescriptive', level 6, maximum).

Organizations should use 'data Analytics' technology to support decision making by receiving support from three organizational skills or competencies: business knowledge, ICT structure and analytical capacity (Meirelles, 2019).

In this study, the level of 'data Analytics' was used to identify whether it affects moderation between the stage level of ICT initiatives and organizational innovation. To do this, a numeric variable was used, ranging from level 0 (without adoption or use of Analytics), up to level 6 (Prescriptive use of Analytics).

3 RESEARCH MODEL AND DEVELOPMENT OF HYPOTHESES

3.1 Stage Level of ICT/IS initiatives, Innovation and ‘data Analytics’

The conceptual model studied by this research is focused on theoretical lens from different study fields: Stages of Growth Theory (SGT) from Information Systems field (Nolan, 1973, 1979), Innovation studies about Exploration and Exploitation (Jansen et al., 2006; March, 1991, 1995) from Management field and Innovation Diffusion (Mahler & Rogers, 1999, p. 732; Rogers, 2003) from Sociology field.

In order to measure and explain the stage level of ICT/IS initiatives in organizations, Favaretto (2015, p. 70) created a scale containing 123 indicators distributed in 6 stages of growth (from Stage I to Stage VI), each one of them covering completely 5 growth processes (AP, IR, IM, UC and EG). In this research, these five growth processes will be independent variables of the first order, to be grouped in a second-order construct (stage level), which may vary from Stage I to Stage VI.

Additionally, it was considered Innovation (exploration and exploitation) (Jansen et al., 2006) acting as a dependent variable of second order, associated with the latent first-order variables of Exploration (6 indicators) and Exploitation (6 indicators). With the interest of measuring the moderation effect of 'data Analytics' Level on the relation between Stage Level and Innovation, the researcher also used a continuous numeric variable (single variable) to add to the conceptual research model.

According to the Spanish researchers Benitez, Llorens and Braojos (2018, p. 517) "how IT influences exploration and exploitation of business opportunities is a cutting-edge research question/problem that has not received sufficient attention in IS research". These academics studied the impact of information technology (IT) on innovation (exploration and exploitation) and have concluded that there was a positive influence in this relationship.

In a second study that dealt with the same research topic (addressing the impact of IT on innovation), now with a sample of 100 small US companies (Benitez, Castillo, Llorens, & Braojos, 2018), it also was empirically tested that IT improved the performance of organizational innovation. In another study that sought to contribute to understandings about the influence of digital transformation on organizational innovation (Ferreira et al., 2018), it was concluded that adopting new digital processes played a positive role in the innovation

capacity of companies. Organizations with superior IT capabilities can create digital platforms that allow them to be agile, and in doing so, this agility is positively related to the capacity for organizational innovation (Ravichandran, 2018). Other Brazilian researchers also carried out studies to operationalize models for measuring the Informatization Level (IL) of organizations in Brazil (Zwicker, Souza, Vidal, & Siqueira, 2007) and also sought the theoretical-empirical validation by the statistical technique using structural equations modeling (Zwicker, Souza, & Bido, 2008).

Analytics, innovation, and organizational adaptation (Gerard George & Lin, 2016), as well as studies mentioned in academic literature that use PLS-SEM to measure the six level of Enterprise Resource Planning (Grant et al., 2013), or to measure big data analytics (BDA) capability in organizations (Gupta & George, 2016) and some contribution of 'data Analytics' in context of Big Data Era or Big Data Analytics (BDA) are mentioned by academics (Côrte-Real, Oliveira, & Ruivo, 2017; Côrte-Real, Ruivo, Oliveira, & Popovič, 2019; Ruivo, Oliveira, & Neto, 2014) that can offer value to companies to understand the path to competitive advantage.

Based on considerations supported by the studied literature (Benitez, Castillo, et al., 2018; Ferreira et al., 2018; Ravichandran, 2018), and the derivations of the hypotheses H1 (a, b) associated to Stage IV (Integration) and Stage V (Data Administration), respectively, the hypotheses are:

H1a. There is a positive relationship between Stage IV (Integration) and Innovation.
H1b. There is a positive relationship between Stage V (Data Admnistration) and Innovation.

3.2 Control Variables (CVs) – Sector and Firm size (Annual Revenue / Budget)

One of the justifications for Control Variables (CVs) to be inserted in statistical models is when the researcher realizes that the heterogeneity of the sample (for example, organizations from different sectors, or even different sizes of companies, etc.) may compromise the results of the conceptual model studied. The literature also reiterates that there are methodological precautions to be followed to avoid CVs even hindering the model, for example by bringing multicollinearity to the model (Becker et al., 2016; Bernerth & Aguinis, 2016), and in such a

way that the researchers Carlson and Wu (2012) make a direct and objective recommendation: "When in doubt, leave them out."

If a categorical variable having more than two levels, it must be transformed into a dummy variable with the number of levels minus one, because this remaining level will be the reference level of that variable itself. (Henseler, Hubona, & Ray, 2016, p. 8).

Research about digital transformation for company innovative capability (Ferreira et al., 2018), used several CVs including one related to the sector of activity of the sample companies studied. Studies that examined the impact of information technology (IT) on innovation (Benitez, Castillo, et al., 2018; Benitez, Llorens, et al., 2018) using statistical technique of PLS-SEM, also used as control variables firm size and industry/sector.

Thus, two dummy variables were created for use as CVs in the model studied in the research, Sector and Firm Size (based on annual revenue/budget). As Sector was measured as a categorical variable with 5 levels (Commercial sector/Retail, Manufacturing, Service, Public sector/Government, Third sector/non-profit), it was converted to dummy variable, with this last sector being the reference level (0=Third sector/non-profit). The same happened for the variable Firm Size, as a categorical variable with 7 levels - first (up to US$ 20 thousand), until the last (higher than US$ 75 million, as the reference level), it was converted to dummy variable, with this last firm size being the reference level (0=+US$ 75 million annual revenue/budget). Two formative Latent Variables (LVs) were then structured using each of the respective dummy variables (Sector and Firm Size) as indicators, with each CV was used in the model one at a time.

3.3 Moderating Effect with data Analytics Level

Moderation is described when there is a relation between two constructs that is not constant, and that is dependent on the values of a third variable, considered as a moderator variable. This moderating construct or variable alters the strength or even the direction of a relationship between two latent variables in the model (Hair, Hult, Ringle, & Sarstedt, 2017).

According to Gardner, Harris, Li, Kirkman, & Mathieu (2017), a moderating variable would be justifiable in a model when is expected this variable affects the relationship between an independent variable and the dependent variable, either positively or negatively, and in this way this moderating variable could strengthen or weaken this relationship.

The moderation of 'data Analytics' level in the relationship between Stages of Growth and Innovation was measured by the researcher through the use of a numeric variable ranging,

from the level of not having the ‘data Analytics’ technology in use in the organization, until the level of having the 'data Analytics' in the organization with maximum level (value 1 in the PLS variable), which is the 'Prescriptive' level (value 7 in the PLS variable). This variable also was added to the conceptual research model.

Occording to the authors Duan et al. (2018), their findings demonstrate the positive impact of business analytics on innovation. Similarly, study on the diffusion of technology in stages, with moderation by the information-sharing (Junior, Oliveira, & Yanaze, 2019), concluded that the information-sharing construct acts as a moderating role in measuring the stages of ERP adoption. Study of Ghasemaghaei (2019) identified that the use of data analytics positively influences organizational decision making.

With the big data and digital technologies impacting organizations, this has changed the determinants of business innovation and competitiveness (Vassakis, Petrakis, & Kopanakis, 2018). Due to the volume of information that is increasing every day, organizations rely more on knowledge to increase innovation and the use of 'data Analytics' has become an important means to create competitive advantage (Bozic & Dimovski, 2019; Côrte-Real et al., 2019) or to generate value for business and enabling organizations to better explore its benefits (Comuzzi & Patel, 2016; Erevelles et al., 2016).

Thus, based on considerations supported by the studied literature (Duan et al., 2018; Ghasemaghaei, 2019; Junior et al., 2019), and the derivations of the hypotheses H2 (a, b) associated to Stage IV (Integration) and Stage V (Data Administration), respectively, the hypotheses are:

H2a: The positive relationship between Stage IV (Integration) and Innovation will be stronger when ‘data Analytics’ Level is high.

H2b: The positive relationship between Stage V (Data Administration) and Innovation will be stronger when ‘data Analytics’ Level is high.

This research operationalized the summarized conceptual model showed by Figure 5.

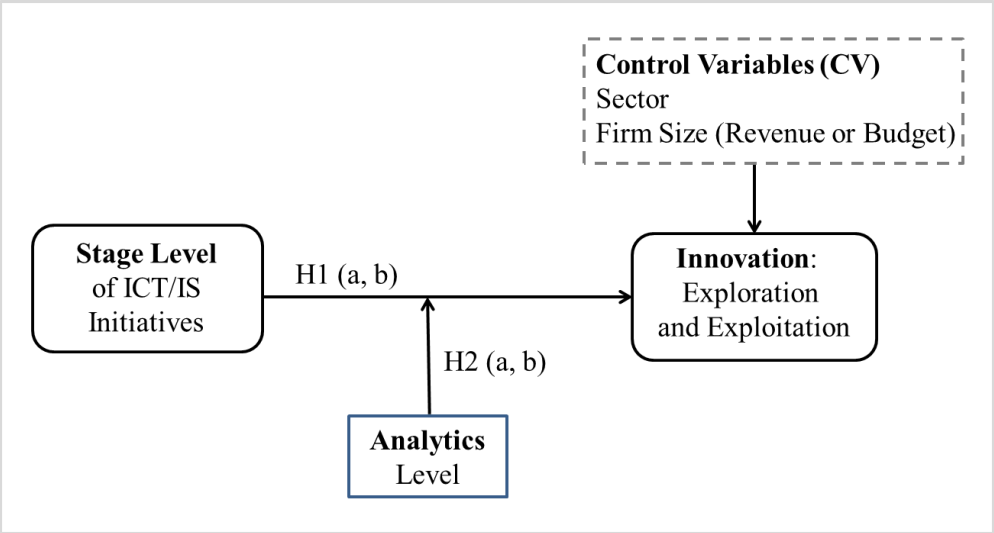

Figure 5 – The summarized conceptual model and hypotheses studied in this research
Source: Created by the Author

The summarized conceptual model in the Figure 5 shows the relationship between the studied variables and the hypotheses that were tested in this research.
It will follow a general framework based in independent variables from Stage Level of ICT/IS Initiatives (Favaretto, 2015, p. 70) – as mentioned in Appendix A. As a dependent variable from Innovation in organizations, it was used a scale of Innovation (exploration and exploitation) (Jansen et al., 2006, 2009, March, 1991, 1995) – as mentioned in Appendix B. The model also included the moderation effect by the 'data Analytics' Level, and also have CVs that were tested with the model: Sector and Firm size (annual revenue or budget).

It is important to mention that the integration of the all the six stage levels in a unique formative construct (Petter, Straub, & Rai, 2007) will not be the main study interest of this research, prevailing the interest of study of the influence of each one of the stages of isolated way, specifically the last three stages (Stage IV - Integration, Stage V - Data Administration and Stage VI - Maturity), because they are the most advanced stages, with the construction of models in a more detailed way only for the two penultimate stages (Stage IV – Integration and Stage V - Data Administration). Thus, from this delimitation of the research by choice of the researcher, Figure 6 was created from Figure 5, in order to operationalize the detailed conceptual models ('a' and 'b') that were studied in this research.

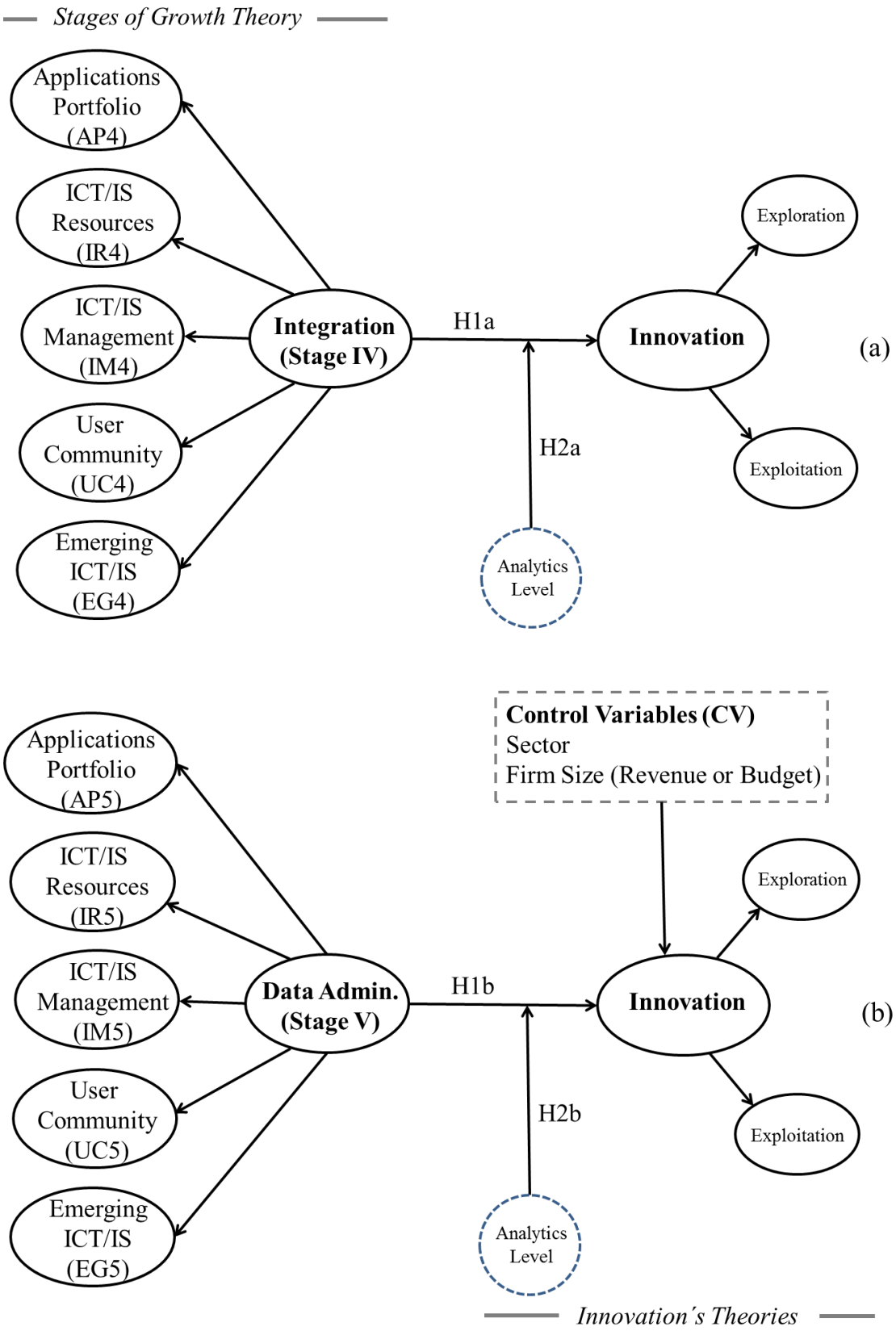

Figure 6 – The detailed conceptual models (a, b) and hypotheses studied in this research
Source: Created by the Author

By the Figure 6, it can be considered that the theoretical corpus of this study will be guided by the Stages of Growth Theory in Information Systems to organizations (Nolan, 1973, 1979, 2001), the Theory of Organizational Learning (Jansen et al., 2006; March, 1991, 1995) and the Innovation Diffusion Theory (Rogers, 2003).
It was possible to expand the information related to the Stages of Growth latent variables, in the two models: respectively (a) for Stage IV (Integration, hypotheses H1a and H2a), and (b) to Stage V (Data Administration, hypotheses H1b and H2b), bringing to these two models the moderation of the 'Analytics Level', and for the model of Stage V also the verification of the influence of two control variables (Sector and Firm size).

At this point, 'data Analytics' will be considered a technology that will be adopted by organizations in a determined period of time (measured by the year of the adoption) and its current level of use (theoretical) will be ranked by the organization in a range, from '0' (do not adopted / used) to 6 (Prescriptive level), based in a categorical variable which specify a more refined use by the organization in terms of analytics (i.e., 0-no adoption/use, 1-event, 2-data, 3-information, 4-descriptive, 5-predictive, 6-prescriptive), considered in this research as the 'Analytics Level'.
The diffusion of Analytics curve was obtained by the accumulation of years (year by year) from the year of adoption of 'data Analytics' in each of the organizations that participated in this research.

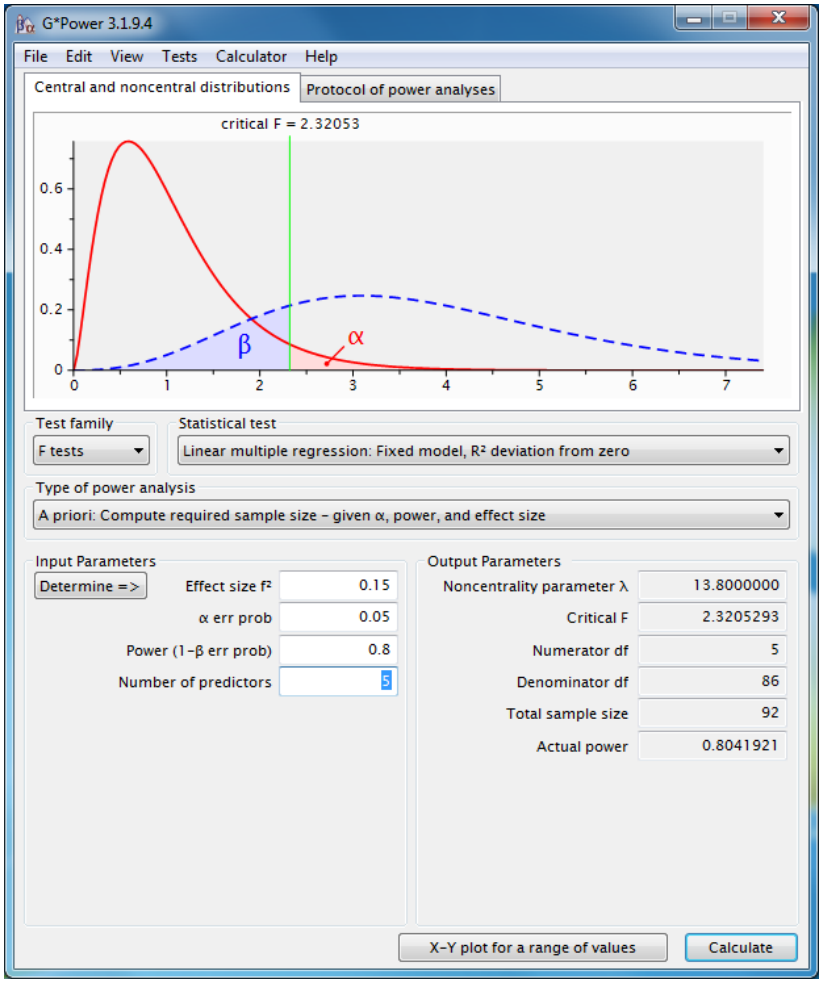

Figure 7 – The sample size required for model specification (G*Power software)
Source: Created by the Author with the use of G*Power software

Figure 7 shows the sample size required for model specification, estimated using G*Power software (Faul, Erdfelder, Lang, & Buchner, 2007), which is based on the number of maximum predictors, that is, the largest number of arrows that arrives at the latent variables that participate in the model. The minimum sample size was defined as 92 respondents to the survey. This research used the variance-based statistical technique of Partial Least Squares Structural Equation Modeling (PLS-SEM), that is widely applied in social sciences and business research (Henseler, 2018; Henseler et al., 2016).

4 METHOD

In order to comply with the rigor of the research method steps, the researcher planned the procedures that would be followed here organized in subsections, largely grounded by the methodological literature, ensuring the replicability of the procedure completely, in order to assist the continuity of derivatives research from this one or future studies supported in this body of knowledge.

4.1 Scales to measure Stage level of ICT/IS initiatives, Innovation in Organizations (Exploration and Exploitation) and 'data Analytics' Level and Diffusion

According to DeVellis (2003, p. 9), the development of a scale is motivated when there is the interest to measure a type of phenomenon that is believed to exist due to the theoretical understanding of the world, but which cannot be directly evaluated by an already existing measure. The use of theory and a detailed literature review will show whether the items or indicators correctly represent the construct (Boudreau, Gefen, & Straub, 2001; Mackenzie, Podsakoff, & Podsakoff, 2011; Straub, 1989) which are intended to be measured (content validity) and may also help to determine if constructs are reflective or formative.
Scale validation has been discussed in IS methodological literature for a long time (Straub, 1989), with a sequence of steps suggested to academics (Benbasat & Moore, 1992; Mackenzie et al., 2011), and updates in IS validation in positivist research (Bagozzi, 2011; Boudreau et al., 2001; Straub, Boudreau, & Gefen, 2004), specially regarding its validity and reliability (Mackenzie et al., 2011).

To minimize the Common Method Bias (CMB) (MacKenzie & Podsakoff, 2012), two methodological recommendations were followed: the first one was to 'shuffle' the indicators that represented the similar assertions by all the pages of the collection instrument (survey form) and the second was to vary the Likert options of the constructs related to the measurement scale of the ICT/IS stage level (Likert of 6 points), differing from the way of collecting the scale of the dependent construct of Innovation (Likert 5 points).
In this way, the use of Measured Latent Marker Variable (MLMV) was dispensed, although recommended in models with PLS use (Chin, Thatcher, Wright, & Steel, 2013), to remove bias from the collection method (Onça, Bido, & Carvalho, 2018), because the survey instrument already had Likert scales with different ranks - 6 options in the independent variables and 5 options in the dependent variables.

Studies in the methodological literature suggest that a 5-point scale seems to be less confusing that 7-point scale, can increase response rate and is easily understandable for respondents allowing them to express their views appropriately (Dawes, 2008).

This research has used two particular Likert scales (agreement), with numerical and verbal response descriptors, such as: a 5-point Likert scale (1-Disagree Completely, 2-Disagree, 3-Neither Disagree or Agree, 4-Agree, 5-Agree Completely) and a 6-point Likert scale (1-Disagree Completely, 2-Disagree, 3-Disagree Slightly, 4-Agree Slightly, 5-Agree, 6-Agree Completely), as shown in Figure 8.

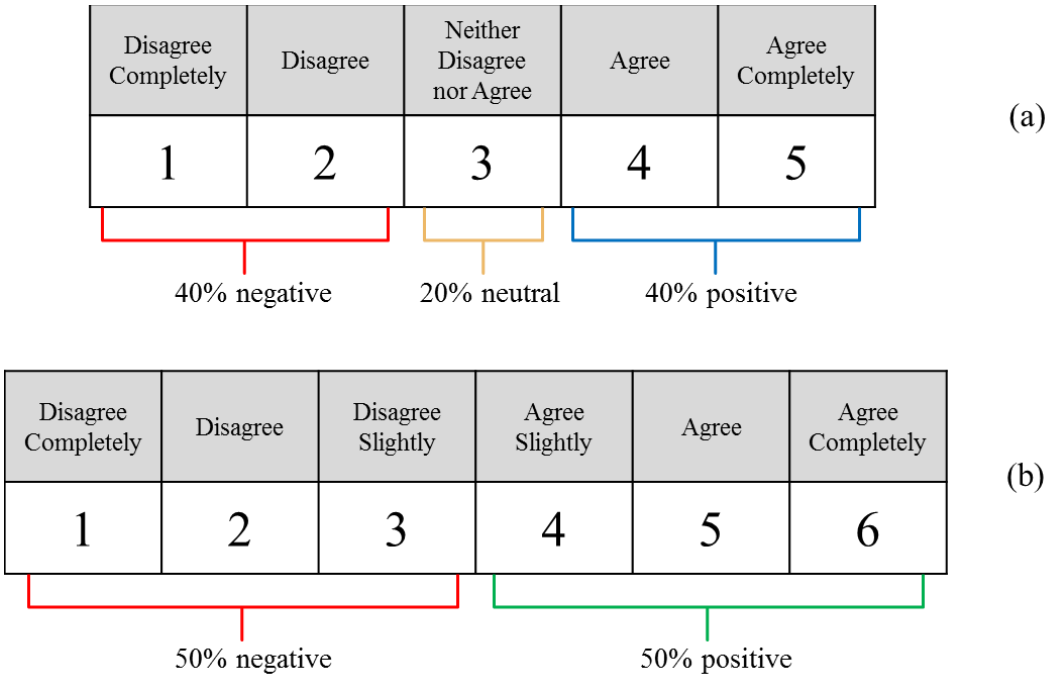

Figure 8 – Verbal and numerical response descriptors to Likert scales, (a) 5-point and (b) 6-point
Source: Created by the Author based on methodological literature

To measure the level of ‘data Analytics’, a categorical variable was used that varied between '1-Event' and '6-Prescriptive', with this scale created in this research with the conceptual support of the academic literature. In order to measure the scale of innovation (exploration and exploitation), it was used the scale of Jansen et al., 2006, also reported in Appendix B of this study.

4.2 Research Website, Research Information Systems and Diagnostic in real time

A bilingual form survey instrument (Portuguese and English) was created and developed by the author, as a software module of a research information systems – made available on-line on the Web - with the intention of interacting with Brazilian respondents and also respondents from other countries. Likert graduations were used in the form survey instrument (Likert, 1932) which were adequated following methodological procedures reported in the academic literature (Ho, 2017; Michalopoulou, 2017; Norman, 2010), and also some initial questions about the respondent's profile and endings about the adoption and diffusion of technologies by organizations.

As the potential survey respondents were considered managers who occupy managerial or leadership roles in their organizations, with the least availability of free time. This way, the researcher planned a data collection instrument that would allow the respondent to fill in the answers in the time he / she had free, using any device that was available (microcomputers, tablets or smartphones), because the survey form automatically was adapted to the screen size (responsive design).

As a way of disseminating the research and facilitating the data collection process, the researcher created a research website in two languages (Portuguese and English), hosted at the adresses http://www.favaretto.net and https://www.favaretto1.net, containing detailed information about the research and links that refer to its history and origin, the seminal publications of the research paradigm, the objective statement and the theoretical corpus of the study. In a menu informed at the top of the site, visitors could fill out a form with some fields (name, organization name, title, contact address in LinkedIn, email, country, among others) requesting an invitation to participate in the survey.

After the authorization granted by the responsible researcher (manual release of each invitation requested), such approval of the invitation was sent by e-mail or message via LinkedIn social network (in-box), containing an Internet link (secure URL), referring to an exclusive access session (unique PIN number) to direct the potential respondent to the survey form, allowing their participation.

All of this flow of semi-automated invitation generation and delivery - Figure 9 - was supported by the Research Information Systems, developed exclusively to technically manage all of the procedures that were active in the research.

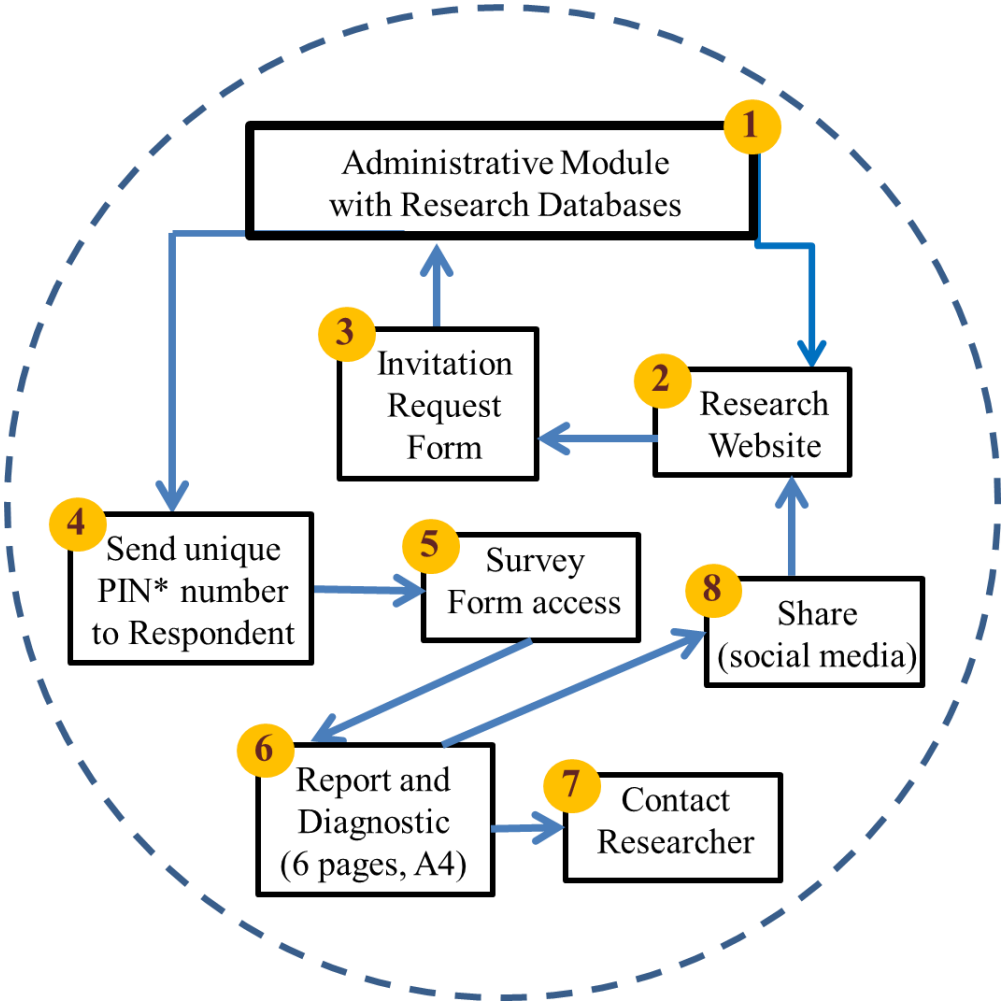

Figure 9 – Operation flow and the steps of using in the Research Information System built to perform data collection and dissemination of the research
Source: Created by the Author
Note: (*) PIN = Personal Identification Number

In general, the researcher planned and implemented the flow of research progress, briefly following a sequence from 1 to 8 (Figure 9), as best detailed as follows.

(1) Administrative module with research databases

Hosted in a restricted access area only to the researcher at www.favaretto1.net (see Appendix K for Portuguese version). This Research Information System module consisted of all source codes used and system operation files, in addition to storing all the databases of the research, including the information of each assertion from the scales used in the survey form. Also included in this module were the prospect records (potential users registered in the system who had not yet responded to the survey), profiles of respondents, records of responses from those invitations that filled the survey to the end, and routines for the entire operation the integrated technical environment, configured on the research server.

(2) Research website

The site created for the dissemination of research and centralization of all pages and access links, hosted on two servers on the Internet: adresses http://www.favaretto.net and https://www.favaretto1.net (see Appendix I for English version or Appendix J for Portuguese version). This research required the creation of a site for the dissemination of research, the availability of a complete server hosted in a data center, the creation and administration of several databases, and the development of scripts in Perl and R languages, for the provision of the collection form and the automation of the generation of the report and Diagnostic of the activities of the ICT/IS of the organization, which motivated a better experience of the respondent in the participation of the survey.

(3) Invitation request form

Online form hosted on the research site, where the potential respondent of the survey would request a participation invitation (see Appendix G for English version or Appendix H for Portuguese version).

(4) Send unique PIN* number to Respondent

The invitations were e-mailed to potential respondents - see Appendix C with full templates in Portuguese and English languages - or through the availability of in-box access via a LinkedIn social network. Each invitation was individual and exclusive, containing a PIN number (Personal Identification Number), which could only be used once.

(5) Survey Form access

Access to the survey form, via research website or via exclusive PIN number link directly (see Appendix D to English and Portuguese version). The great challenge parallel to this academic-scientific research was the structuring and execution of the empirical collection, which required the researcher to develop a complete information system, available on the internet, to directly support the electronic collection instrument – the main intention was to assist the respondents in the task of completing the answers, a procedure that would hardly have spontaneous accessions if they used the free tools available for research surveys on the Internet. Both the research site and the collection form followed the assumptions: 'mobile first' and 'responsive interface', i.e. all of screens were adapted to be visualized in any type of electronic device that the users wanted to use to answer the survey (smartphone, tablet,

notebook, desktop computer, TV, etc.), with all of these resources to motivate their participation.

The steps of filling out the survey form were diagrammed with 'tabs', which allowed the respondent to contribute the answers on an ongoing basis – once it stopped filling in any of them, he/she could return to the survey form at another time and just fill in those steps that were still incomplete, until its completion in a total form, when the system in turn blocked the change of the data (already answered), as well as, do not allow the same invitation already used could be reused by the respondent himself or another third party, but still allowing the respondent to re-generate the diagnosis of their organization.

(6) Report and Diagnostic

After completing the survey, the respondent received a report and Diagnostic containing 6 pages (A4 format), as a 'photograph' of the current stage level regarding the ICT initiatives of its organization, based on the academic study field of Information Systems (IS) (see Appendix E for English version or Appendix F for Portuguese version).

(7) Contact Researcher

On the research site, any visitor (including the survey respondents themselves) could access a page that contained a form to direct contact with the researcher responsible for the research.

(8) Share research in social media

Respondents had access to a link on the survey site that facilitated the task of sharing the website research with their friends. This resource was created with the purpose of broadening the dissemination of the research (see Appendix I – part 3, for English version or Appendix J – also part 3, for Portuguese version).

Thus, access to the questionnaire survey was done automatically by a hyperlink containing a valid URL, directing the respondent to the online collection instrument, available both in English and Portuguse (example: https://www.favaretto1.net/pesquisa/uk/start/PINnumber) bringing responsive layout, that was, automatically adapted to be used in the various platforms and screen formats (smartphones, tablets, notebooks, microcomputer desktop, TVs, etc.), thereby creating a user experience for the respondent that could assist in completing the survey form.

The survey participation form (see Appendix D to English and Portuguese version) was divided into six tabs, named sequentially as 'Profile', 'Part A', 'Part B', 'Part C', 'Part D', and 'Diagnostic'. The first tab, 'Profile', contained questions for the detailed identification of the respondent and the organization that he / she represented in the survey (demographic questions), and also already informed the alphanumeric code of that particular respondent's unique invitation (PIN number).

The second, third and fourth tabs, respectively named 'Part A', 'Part B' and ‘Part C', carried the 123 assertions (shuffled in relation to the original scale) regarding the stage levels of ICT/IS organizational initiatives, and offered the respondent to choose a Likert grade ranging from 1 to 6, or specifically, in the categories of answers: 1-Disagree Completely, 2-Disagree, 3-Disagree Slightly, 4-Agree Slightly, 5-Agree, 6-Agree Completely.
When first accessing the survey form, all the assertions were marked with the text ‘Not Rated’, to emphasize to the respondent, his / her needs to provide the answer in that assertion, as mentioned in Figure 10.

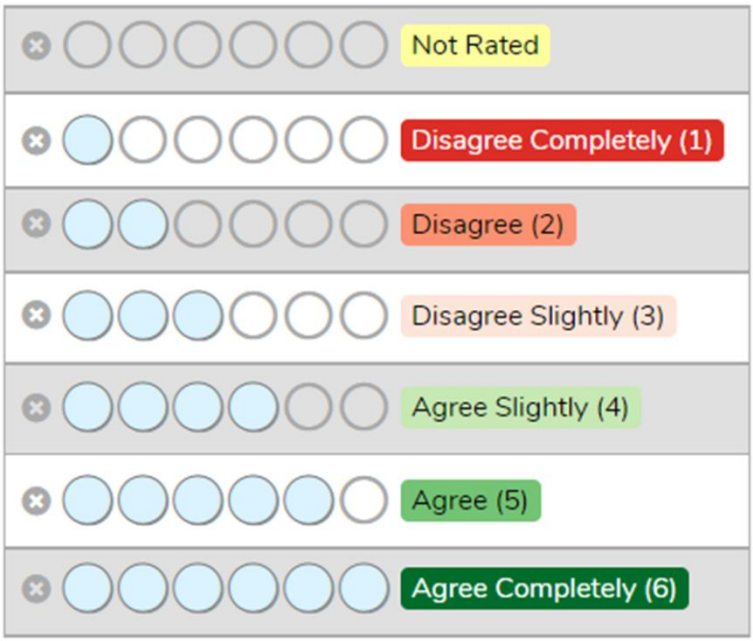

Figure 10 – Likert categories of answers in Parts A, B, and C of the Survey form (English version)
Source: Created by the Author

Figure 10 highlights the variations offered (from 1 to 6) for the respondents of the categories of answers allowed in Parts A, B and C of the survey - assertions for measurement the stage level of the ICT/IS activities in organizations. By clicking on the image of a gray circle containing an 'x' (reported on each of the lines of assertions), the respondent could 'clean' the option in a practical and quick way, returning it to the initial format (‘Not Rated’).

The fifth part of the research form, Part D, had in its first half questions related to the adoption / diffusion of a set of technologies to be answered by the organization, including ‘data Analytics’, and in the same fifth part 'Part D', in its second half, a set of 12 assertions related to the scale of Organizational Innovation (exploration and exploitation) - in this case, the choice of a Likert grade varying from 1 to 5 (one option less than the previous scale), or specifically varying in the categories of responses, such as: 1-Disagree Completely, 2-Disagree, 3-Neither Disagree nor Agree, 4-Agree, 5-Agree Completely.

As the respondent filled out each of these parts (tabs) of the survey, a horizontal green bar, available at the top of the survey form, would report the percentage progress / total progress of that fill. Once all the 'parts' of the survey have been completed, between tabs 1 to 5 (i.e ' Profile', 'Part A', 'Part B', 'Part C', 'Part D'), the sixth and final part of the research, called ‘Diagnostic', was enabled bringing the generation of a report and diagnostic in real time, made available in the format of a managerial report containing 6 pages in A4 format, titled Diagnostic of ICT/IS initiatives of that organization and the respondent received a message on the screen, with gratitude for their participation in the survey, containing access links to allow the reissue of the same Diagnostic and also to contact the researcher in case of doubts about the research.
From that moment, the use of that same invitation provided was automatically disabled by the system, so there was no possibility of the survey contemplating a duplicate response from the same authorized respondent.

4.3 Diagnostic and report as an applied contribution

Upon completing the survey the respondent received a Diagnostic generated in real time, containing 6 pages in A4 format. A bilingual example of such pages is reported in Appendix E (English) and Appendix F (Portuguese). Two aspects to highlight: the Stage Level gauge was immediately informed on the first page of the Diagnostic, with 6 percentage markings representing the measurements of each stage level, from Stage I (Initiation) to Stage VI (Maturity), as shown in Figure 11.

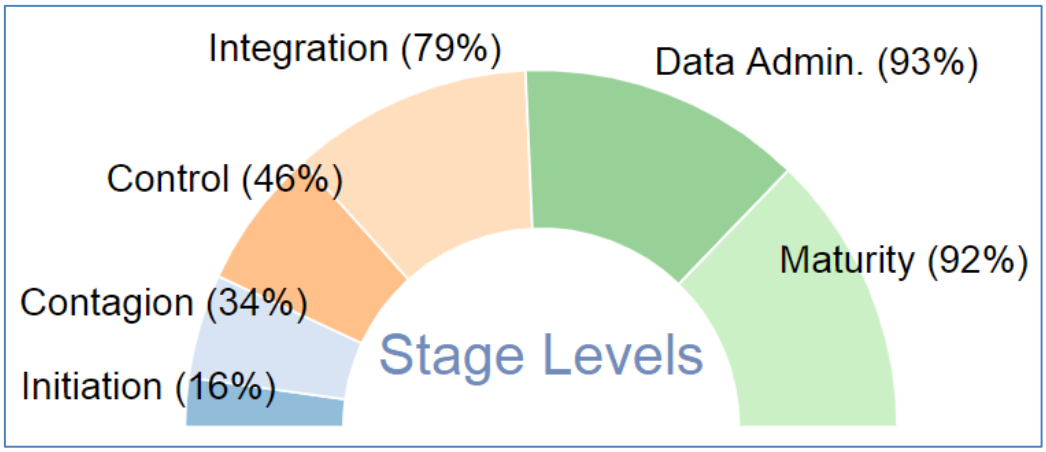

Figure 11 – Stage levels gauge informed on the first page of the Diagnostic report (example)
Source: Created by the Author

Very Low	Low	Medium	High	Very High
up to 20%	from 21% to 40%	from 41% to 60%	from 61% to 80%	more than 80%

Figure 12 – Marking and level ranges to the stages and growth processes
Source: Created by the Author

Figure 12 shows a table of markings and and level ranges that are used to identify such characteristics in Stages and Growth Processes concerning the ICT/IS initiatives of the organization. Taking advantage of the definitions made by Favaretto (2015) in its previous work on part of the topic discussed in this research, it is necessary to highlight an aspect of redefinition of the limits of scale, when transposing the measurement of the research instrument academic-scientific (using Likert gradings from 1 to 6 on the stage level measurement scale) for the generation of the applied Diagnostic - see Appendices E and F which illustrate a bi-lingual example of an already structured example document.

The report and Diagnostic applied uses intervals from 0 to 5 in the calculation of your numerical information (level meter, stage graphs, process charts, etc.), which are related to the level mark intervals of Figure 12.

This way, the artifice for changing a scale from 1 to 6 to another from 0 to 5 is documented with a feature of SPSS statistical software (International Business Machines, 2016), and also

discussed and documented in the academic literature (Chomeya, 2010; Dawes, 2008; Leung, 2011). The researcher took advantage of the Information System that managed this research to do the automatic conversion of scale at the moment that the Diagnostic with the managerial report was generated and constructed by the system for 'delivery' to the respondent.

4.4 Instrument validation steps and pretest

In order to empirical validation of the full scale instrument integrated by constructs and items for measurement the Stage Level of ICT/IS in Organizations (English and Portuguese) as independent variables – adapted from Favaretto (2015, p. 70), additionally with constructs and items to measure Innovation (Exploration and Exploitation) in organizations as dependent variable – adapted from Jansen et al. (2006, p. 1672), the researcher has followed a group of procedures studied in methodological academic literature (Benbasat & Moore, 1992; Mackenzie et al., 2011; Recker & Rosemann, 2010b, 2010a; Schmiedel et al., 2014), as detailed in Figure 13.

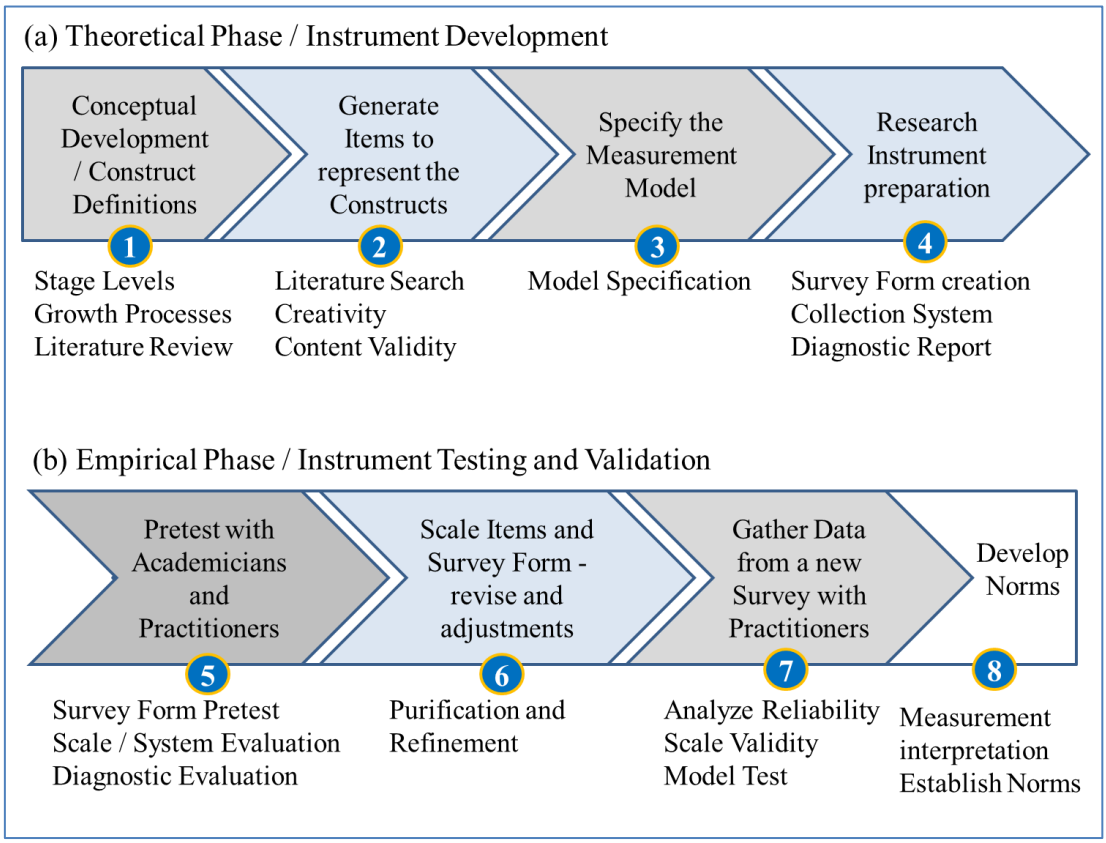

Figure 13 – Methodological steps followed by the author in order to develop and validate the research instrument
Source: Created by the Author based on research phases and literature review

From Figure 13, it is possible to identify in part (a) of the research (‘Theoretical Phase / Instrument Development’) that some of these steps were started in Favaretto's academic dissertation (2015), i.e. step 1) 'Conceptual Development / Construct Definitions', step 2) 'Generate items to represent the constructs', and step 3) 'Specify the measurement model', and also revised and adjusted to be integrated in this research.

Thus, after executing the steps from 1 to 4 (Conceptualization, Development of Measures, Model Specification, as explained in the last chapters), it was necessary to collect data to conduct a pretest with a group of potential respondents to carry out the validation of the empirical research instrument (Hardesty & Bearden, 2004; Netemeyer, Bearden, & Sharma, 2003).

This way, to execute the pretest phase, the author contacted 19 potential respondents that were chosen among names of their own network of contacts, where 7 respondents as Academicians (teachers / researchers - all of them with a full doctorate, with a vast experience in the teaching disciplines in the field of Information Systems/Information Technology and / or related with Administration studies area) and 12 respondents as Practitioners (professionals - with more than 20 years of pratical experience in the ICT area were chosen, occupying positions of CEOs, CIOs, Project Directors, Technology Directors or Technology Managers, in small, medium and large companies located in Brazil, positioned in diferent sectors of the economy).

All of these potential respondents were invited individually by email, by sending a standard message formatted in HTML (including text, image and links content), but also containing an initial paragraph with a message written by the author in a personalized way specifically for each of the respondents, in order to demonstrate that the communication was not generated in a 100% automated way and systematically [by a mass mailing system], and that the author acknowledged the importance of that respondent's participation in the evaluation of the Pretest of his research - Figure 14.

Figure 14 – Partial printed copy of the invitation sent to potential respondents (upper half) for participation in the pretest of the survey instrument (Portuguese version as example)
Source: Created by the Author

Among the various links that were available in the content of the invitation, the respondent could know more about the research by visiting the website constructed specifically for this purpose, to contact directly the researcher (e-mail, telephone or via the form on the website) or click on the link that had a personal identification number (PIN), personal invitation and non-transferable, exclusively generated so that responds to access the instrument of data collection - Figure 15.

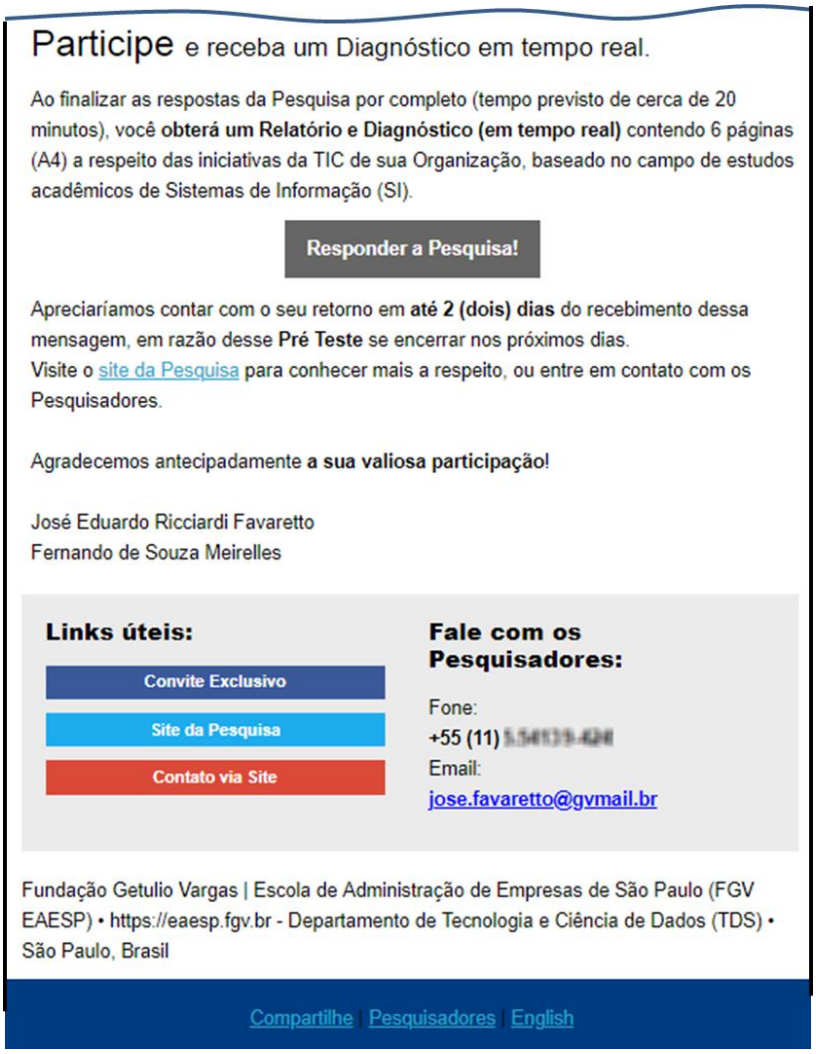

Figure 15 – Complementary printed copy of the invitation sent to potential respondents (lower half) for participation in the pretest of the survey instrument (Portuguese version as example)
Source: Created by the Author

Once the survey questionnaire was answered in full, the respondent's unique PIN code could not be used again, because the research system made this automatic recognition and blocked any attempt to fill out a new form, avoiding the generation of duplicate answers from the same respondent. The pre-test period of the research lasted nine days, with a new email sent as a reminder to a group of 7 potential respondents [who had not yet manifested], in addition to a private message via Linkedin social network (inMail mode), two days before the deadline for this phase of the survey. Effective adherence to the pre-test responses counted on a total of twelve respondents, five academic respondents (teachers / researchers) and seven practical respondents (market professionals), with two of them responding to the survey after receiving the reminder sent by the researcher - Table 6.

Table 6 – Result of adherence to the pretest procedure of the research, after actions taking by the Researcher, contacting 19 potential pretest respondents

Sequence	Actions taken by the Researcher | Respondent type	Academicians (number of)	Practitioners (number of)
1st	sent invitations by e-mail (PIN exclusive code)	7	12
2nd	received autoreply (access limitation / vacation)[a]	1	1
3rd	collected responses (no reminders)	5	5
4th	sent reminders by e-mail (last 2 days)	1	6
5th	sent LinkedIn message (reinforcement via Inmail)	0	5
6th	collected responses (after sent reminders)	0	2
	Total of respondents (pretest)	5	7

Source: Elaborated by the Author based on pretest results
Note: (a) one Academician was on vacation and one Practitioner had left the company

From the contact feedback of the participants of the pretest phase, there were suggestions for adjustments and adaptations to the research collection instrument, which were treated and justified by the researcher, as highlighted in Table 7.

Table 7 – Perceptions and informed suggestions received by the researcher obtained from respondents who participated in the pretest and the actions taken by the researcher

Perceptions and informed suggestions	Respondents[a] mentions (number of)	Action taken by the Researcher
The diagnostic feature at the end of the survey was considered of value	8	Maintained - this resource was planned in the research in an attempt to obtain the adhesion of more respondents
The organization of the research system (website, features in the survey instrument, invitation announcement, unique PIN, etc.) was well planned and structured	7	Maintained - the researcher's intention was to carefully structure the various resources of the research system, so that they could reflect on the methodological rigor of the data collection procedure of the research [and then possibly on the quality of its results]
The diagnostic feature at the end of the search stimulates the respondent's participation until the end (complete fulfillment)	5	Maintained - as the generation of the diagnosis depends on the responses of Parts A, B and C of the survey, this feature is only generated in the final part of the research instrument, ensuring that the respondent answered the survey completely

Perceptions and informed suggestions	Respondents[a] mentions (number of)	Action taken by the Researcher
The research instrument is extensive to be fully answered	5	Unchanged - for here the methodological rigor must be maintained. The literature suggests at least the existence of three indicators to operationalize each latent construct of the model
The writing of certain assertions brings two or more meanings for the understanding of the respondent	4	Adjusted - the text of the assertions were reworked to keep only sense
Highlight in the research that the answers of the form can be carried out 'gradually', with the 'recording' of the answers taking place as the assertions / questions are answered, allowing the respondent to return from the point where they stopped at any moment	3	Adjusted - the communication of the existence of this resource was highlighted in some parts of the research system: in the message of the opening of the research instrument and in the part-B tab, in the research site and also in the content (text) of the invitation sent to the respondent (email or LinkedIn message)
Lack of clarity in the wording [complete] of some assertions	3	Adjusted - the text of the assertions were adapted to facilitate the understanding and adequate response of the respondent
The text contained in some assertions present other proximities in different tabs of the search instrument	2	Maintained - because it is due to the methodological aspect of the composition of the reflexive indicators of the research (scrambled scale distributed between the tabs)
The research tool is extensive, reduce the number of questions	2	Not altered - because here also the methodological rigor of the research should be maintained. There are two measurement scales in the collection instrument, as well as a set of four questions on the diffusion of technologies
Mention that the survey form can also be answered using a smartphone (mobile) device, as the response form has 'responsive' features (that is, it fits any screen, whether micro desktop, laptop, tablet and smartphone).	2	Adjusted - the communication of the existence of this resource was highlighted in some parts of the research system: in the research site, in the survey instrument in the Part-B tab, and also in the content (text) of the invitation sent to the respondent or LinkedIn Inmail message)
"Change with the same Likert grad (or all with 6, or all with 5) different parts of the search"	2	Unchanged - because this is a question to also reinforce the methodological rigor of the collection instrument. The scale of the independent variables with different gradations of the dependent variables scale softens the bias of the common collection method

Perceptions and informed suggestions	Respondents[a] mentions (number of)	Action taken by the Researcher
The writing of some blocks / parts of assertions lack adjustments in the text for a better understanding	1	Adjusted - the wording of the blocks and suggested parts were adequate
There are in some assertions the use of words or words rescued from the past	1	Adjusted - the term or word has been updated / suitable for the current season
"I missed a 'do not know' or 'not applicable' option, which can happen" [among the assertive response alternatives]	1	Unchanged - because the qualification of respondents (CIOs, CTOs, CDOs, Directors or ICT Managers, etc.), profiles of individuals and organizations previously 'filtered' by the Researcher, suggests adequate and complete knowledge to answer all research questions

Source: Elaborated by the Author based on pretest results
Note: (a) only Respondents who participated in the pretest of the survey – perceptions and informed suggestions ordered from the highest number of mentions for the smallest number of mentions

4.5 Previously qualified pontencial respondents and invitations sent by Linkedin and / or email

As the research analysis unit (Sekaran, 2000) referred to organizations rather than individuals, respondent audiences should belong to the top management level of an organization (e.g CEO, CIO, CFO, CDO, CTO, Vice Presidents, Directors, General Managers, IT Managers, etc.), since this respondent should have, under his / her responsibility and technical / administrative attribution, the involvement with the organizational ICT/IS initiatives, so that their answers reflect the reality that is closer to what would happen in the organization, instead of just being a personal opinion of a respondent as an individual.

After the researcher identified and selected potential respondents for the survey, through media identification and award-winning events of technology leaders who had excelled by their performance in their organizations (CXO levels, president, managing directors, coordinators – all preferably in the leadership of the technology area of their organizations), four actions were implemented simultaneously to seek the adherence of respondents to the survey:

1) by direct contact message via email (see invitation letter template, English and Portuguese, in Appendix C) or in-box message on the LinkedIn social network;
2) through communication in CIO communities and association of technical professionals from the software market;
3) per message posted on the researcher's active network of contacts on the LinkedIn social media platform (www.linkedin.com) an on-line social environment that has also been explored by other researchers in the world (Schmiedel et al., 2014; Tifferet & Vilnai-Yavetz, 2018);
4) by message contact posted in LinkedIn discussion groups, which had a focus on discussing Technology and Management, also previously qualified and selected by the author.
Supported by the four actions reported, several simultaneous activities were held to bring together a qualified number of respondents, offering them the option of choosing to fill out the survey form in Portuguese or English, which included all the instructions, screen messages and assertions of the research in the respective language.

4.6 Data Collection and final sample

The data collection period occurred during a period of 30 days in the first months of 2019. A total of 109 respondents filled out the survey form completely, without the occurrence of missing data due to the reason the research system itself made it impossible to record incomplete forms.
For the identification of atypical respondents, two complementary procedures were used to refine the research sample. The first was to automatically record the respondent's start / end date and time to complete the survey form. Thus, two respondents who completed the survey in less than 15 minutes (one respondent in 4 minutes and another in 5 minutes) were identified, which characterized that the responses of these respondents were not spontaneous, since the average time predicted for such responses would be about 20 minutes, requiring the removal of these two records from the database.

The second procedure was to identify the occurrence of equal answers above 60% of the same respondent, observing in isolation the 6-point scale (Stage Level Scale, with 123 indicators) – only one respondent was identified with this characteristic, and even this way, the researcher

decided to keep it in the research sample because there were no other clues in the research data that such a response had not been spontaneous.

In the 5-point scale (Innovation - Exploration / Exploitation) for being scaled with 12 indicators and also on convergent subjects for respondent perceptions that may be unique, there is the real possibility that the same respondent may choose a certain option that he / she understands appropriate. As the researcher identified only 10 records that responded with equal choices above 90%, these respondents were also kept in the research sample. The description of these treatment steps of the research sample were integrated and summarized in Table 8.

Table 8 – Treatment of data collection to prepare the study sample

Identified steps (collection and verification of sample data)	**Number of Respondents**	**Action taken**
Total records collected	109	Data collect
Records with missing data	0	Confirmation via Rearch System
Completion of survey form responses in time less than 15 minutes	2	Removal from the study sample
Completion with occurrence of more than 60% of answers in the same option (scale of stage levels)	1	Maintained in the study sample by the absence of other evidence
Final sample identified	107	Used for the study

Source: Elaborated by the Author based on the sample of respondents

From the preliminary treatment of the data collected with the consequent final identification of the sample for the study - Table 8, the researcher moved to the characterization section of the sample and presentation of the results of the research.

To compile the data and information extracted from the respondent sample, different types of softwares were used in this research: MS-Excel, R scripts, D3.v5 Library, Minitab and SmartPLS.

5 RESULTS, ANALYSIS AND DISCUSSION

In this chapter and in its sections are presented the results found in the research, integrated with analyzes and discussions of the main findings.

5.1 Descriptive Analysis of Sample Data

Table 9 – The characteristics of respondents

Sector, Revenue, # of Employees, Countries originated	Quantity[(a)]	%
1. Sector		
Commercial sector (Retail)	7	6,5
Manufacturing sector	28	26,2
Service sector	62	58,0
Public sector (Government)	4	3,7
Third sector (voluntary, non-profit)	6	5,6
2. Annual Revenue or Budget (US dollar)		
up to US$ 20 thousand	3	2,8
+ US$ 20 thousand - US$ 90 thousand	5	4,7
+ US$ 90 thousand - US$ 1.2 million	11	10,3
+ US$ 1.2 million - US$ 4 million	2	1,9
+ US$ 4 million - US$ 22.5 million	18	16,8
+ US$ 22.5 million - US$ 75 million	9	8,4
higher than US$ 75 million	59	55,1
3. Number of Employees		
1 - 5	7	6,5
6 - 20	7	6,5
21 - 50	2	1,9
51 - 100	3	2,8
101 - 300	6	5,6
301 - 500	12	11,2
501 - 1,000	10	9,3
1,001 - 5,000	17	16,0
5,001 - 10,000	12	11,2
Above 10,000	31	29,0
4. Countries originated (Regions or Cities)		
Brazil *(90 Southeast, 7 Center-West, 2 South, 1 North, 1 Northeast)*	101	94
Belgium (Leuven and Mechelen)	2	2
India (Bangalore and Mumbai)	2	2
Ireland (Dublin)	1	1
United Kingdom (London)	1	1

Source: Elaborated by the Author based on the sample of respondents Note: (a) n=107

Table 9 describes the composition of the organizations included in the sample in terms of the Sector in which they operate, the Annual Revenue or Budget (in US dollar), the Number of Employees and Countries (Regions or Cities) where they originated (n=107 respondents).
From the data presented, we can observe that, 84% of the sample was composed by organizations in the Manufacturing and Services sectors, and 63% of the sample was composed of organizations with Annual Revenue or Budget higher than US$ 22.5 million, and 65% of these organizations have more than 500 employees.

Regarding the main role or position of the respondent, who answered the survey form on behalf of their respective Organizations, the sample of 107 qualified respondents was composed by: 33 C-Level professionals (which included 16 CIOs - Chief Information Officer, and 7 CTOs - Chief Technology Officer), 15 IT Director, General Director or Superintendent, 29 IT or Project Manager, 20 IT Coordinator or IT Leader, and 10 with other types of functions. The survey was answered by 101 respondents from Brazil and and 6 respondents from other countries - 2 coming from Belgium (Mechelen and Leuven), 2 from India (Bangalore and Mumbai), 1 from Ireland (Dublin) and 1 from the United Kingdom (London). In this total, 100 respondents were of the masculine gender, 6 of the feminine gender and 1 respondent did not inform the gender. The academic background of the respondents was identified as: 45% with Postgraduate or MBA, 23% with Master´s degree (Academic or Professional), 15% Bachelor / Licentiate´s degree, 13% Doctoral degree, and 4% others.

Based on these qualifications, due to the respondents occupy the appropriate technical and managerial function, with academic education compatible to the position, they were able to answer the survey form on behalf of the organization, and as organization is the unit of analysis in this study (Pentland & Feldman, 2005; Sadeghi, Talan, & Clayton, 2016; Sekaran, 2000), the choice of this sample was considered adequate to be explored in this research. Also, the sample size (n = 107) also met the conditions necessary for the use of the PLS-SEM statistical technique (Henseler, Ringle, & Sinkovics, 2009), which required a minimum of 92 respondents (Cunningham & McCrum-Gardner, 2007).

5.2 Descriptive Analysis of Indicators of the Research Instrument

Table 10 presents the average, standard error and standard deviation of the indicators of the research model for the sample of 107 organizations.

Table 10 – All indicator of the research model (average, standard error and standard deviation)

LV 2nd order	LV 1st order	indicator	mean	standard error	standard deviation
Stage I	(AP1) Application Portfolio	AP11	3.7	0.132	1.368
		AP12	3.2	0.140	1.445
		AP13	2.7	0.138	1.428
		AP14	3.3	0.138	1.426
Stage II	(AP2) Application Portfolio	AP21	3.6	0.136	1.411
		AP22	4.6	0.112	1.164
		AP23	3.0	0.145	1.498
Stage III	(AP3) Application Portfolio	AP31	3.7	0.119	1.229
		AP32	3.6	0.152	1.572
		AP33	2.2	0.128	1.326
		AP34	3.5	0.144	1.488
Stage IV	(AP4) Application Portfolio	AP41	3.1	0.132	1.368
		AP42	4.1	0.151	1.558
		AP43	4.0	0.123	1.274
		AP44	4.5	0.116	1.200
Stage V	(AP5) Application Portfolio	AP51	4.3	0.126	1.302
		AP52	4.1	0.143	1.475
		AP53	3.9	0.125	1.296
		AP54	4.4	0.120	1.243
Stage VI	(AP6) Application Portfolio	AP61	4.3	0.126	1.302
		AP62	4.2	0.120	1.245
		AP63	3.6	0.122	1.258
Stage I	(IR1) ICT/IS Resources	IR11	2.7	0.132	1.364
		IR12	3.5	0.130	1.348
		IR13	2.7	0.127	1.318
Stage II	(IR2) ICT/IS Resources	IR21	3.4	0.138	1.432
		IR22	2.9	0.120	1.245
		IR23	2.5	0.123	1.277
		IR24	3.6	0.144	1.486
Stage III	(IR3) ICT/IS Resources	IR31	3.8	0.123	1.274
		IR32	4.3	0.128	1.319
		IR33	4.1	0.141	1.464
		IR34	4.4	0.112	1.164
Stage IV	(IR4) ICT/IS Resources	IR41	4.4	0.111	1.151
		IR42	4.9	0.104	1.074

LV 2nd order	LV 1st order	indicator	mean	standard error	standard deviation
		IR43	4.3	0.107	1.104
Stage V	(IR5) ICT/IS Resources	IR51	3.7	0.112	1.158
		IR52	3.7	0.155	1.607
		IR53	4.5	0.149	1.544
		IR54	4.2	0.123	1.272
Stage VI	(IR6) ICT/IS Resources	IR61	3.0	0.157	1.625
		IR62	4.0	0.135	1.397
		IR63	4.7	0.122	1.265
		IR64	4.4	0.117	1.214
Stage I	(IM1) ICT/IS Management practices	IM11	3.0	0.134	1.383
		IM12	2.3	0.126	1.304
		IM13	2.4	0.123	1.276
		IM14	3.2	0.153	1.578
		IM15	3.2	0.131	1.352
Stage II	(IM2) ICT/IS Management practices	IM21	4.6	0.120	1.243
		IM22	2.7	0.128	1.328
		IM23	3.5	0.137	1.417
		IM24	3.0	0.133	1.380
		IM25	3.2	0.141	1.456
Stage III	(IM3) ICT/IS Management practices	IM31	3.8	0.117	1.207
		IM32	4.1	0.135	1.393
		IM33	3.5	0.126	1.306
		IM34	4.7	0.118	1.218
		IM35	4.3	0.096	0.993
Stage IV	(IM4) ICT/IS Management practices	IM41	4.2	0.123	1.271
		IM42	4.5	0.139	1.436
		IM43	3.7	0.114	1.174
Stage V	(IM5) ICT/IS Management practices	IM51	4.4	0.122	1.259
		IM52	4.9	0.121	1.253
		IM53	4.4	0.127	1.315
		IM54	3.9	0.128	1.323
Stage VI	(IM6) ICT/IS Management practices	IM61	4.5	0.123	1.277
		IM62	3.9	0.138	1.423
		IM63	4.4	0.114	1.180
		IM64	4.8	0.117	1.209
Stage I	(EG1) Emerging ICT/IS	EG11	3.7	0.138	1.431
		EG12	3.3	0.136	1.406
		EG13	2.1	0.139	1.436
		EG14	3.0	0.157	1.625
		EG15	1.9	0.128	1.323
Stage II	(EG2) Emerging ICT/IS	EG21	2.7	0.128	1.325
		EG22	4.3	0.122	1.265
		EG23	3.3	0.161	1.663

LV 2nd order	LV 1st order	indicator	mean	standard error	standard deviation
		EG24	3.0	0.127	1.310
		EG25	3.6	0.138	1.432
Stage III	(EG3) Emerging ICT/IS	EG31	3.7	0.168	1.738
		EG32	4.2	0.141	1.458
		EG33	4.1	0.118	1.220
		EG34	4.4	0.108	1.114
		EG35	4.6	0.113	1.164
Stage IV	(EG4) Emerging ICT/IS	EG41	3.9	0.137	1.419
		EG42	3.0	0.131	1.356
		EG43	4.5	0.108	1.119
		EG44	4.3	0.127	1.313
		EG45	4.0	0.142	1.473
Stage V	(EG5) Emerging ICT/IS	EG51	4.5	0.155	1.604
		EG52	4.6	0.140	1.445
		EG53	4.3	0.142	1.470
		EG54	4.6	0.125	1.288
		EG55	4.3	0.118	1.225
Stage VI	(EG6) Emerging ICT/IS	EG61	4.0	0.145	1.495
		EG62	3.9	0.140	1.453
		EG63	3.7	0.139	1.435
		EG64	4.2	0.118	1.216
		EG65	3.8	0.169	1.753
Stage I	(UC1) User Community	UC11	2.7	0.135	1.400
		UC12	2.7	0.120	1.242
		UC13	3.3	0.137	1.421
		UC14	2.7	0.117	1.206
Stage II	(UC2) User Community	UC21	4.5	0.111	1.152
		UC22	4.2	0.122	1.265
		UC23	4.2	0.099	1.023
Stage III	(UC3) User Community	UC31	4.5	0.132	1.362
		UC32	3.1	0.136	1.406
		UC33	3.5	0.131	1.355
		UC34	3.1	0.138	1.423
Stage IV	(UC4) User Community	UC41	3.4	0.134	1.383
		UC42	4.4	0.121	1.249
		UC43	4.1	0.135	1.399
		UC44	4.4	0.106	1.099
		UC45	4.3	0.113	1.166
Stage V	(UC5) User Community	UC51	4.0	0.117	1.205
		UC52	4.6	0.128	1.326
		UC53	3.5	0.145	1.501
Stage VI	(UC6) User Community	UC61	2.8	0.126	1.299
		UC62	4.2	0.131	1.354

LV 2nd order	LV 1st order	indicator	mean	standard error	standard deviation
		UC63	4.1	0.118	1.219
		UC64	3.1	0.133	1.378
Innovation	Exploration	inex01	4.3	0.069	0.711
		inex02	4.1	0.087	0.902
		inex03	4.1	0.089	0.924
		inex04	3.7	0.107	1.106
		inex05	3.9	0.091	0.941
		inex06	3.4	0.108	1.116
Innovation	Exploitation	inep01	3.7	0.098	1.019
		inep02	4.1	0.077	0.793
		inep03	2.7	0.114	1.176
		inep04	4.0	0.080	0.830
		inep05	3.7	0.092	0.952
		inep06	4.1	0.088	0.912

Source: Elaborated by the Author based on the sample of respondents

Notes: n=107; parts of this table is displayed on multiple pages because of its extensive size

5.3 Descriptive Analysis of Growth Processes and Stages Level of ICT/IS initiatives

Based on the integration of the research data related to the five growth processes (AP, IR, IM, UC and EG), as well as the six levels of stages of growth, the researcher decided to generate descriptive documentation containing a total of fifteen graphs available in Appendices L through P. Such material can help in the interpretation procedure of the data that were obtained by the research, and also bring complementary explanations, when viewed collectively the group of organizations (total of respondents of the research), for the information that was made available in the report and diagnostic generated to the respondents. This initial interpretation is already a sign of a preliminary process of development and establishment of norms (Mackenzie et al., 2011) to this new scale of measurement.

From the histograms reported in Appendices (L through P), which is related to the measurements of the maximum values (percentage mark) of each of the 5 Growth Processes, when observed in all of the 6 Stages of Growth, it was possible to compile the information for elaboration of the Table 11 and Table 12:

Table 11 – Number of Organizations based on the maximum percentage mark regarding each Growth Processes in all the six Stages of Growth

Growth Processes	Stage I	Stage II	Stage III	Stage IV	Stage V	Stage VI	Total (100%)
AP	10	17	4	21	**37**	18	**107**
IR	6	5	21	**46**	14	15	**107**
IM	8	6	15	19	**33**	26	**107**
UC	13	**42**	7	20	22	3	**107**
EG	8	11	26	7	**47**	7	**107**

Source: Created by the Author using research data

Note: the last column brings the sum of each line (n=107); see histograms reported in Appendices (L through P) for details about the numerical values integrated in this table

In Table 11 was possible to identify for the growth process of AP (Applications Portfolio - which is associated with the applications of systems / softwares that are in use in the organization) that the largest concentration of companies is positioned in Stage V (Data Administration), with 37 organizations (34.6% of the sample). In this same Stage V, there is also the concentration of a larger number of organizations in the growth processes of IM (ICT/IS Management) and EG (Emerging ICT/IS), respectively, 33 (30,1%) and 47 (44%).

However, for the growth process of IR (ICT/IS Resources - which represents the organization's IT staff / teams and the technological resources themselves), most organizations are concentrated on Stage IV (Integration), being 46 organizations in total (43% of the sample). And finally, the worst position among all other growth processes was identified in the UC process (User Community - which represents the community of users that the organization relates to). In this growth process, a total of 42 companies (39.2% of the sample) is positioned in Stage II (Contagion), but if added to those positioned on Stage I (Initiation), the total number reaches 55 companies, representing 51% of the sample. This reiterates a reality that is perceived in the day to day of the organizations, now confirmed by the theory (Nolan, 1979, p. 117), that users have difficulties in meeting their specific demands when asked for IT teams – this growth process (UC) captured this characteristic, reflecting the results presented.

Table 12 – Number of Organizations based on the maximum-minimum set regarding each Growth Processes, in all the six Stages of Growth, but with the minimum always being in Stage I

Growth Processes	Stage II->I (21)	Stage III->I (31)	Stage IV->I (41)	Stage V->I (51)	Stage VI->I (61)	Subtotal %
AP	4	2	12	**26**	11	**51.4**
IR	2	12	**22**	8	9	**49.5**
IM	0	10	11	**27**	19	**62.6**
UC	**29**	2	16	16	2	**60.7**
EG	4	20	6	**40**	6	**71.0**

Source: Created by the Author using research data

Note: partial sample - only those respondents that the minimum value of each process is positioned in Stage I; see the Appendices (L through P) for the bar charts that inform the maximum-minimum sets, bringing more details about the numerical values integrated in this table

Also with Table 12 it was possible to create a new way of understanding, as maximum value of each Growth Process is related to its minimum value, for a grouping of organizations, especially those organizations that are in higher stages (with the maximum level) in certain Growth Processes, and which in turn also report 'level 1' as the minimum of that same grouping. To this procedure to be identified graphically, was defined by the researcher a 'set or pair' of numbers called the 'maximum-minimum' pair, each being placed side by side (the maximum value followed by the minimum value), which allowed the generation of a comparative graph available in the **A**ppendices (L through P)**,** and intuitively, it was allowed

to 'construct' these relations from the theoretical to the empirical. For example, for the 29 organizations that are concentrated in Stage II by the UC process (their maximum value), these same 29 companies have Stage I as the minimum value.

Using the same reasoning it is also possible to observe that 40 organizations are in Stage V [of maximum value marking in the growth process] of EG, and these same organizations also report having the minimum value in this growth process identified in Stage I.
This shows that in the growth process EG there is a greater perception by organizations that Stage I is the most limited of all, and therefore with the answers of the research assertions having the lowest grades, when the averages are summed and generated, the minimum markings were registered in this same Stage I, reiterating that such initial Stage I is distant from the reality of these organizations.

The last column of Table 12 informs the percentage of the subtotalisation of each row in relation to the total of 107 organizations that answered the survey. The interpretation of this column takes into account how much a certain stage of growth ensures that the minimum marking value occurs in Stage I. It is noticed that for the EG growth process (new and emerging ICT/IS influencers) this occurs for 71% of the sample studied, thus identifying that there is another 29% of the sample [of organizations that participated in the research] which report that the minimum value of the EG process is not in Stage I.
In the same way, for the IR growth processes (the resources; personnel / staff and available technology) the minimum marking value for Stage I is only guaranteed for 49.5% of those organizations and in the growth process of AP (Applications Portfolio) for a similar percentage of sample organizations (51.4%) - it is hereby clarified that organizations still report basic difficulties in adapting the ICT/IS initiatives of these processes in their own initial stage (Stage I), since they reported that intermediate stages brought minimal notes of adequacy of these processes, instead of these minimum notes being concentrated in Stage I itself, of any of the growth processes.

5.4 Descriptive Analysis of LV Exploration and Exploitation Indicators

By integrating in a grouped form the answers obtained in the assertions of the indicators of the LVs of Exploration and Exploitation (Likert graduation with 5 points), Tables 13 and 14, it was possible to interpret them visually using stacked bar graphs (Heiberger & Robbins, 2014), as shown in Figures 16 and 17 – LV Exploration and LV Exploitation.

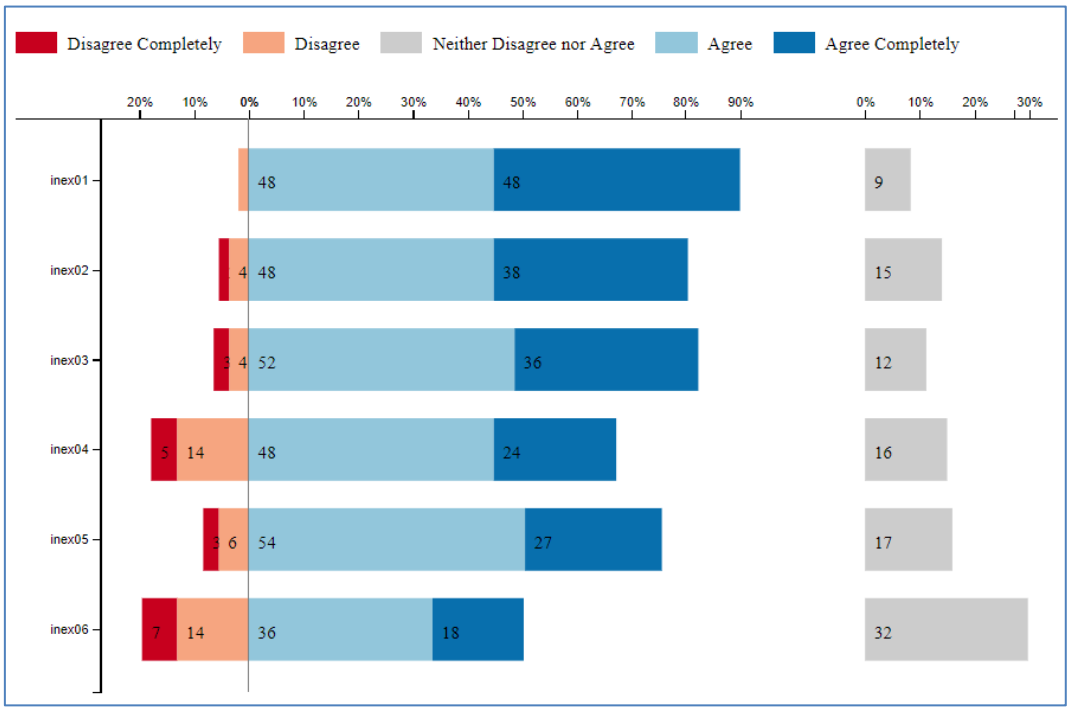

Figure 16 – Responses to the indicators of the latent variable Exploration (inex01 – inex06)
Source: Created by the Author using research data

Table 13 – Responses to the indicators of LV Exploration (inex01 – inex06)

	Disagree Completely	Disagree	Neither Disagree nor Agree	Agree	Agree Completely
	1	**2**	**3**	**4**	**5**
inex01	0	2	9	48	48
inex02	2	4	15	48	38
inex03	3	4	12	52	36
inex04	5	14	16	48	24
inex05	3	6	17	54	27
inex06	7	14	32	36	18

Source: Created by the Author using research data
Note: n=107

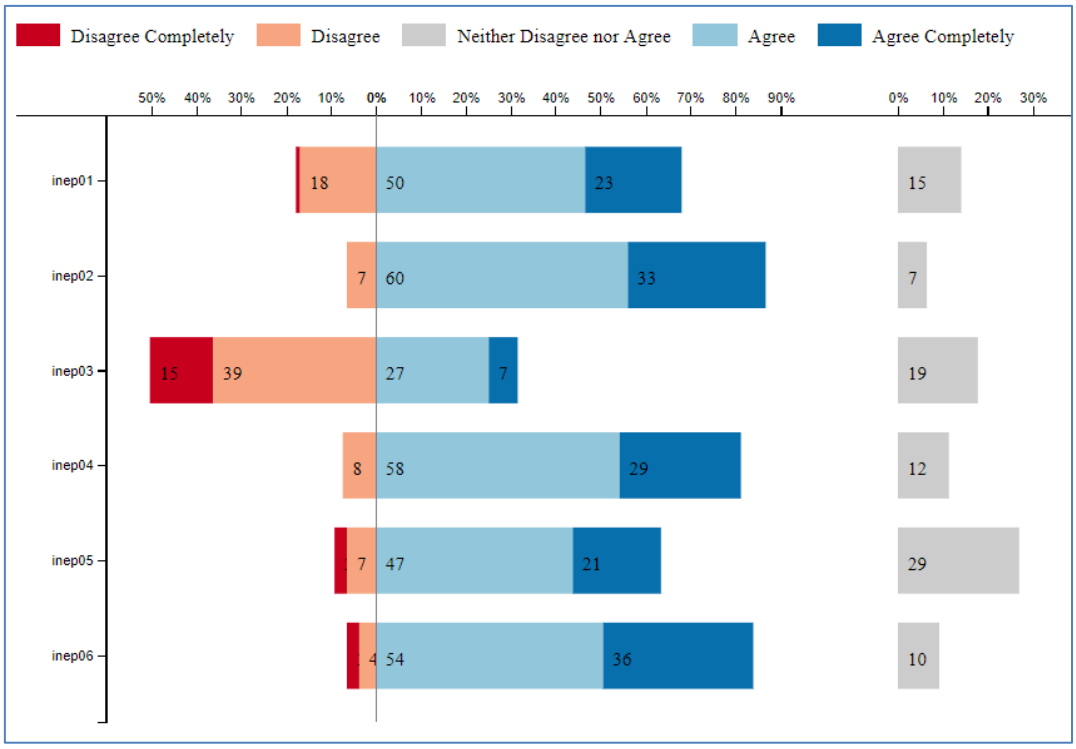

Figure 17 – Responses to the indicators of the latent variable Exploitation (inep01 – inep06)
Source: Created by the Author using research data

Table 14 – Responses to the indicators of LV Exploitation (inep01 – inep06)

	Disagree Completely	Disagree	Neither Disagree nor Agree	Agree	Agree Completely
	1	**2**	**3**	**4**	**5**
inep01	1	18	15	50	23
inep02	0	7	7	60	33
inep03	15	39	19	27	7
inep4	0	8	12	58	29
inep5	3	7	29	47	21
inep6	3	4	10	54	36

Source: Created by the Author using research data
Note: n=107

To evaluate the organizational perception about the agreement of the Innovation initiatives (exploration and exploitation) (Jansen et al., 2006), the assertions of the study used 5 levels of

evaluation, varied from 1 to 5, being: 1-Disagree Completely, 2-Disagree, 3-Neither Disagree nor Agree, 4-Agree and 5-Agree Completely.

Evaluation scales using Likert's graduation (Likert, 1932) are commonly used in academic research questionnaires, but rarely interpreted with the use of graphical resources, of wide integration and easy comprehension.

It was possible to identify that the indicators of the LV Exploration that received most graduation 5 (‘Agree Completely’) were the: inex01, ‘*Our unit accepts demands that go beyond existing products and services*’, with a number of 48 choices and inex02, ‘*We invent new products and services*’, with a number of 38 choices. With similar analysis, the LV of Exploitation received in the indicator inep03, ‘*We introduce improved, but existing products and services for our local market*’, the largest number of negative graduated responses, with rank 2 ('disagree') having 39 choices among all respondents.

5.5 Descriptive Analysis of ‘data Analytics’ Level

Among the number of organizations that have adopted 'data analytics' technology (84), most are at the ‘3-Information’ level (31), representing 37% of these companies - Figure 18.

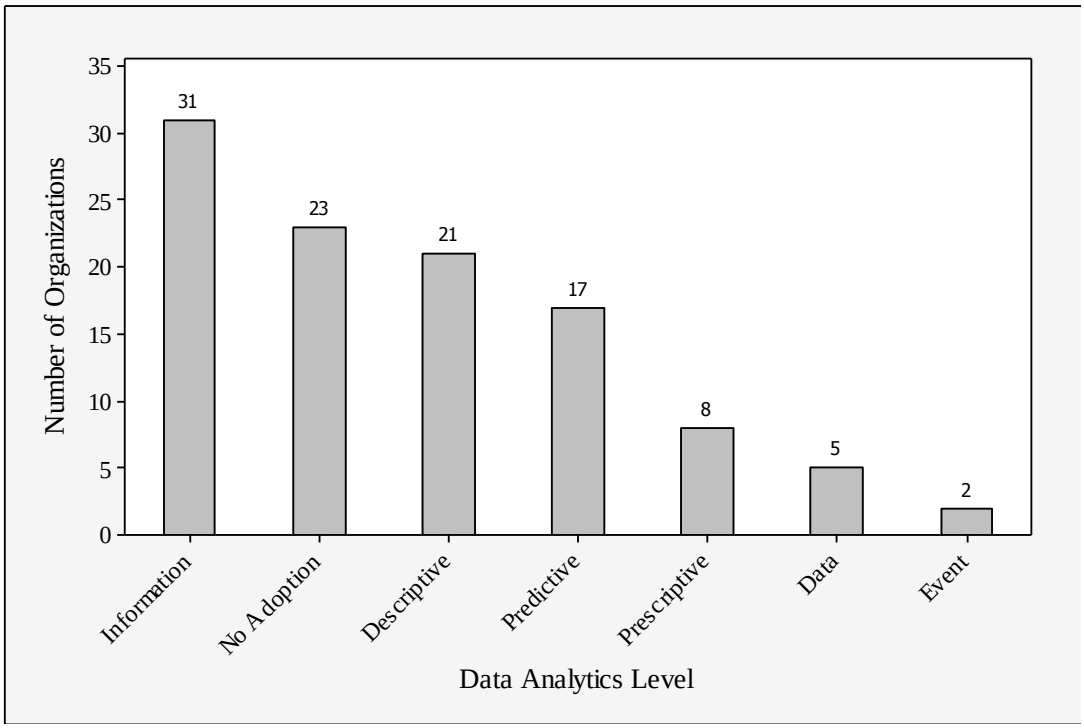

Figure 18 – Types of Data Analytics Level comparable with the number of Organizations
Source: Created by the Author using research data

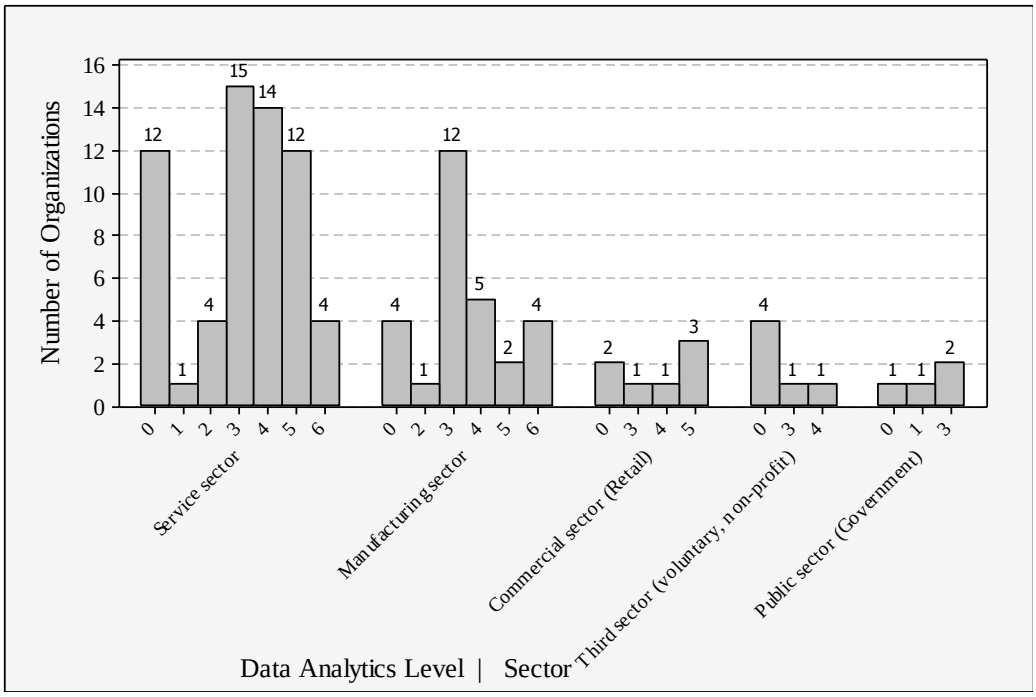

Figure 19 – Types of Data Analytics Level compared between the Sectors of the respondent Organizations
Source: Created by the Author using research data
Note: The levels range from 1 to 6, respectively, 1-event, 2-data, 3-information, 4-descriptive, 5-predictive, 6-prescriptive. The zero (0) level is when the organization did not adopt data analytics technology to use.

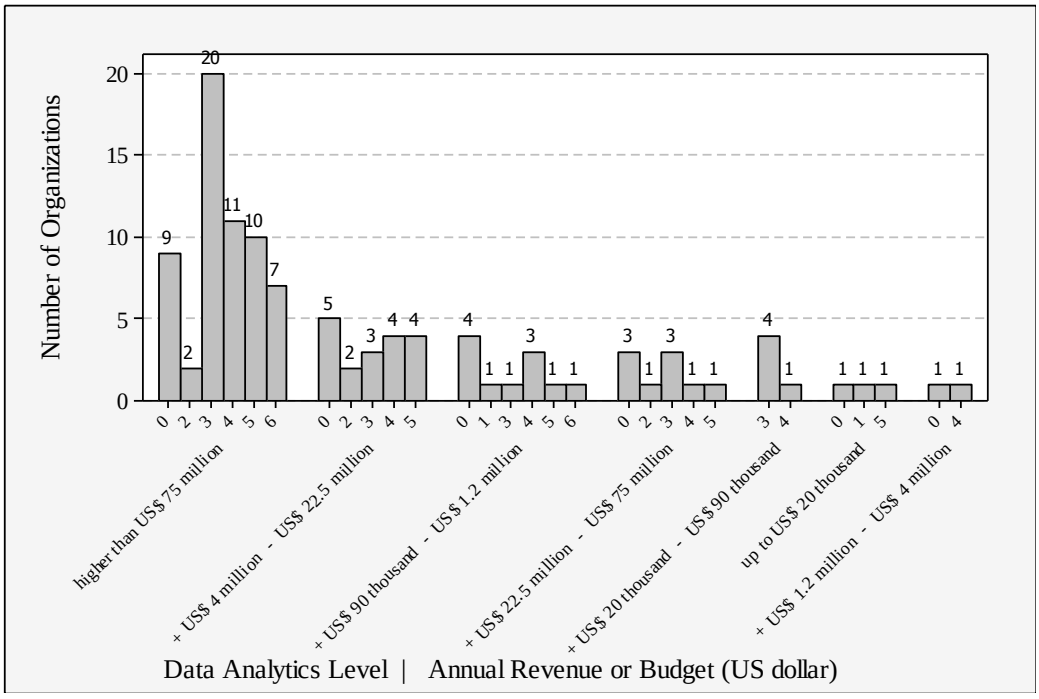

Figure 20 – Types of Data Analytics Level compared between the Annual Revenue or Budget of the respondent Organizations
Source: Created by the Author using research data

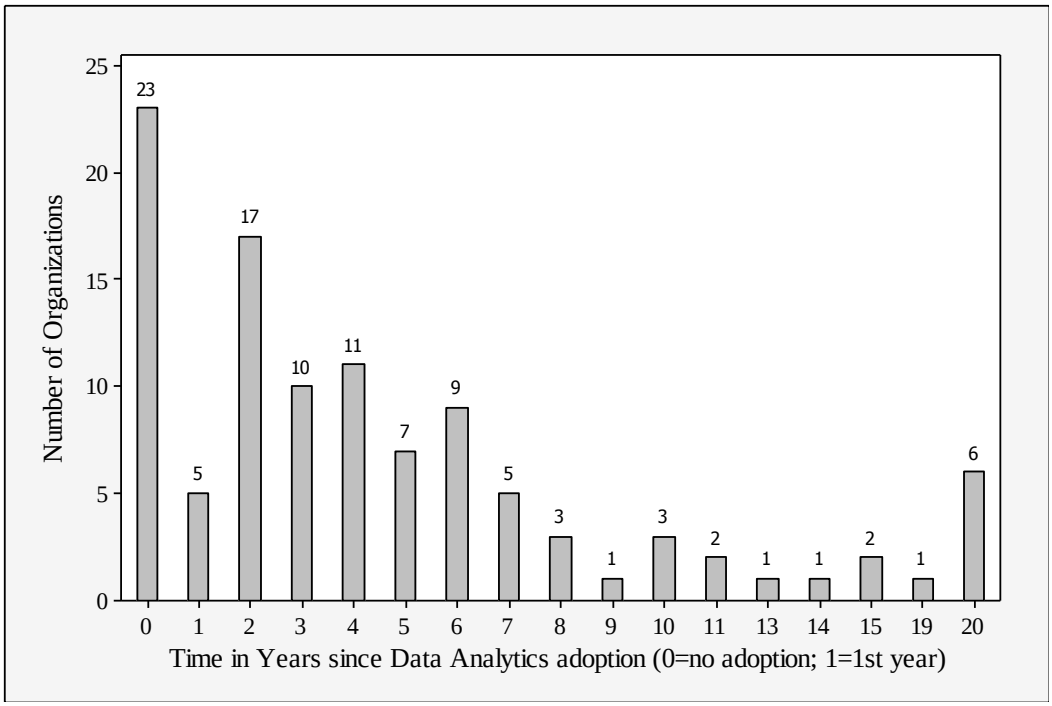

Figure 21 – Time in years since 'data Analytics' adoption totalized by the number of Organizations
Source: Created by the Author using research data
Note: zero (0) means 'no adoption' up to 2019, one (1) first year, two (2) second year, etc.

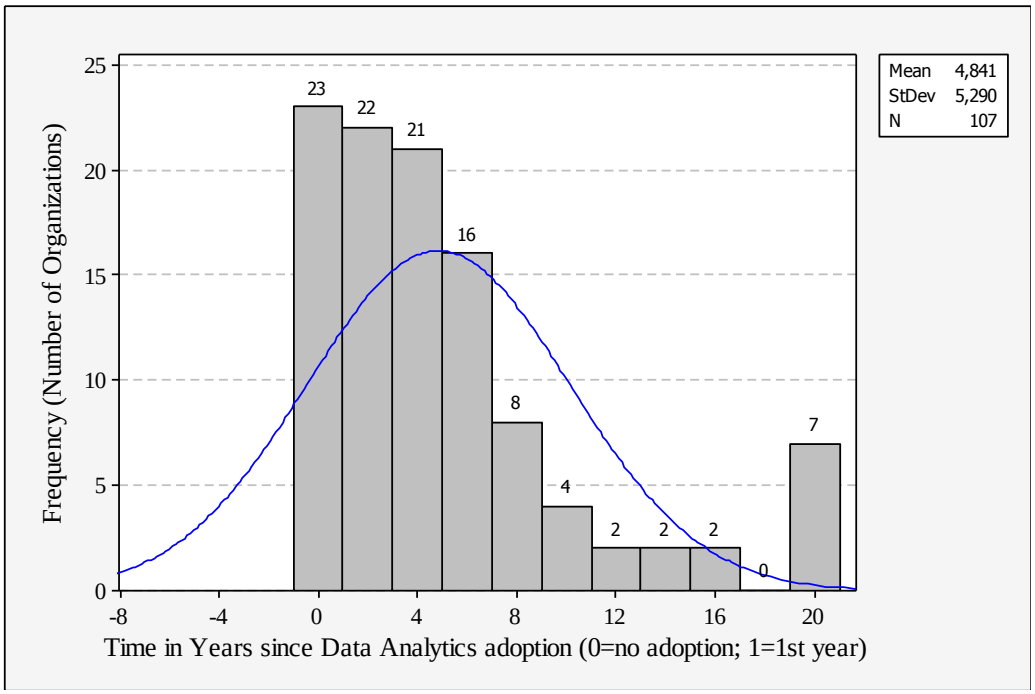

Figure 22 – Time in years since 'data Analytics' adoption - grouped frequency (Organizations)
Source: Created by the Author using research data
Note: zero (0) means 'no adoption' up to 2019, (4) fourth year, (8) eighth year, etc.

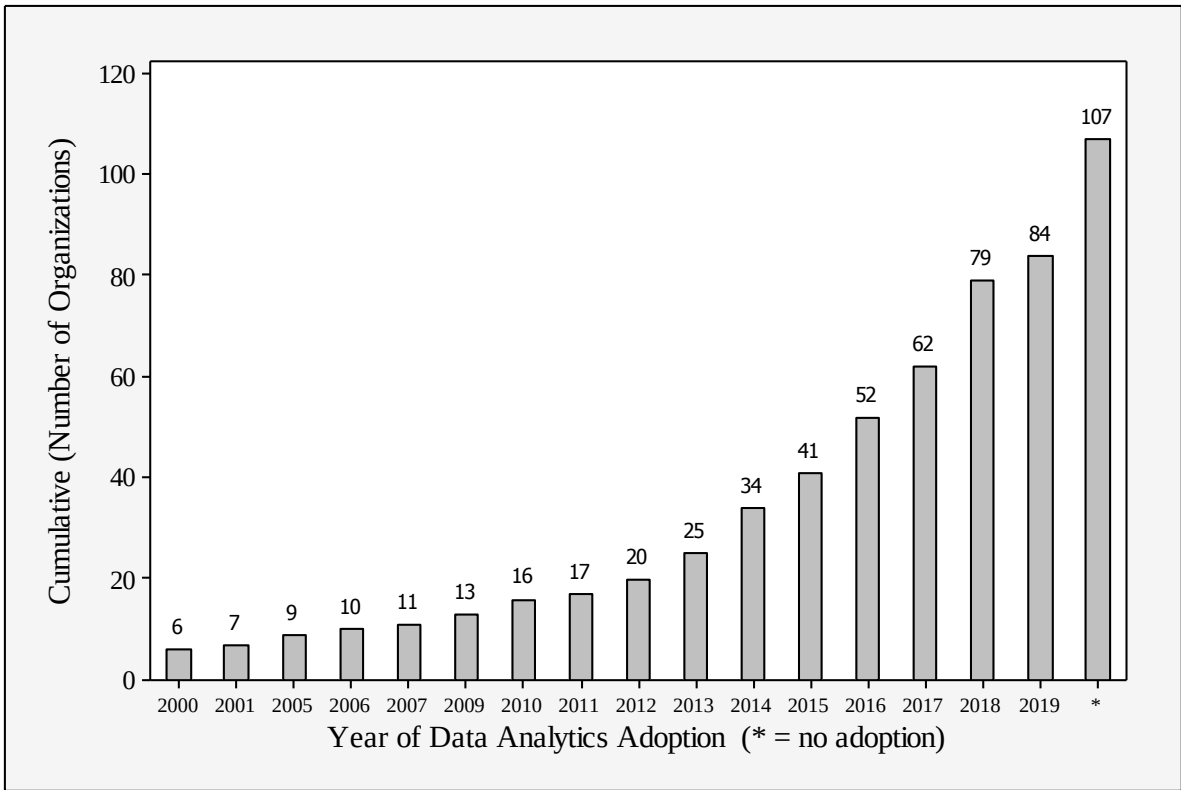

Figure 23 – Cumulative S-curve with respect to the diffusion of 'data Analytics' among the organizations studied in this research
Source: Created by the Author using research data
Note: The last bar (*) means ‘no adoption’ - it is intentionally reported in the graph only to illustrate in the curve the difference of 23 companies that have not yet adopted 'data Analytics'.

The number of organizations that participated in the survey and stated to have adopted ‘data Analytics’ technology was 84 (79%), of a total of 107 respondents. Of this total, 23 organizations reported that they do not use analytics, 7 organizations are at level 1-Event or 2-Data, 31 organizations are at level 3-Information, 21 at level 4-Descriptive, 17 at level 5-Predictive, and only 8 organizations are at the 6-Prescriptive level, as shown in Figure 18. The '6-Prescriptive' level was declared by only 8 companies in the sample (107), representing 7.5%, or compared with only those who have already adopted 'data analytics' technology, 84 companies represent only 9.5% of these respondent companies. Data analytics adoption 'de facto' has been occurring in the last 4 to 5 years. The Services and Manufacturing sectors (the largest portion of the sample) are those that make the best use of ‘data analytics’ technology - (‘5-predictive’ and ‘6-prescriptive’ levels already appear in these companies). The size of the organization is important for adoption and effective use of ‘data Analytics’ technology, occurring most often in companies with a +US$75 million of annual revenue ou budget. The average of years of initial adoption, is currently (in 2019) between the fourth and fifth years.

5.6 Measurement model

The use of the statistical technique of Partial Least Squares Structural Equation Modeling (PLS-SEM) followed steps for the evaluation of the measurement model and the structural model (Hair, Hollingsworth, Randolph, & Chong, 2017; Hair, Sarstedt, Hopkins, & Kuppelwieser, 2014; Henseler et al., 2016, 2009), with dimensions that were defined a priori based on the theoretical body of knowledge.
As the models had second order variables composed of factors that contained a similar number of indicators (between 3 and 5 indicators), the two-step approach was used. It was enough to repeat all the indicators in the respective LVs of the second order.

By delimitation of this research, the analyzes of the measurement models were performed for the last three stages (Stage IV, V and VI), as reported in Appendices Q, R and S, but for the researcher's interest in more details for Stage IV and Stage V, since the focus of the researcher's study had exactly this intention, supported by the literature and the theoretical framework (Figure 6). In other words, there was no theoretical sense to simultaneously integrating all stages into a single construct called 'Stages', in order to study the influence of the six integrated stages of ICT/IS initiatives on organizational innovation.

With the use of the software SmartPLS v.3 (Ringle, Wende, & Becker, 2015) it was possible to evaluate internal consistency (composite reliability), indicator reliability, convergent validity and discriminant validity of the two models from Figure 6 (Stage IV model, hypothesis H1a and Stage V model, hypothesis H1b) separately. To accomplish this task, a similar step-by-step approach was followed for each of the two models, which were specified following the theoretical framework.

The first step was to identify the convergent validity (Ringle, Silva, & Bido, 2014) in the latent variables (LVs) of the first order that participate in the composition of each of the Stages - Applications Portfolio (AP), ICT/IS Resources (IR), ICT/IS Management (IM), User Community (UC), Emerging ICT/IS (EG) and additionally in the LVs of Exploration and Exploitation - by checking the outer loading of all its indicators. The literature recommends that indicators with low loads (values <0.4) should be removed from the model (Hair, Hult, et al., 2017; Hair, Ringle, & Sarstedt, 2011).

The authors Hair, Hult, et al. (2017) also recommend that indicators with factorial loads > 0.4 and < 0.7 can be kept in the model, according to the researcher's perception that such indicators 'make sense' for the research. Thus, some indicators that had a factorial load above 0.6 were maintained in the evaluated models, without compromising their convergent validity, discriminant validity and reliability.

This procedure was carried out in a gradual manner until the composition of indicators was reached, allowing the researcher to proceed with the confirmation of the convergent validity of each of the respective two models (Stage IV and Stage V).

The second step was the verification of statistical significance, based on Student's test (t> 1.96) and p-value (p <0.05) (Hair, Hult, et al., 2017; Ringle et al., 2014), and it was possible to generate a measurement evaluation table for all the indicators of each of the two models – see Appendix Q, to Stage IV (cross loading and outer loading) and Appendix R, to Stage V (cross loading and outer loading).

The third step was to evaluate the discriminant validity via two tests: with the verification criteria of Fornell and Larcker (Henseler et al., 2009) - compare square root of the Average Variance Extracted (AVE) value for each construct to be greater than the correlation of that construct (first and second order) - and the other test was to observe if each reflective indicator loaded highest on the construct it was associated (Ringle et al., 2014). Also, the values of AVE should be greater than 0.50 (i.e, AVE > 0.50).

A complementary analysis for the second-order construct of the Stage IV model was the insertion of the moderating variable that measured the ‘Analytics Level’, as planned with the statement of the hypothesis H2a. And in a similar way, in the Stage V model, were also included CVs related to the Sector and to the Size of the company (based on its annual revenue or budget), as well as the moderating variable ‘Analytics Level’, as planned with the hypothesis statement H2b.

As shown in Appendix Q and in Appendix R, and in Figure 24 and Figure 25, after removal of some indicators in the models with factor loads below 0.6, the indicators that compose the model of Stage IV (Integration) and the model of Stage V (Data Administration) were validated in the test of statistical significance.

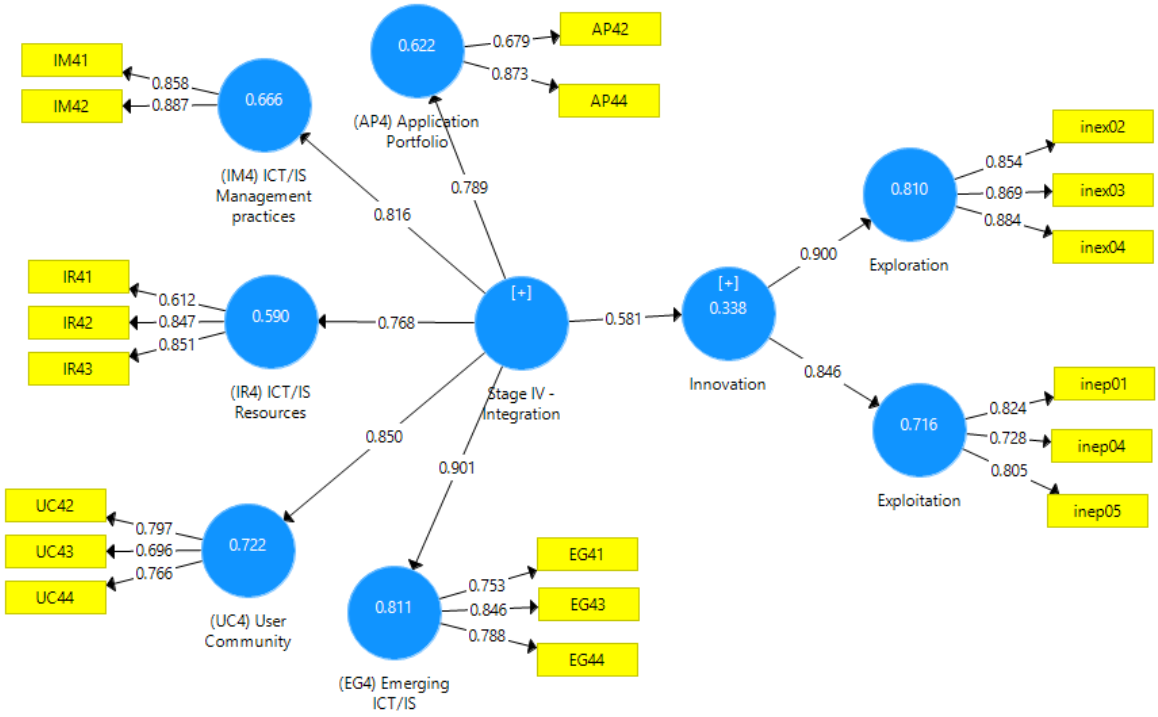

Figure 24 – Final measurement model of the Stage IV with the remaining indicators of the model
Source: Created by the Author using software SmartPLS v.3 (Ringle et al., 2015)

Table 15 – Measurement assessment to Stage IV (AVE, CR and R square) – LVs of 1st order

Stage IV – LV of 1st order	1	2	3	4	5	6	7
1 - (AP4) Application Portfolio	**0.782**						
2 - (EG4) Emerging ICT/IS	0.691	**0.797**					
3 - (IM4) ICT/IS Management practices	0.567	0.661	**0.873**				
4 - (IR4) ICT/IS Resources	0.485	0.629	0.501	**0.778**			
5 - (UC4) User Community	0.620	0.680	0.656	0.534	**0.754**		
6 - Exploitation	0.386	0.488	0.452	0.378	0.482	**0.787**	
7 - Exploration	0.305	0.400	0.563	0.342	0.391	0.529	**0.869**
Average Variance Extracted (AVE)	0.611	0.635	0.761	0.606	0.568	0.619	0.755
Composite Reliability (CR)	0.756	0.839	0.865	0.819	0.798	0.829	0.902
R Square	0.622	0.811	0.666	0.590	0.722	0.716	0.810

Source: Elaborated by the Author based on research data
Note: The square root of the AVE is distributed along the main diagonal, in bold.

Table 16 – Measurement assessment to Stage IV (AVE and CR) – LVs of 2nd order

Stage IV – LV of 2nd order	Innovation	Stage IV - Integration
Innovation	**0.873**	
Stage IV - Integration	0.581	**0.826**
Average Variance Extracted (AVE)	0.763	0.683
Composite Reliability (CR)	0.865	0.915

Source: Elaborated by the Author based on research data
Note: The square root of the AVE is distributed along the main diagonal, in bold.

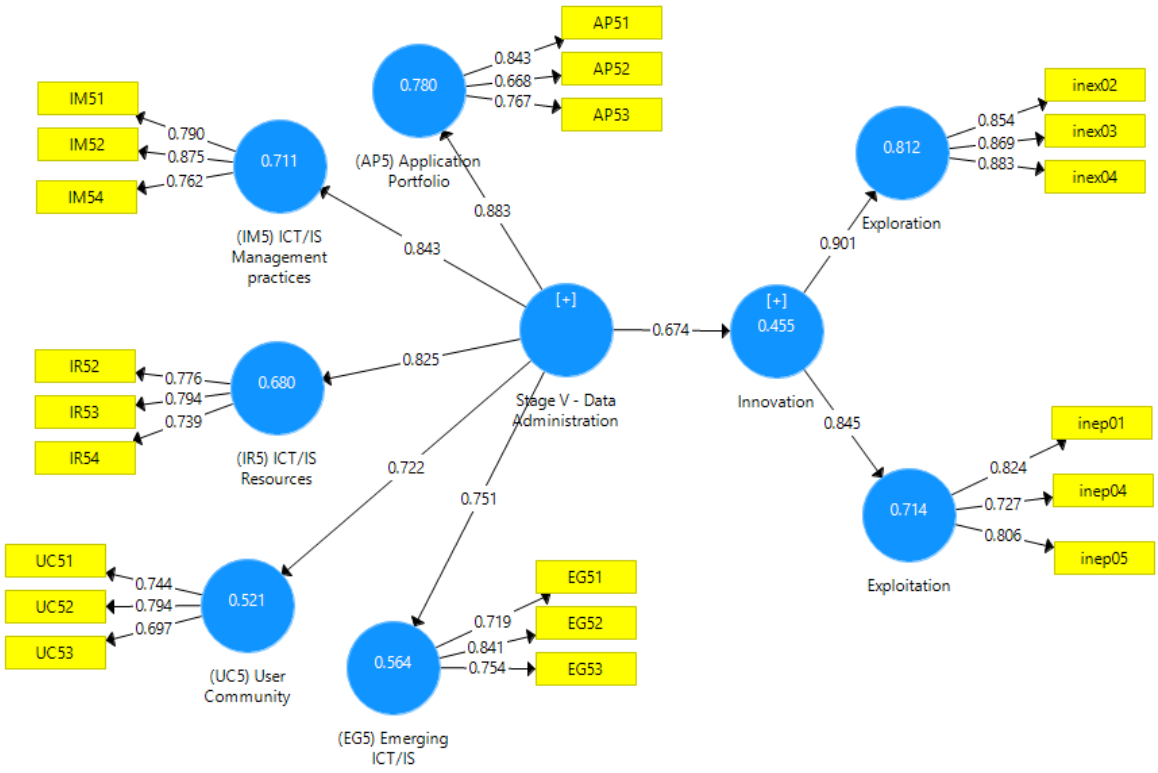

Figure 25 – Final measurement model of the Stage V with the remaining indicators of the model
Source: Created by the Author using software SmartPLS v.3 (Ringle et al., 2015)

Table 17 – Measurement assessment to Stage V (AVE, CR and R square) – LVs of 1st order

Stage V – LV of 1st order	1	2	3	4	5	6	7
1 - (AP5) Application Portfolio	**0.763**						
2 - (EG5) Emerging ICT/IS	0.625	**0.773**					
3 - (IM5) ICT/IS Management practices	0.659	0.524	**0.810**				
4 - (IR5) ICT/IS Resources	0.708	0.454	0.638	**0.770**			
5 - (UC5) User Community	0.541	0.449	0.515	0.498	**0.746**		
6 - Exploitation	0.565	0.460	0.520	0.462	0.418	**0.787**	
7 - Exploration	0.459	0.584	0.498	0.435	0.329	0.529	**0.869**
Average Variance Extracted (AVE)	0.582	0.598	0.657	0.593	0.556	0.619	0.755
Composite Reliability (CR)	0.805	0.816	0.851	0.814	0.790	0.829	0.902
R Square	0.780	0.564	0.711	0.680	0.521	0.714	0.812

Source: Elaborated by the Author based on research data
Note: The square root of the AVE is distributed along the main diagonal, in bold.

Table 18 – Measurement assessment to Stage V (AVE and CR) – LVs of 2nd order

Stage V – LV of 2nd order	Innovation	Stage V – Data Administration
Innovation	**0.873**	
Stage V - Integration	0.674	**0.807**
Average Variance Extracted (AVE)	0.763	0.651
Composite Reliability (CR)	0.865	0.903

Source: Elaborated by the Author based on research data
Note: The square root of the AVE is distributed along the main diagonal, in bold.

Other aspects that were also evaluated in these two models were the AVE (AVE > 0.50) and the Composite Reliability (CR) (CR > 0.70), checking the matrix of correlations between all LVs of first and second order, as seen in Table 15 and Table 16 to the Stage VI (Integration), and in Table 17 and Table 18 to the Stage V (Data Administration). As the square root of the AVE distributed along the main diagonal (in bold) are greater than the values outside the

diagonal (correlation), this indicates that there is discriminant validity between the constructs (Hair, Hult, et al., 2017) in these two models.

5.7 Structural Model

The impacts of control variables (i.e., Sector and Firm size) on Innovation were also examined, by choice of the researcher, only on the Stage V (Data Administration) model. Findings indicated that Sector (β=-0.107) and Firm size (β=0.078) did not significantly impact Innovation. The researcher's perception is that this step should be better explored in future research to ensure that such variables do not bias the model.

The study interest in this research were the second order variables of the Stage IV (Integration) and Stage V (Data Administration), and their relations with the other second order variable of the model, the organizational Innovation – Table 19.

Table 19 – Summary results of hypotheses H1 (a,b) testing

Hypothesis	**Hypothesized path**	**f^2**	**Standard path coefficent**	**Standard error**	***t-values***	***p-values***	**R^2**
H1a	Stage IV -> Innovation	0.510	0.581	0.099	5.862	0.000	0.338
H1b	Stage V -> Innovation	0.834	0.674	0.059	11.441	0.000	0.445

Source: Elaborated by the Author based on research data
Note: *** p<0.001, ** p<0.01, * p<0.05, ns = not significant; Statistical significance was estimated using bootstrap with 107 registers (sample size) and the use of 5,000 subsamples (Hair, Hult, et al., 2017).

As shown in Table 19, there are a positive relationship between Stage IV and Innovation (β=0.581), and Stage V and Innovation (β=0.674) with statistical significance, and in this way, the hypotheses H1a and H1b were supported.

These results corroborate Benitez, Llorens and Braojos (2018) research that also concluded that there was a positive influence on the relationship between information technology and innovation [also studied in the dimensions of exploration and exploitation].

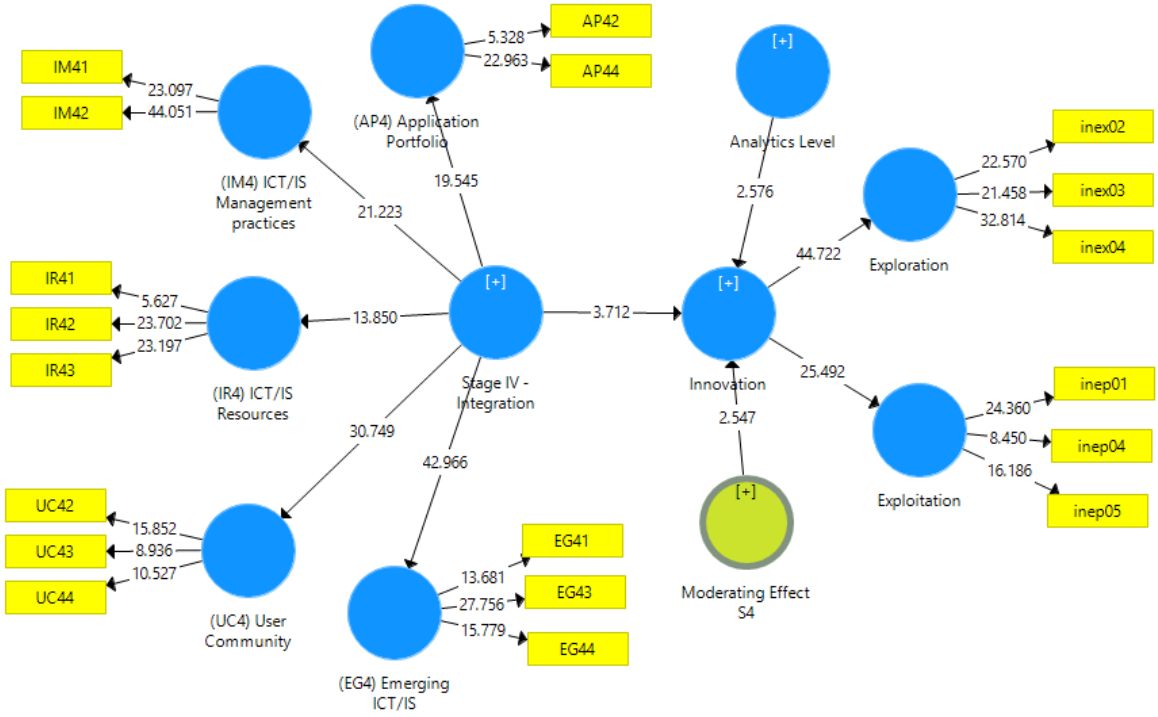

Figure 26 – Moderating Effect of the Analytics Level in the Stage IV (Integration)

Source: Created by the Author using software SmartPLS v.3 (Ringle et al., 2015)

Table 20 – Moderating Effect in Stage IV model, results of hypothesis H2a testing

Structural path	**Gardner et al.** (2017, p. 614)	**f^2**	**Standard path coefficent**	**Standard error**	***t-values***	***p-values***
Moderating Effect S4 -> Innovation	XZ	0.101	0.252	0.099	2.547	0.011*
Stage IV (Integration) -> Innovation	X	0.302	0.460	0.124	3.712	0.000***
Analytics Level -> Innovation	Z	0.100	0.264	0.103	2.576	0.010*

Source: Elaborated by the Author based on research data and Gardner et al. (2017, p.614)
Note: *** p<0.001, ** p<0.01, * p<0.05, ns = not significant, X=independent variable, Z= Moderating Effect variable, XZ = Interaction term

From the observation of Figure 26 and Table 20, the result of the moderating effect was presented to Stage IV model. After running the bootstrapping procedure with 107 cases and 5,000 subsamples, this resulted in a t-value of 2.547, indicating that the moderator effect is significant.

To assess the size of the moderating effect, the authors Hair, Hult, et al. (2017) recommend the classification of Kenny (2018), which specifies: $f^2 = 0.005$ (small); $f^2 = 0.010$ (medium); f2 = 0.025 (large). This way, it is possible to conclude that the moderating effect in the Stage IV model is significant and large, and affects positively the relationship between 'Stage IV (Integration)' and 'Innovation'. Thus, the hypothesis H2a was supported.

For interpretation of the positive interaction term 'Moderating Effect S4' it is necessary to be considered that a medium level of 'Analytics Level' (i.e., the moderator variable 'Analytics Level') is the reference point. For this level of 'Analytics Level', the relationship between 'Stage IV (Integration)' and 'Innovation' (i.e., the simple effect in the moderator model) has a value of 0.460.

If the 'Analytics Level' become higher (i.e., 'Analytics Level' is increased by one standard deviation point – see Figure 27), this would imply that the relationship between 'Stage IV (Integration)' and 'Innovation' would increase by the size of the interaction term ('Moderating Effect S4'), getting the value of 0.460 + 0.252 = 0.712, representing an increase of 55% in this relationship.

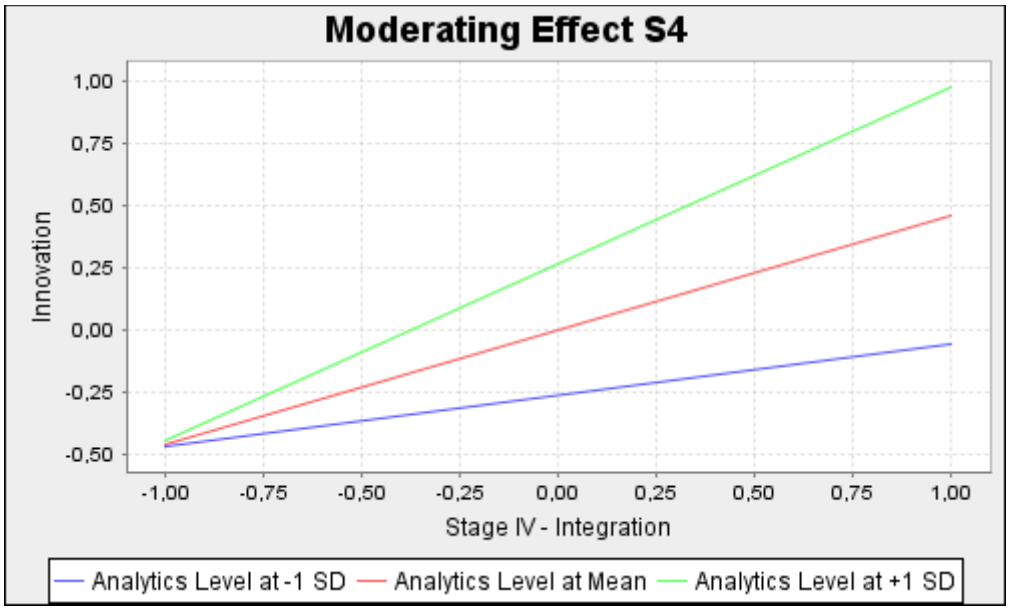

Figure 27 – Graphic of the Moderating Effect - Analytics Level in the Stage IV-> Innovation

Source: Created by the Author using software SmartPLS v.3 (Ringle et al., 2015)

When a multiplicative term is specified using the software SmartPLS v.3 (Ringle et al., 2015), the 'Simple Slope Analysis' graph is generated (Figure 27), containing three lines: one for the

average value of the moderator variable (red color) and another two with a standard deviation above the average (green color) and below the average (blue color).

For this case (Stage IV model), the upper line (green) represents the relationship between ‘Stage IV (Integration)->Innovation’ when 'Analytics Level' has high values (1 standard deviation above mean). For high values of 'Analytics Level' the relation 'Stage IV (Integration) -> Innovation' is stronger. According to Gardner et al. (2017, p. 614): "Strengthening: Z moderates the positive (negative) relationship between X and Y such that the relationship becomes stronger as Z increases". The lower line (blue) represents the relationship between 'Stage IV (Integration)->Innovation' when 'Analytics Level' has low values (1 standard deviation below the mean). For low values of 'Analytics Level' the relation 'Stage IV (Integration) -> Innovation' is weaker.

Table 21 – Moderating Effect in Stage V model, results of hypothesis H2b testing

Structural path	**Gardner et al.** (2017, p. 614)	**f^2**	**Standard path coefficent**	**Standard error**	***t-values***	***p-values***
Moderating Effect S5 -> Innovation	XZ	0.086	0.213	0.145	1.469	0.142ns
Stage V (Data Admin.) -> Innovation	X	0.519	0.586	0.074	7.868	0.000***
Analytics Level -> Innovation	Z	0.045	0.172	0.083	2.070	0.039*

Source: Elaborated by the Author based on research data and Gardner et al. (2017, p.614)
Note: *** p<0.001, ** p<0.01, * p<0.05, ns = not significant, X = independent variable, Z = Moderating Effect variable, XZ = interaction term

The result of the hypothesis test H2b is shown in Table 21.

More specifically, to evaluate H2a and H2b, that is, the moderating effect of ‘data Analytics’ on the relationships between ‘Stage IV (Integration)’ and Innovation, and ‘Stage V (Data Administration)’ and Innovation respectively, the function of "Add Moderating Effect" provided by SmartPLS v.3 was used (Ringle et al., 2015).

The bootstrapping result indicated that ‘Analytics Level’ has no statistically significant moderating effect (p > 0.142) on the relationship between ‘Stage V (Data Administration)’ and Innovation. Thus, H2b was rejected.

Stage II (Contagion) in the literature of stage theory (Nolan, 1973, 1975, 1979) is considered a stage where organizations experience a period of high learning with the ICT/IS initiatives proliferating in a less controlled manner. According to Nolan (1979, p. 117) "In Stage II more and more senior and middle managers become frustrated in their attempts to obtain information from the company's computer-based systems to support decision-making needs". This research identified that the growth process of UC (User Community) in Stage II is the reality of a total of 42 companies (39.2% of the sample), confirming that this difficulty reported in theory still prevails nowadays.

On the other hand, it has been proven that Stage IV (Integration) and Stage V (Data Administration) positively influences organizational innovation, and when organizations that are positioned at Stage IV and also make use of the ‘data Analytics’ technology feature, was perceived a 55% increase of this direct influence (ICT/IS -> organizational innovation), being characterized as an important finding of this study, which may suggest a path to be followed by organizations, based on statistical evidence of the data collected and studied in this empirical research. This finding is in part aligned with the work of Duan et al. (2018), which also identified the positive impact of business analytics on innovation.

In the seminal concepts that are involved in the theory of stages of growth in Management Information Systems, the Stage VI is designated as 'Maturity' (Nolan & Koot, 1992). This word suggests ‘the end of growth’ in the development of organizational processes. But in reality what happens is that a certain S-curve (the graphical symbol generally used to represent stage models, due to its mathematical characteristic of cumulative function) has reached its apex, reaching the end with the conclusion of a certain cycle. Thus, due to the nature of the growth processes associated with technological discontinuities (Christensen, 1997), a new cycle begins, using a new S-curve to identify the levels of the stage of organizational learning, as well as the use of ICT/IS initiatives and innovation in administrative practices in organizations. And these cycles, tend to arise periodically, mainly influenced by the technological ruptures inserted in the society and in the organizations.

The literature that discussed in previous decades the research work of Richard Nolan (Cash et al., 1994; Nolan, 2001; Nolan & Koot, 1992), with the development of the SGT in the field of MIS, strongly suggested the importance of creating new studies (McFarlan, 1984; Mutsaers et al., 1998) that could exploit gaps of this native body of knowledge of the field, preferably with the participation of users and business areas, going beyond the leadership of the ICT/IS area.

6 LIMITATIONS AND FUTURE STUDIES

One of the major limitations of the research was the refinement of the writing of the assertive texts of the Nolan scale, which should concomitantly identify a grouping of 5 processes in each of the 6 stages, and also bring the idea into the text that 'certain' evolution of levels was occurring as there was the 'advance' from one stage to another.
By the character of the permanent evolution and change of information and communication technologies, in addition to the use of the scale instrument developed and tested in this work, the researcher suggests other revisions and refinement of the writing and grouping of the assertive of the research, accompanied by a new empirical test, to allow that new perceptions can be obtained from this body of knowledge in search of the construction of a model that brings closer proximity to reality administrative practices.

Due to the high number of assertions that were used in the survey instrument (123 indicators in the Stages of Growth scale and 12 indicators of the Innovation scale) and other complementary questions for the measurement of the diffusion of ‘data Analytics’ technology, this research identified a certain complexity in the construction of the form / data collection tool, especially to facilitate the user experience in the participation of this research - this perception of the researcher is pointed out as a limitation of the research because it may be a restrictive aspect for other researchers who wish to explore the continuity of this study, or even replicate it.

The literature reports that there are varied ways of studying aspects of organizational innovation (van Oorschot et al., 2018; Yeo, Kim, Park, & Kang, 2015), and without any restriction with the other existing ones, this research chose to follow by the studies of organizational learning (Jansen et al., 2006; March, 1991) and diffusion of innovation (Mahler & Rogers, 1999; Rogers, 2003), for considering such aspects more closely related to the study complement and the focus that was intended in it.

The validation of the English-language research instrument was requested during the pre-test for two respondents, but both did not adhere to this participation. Thus, this aspect, as a limitation of the research, can be better treated from the international insertion of the researcher and the research, in an environment of academic collaboration with other researchers (and practitioners, market professionals) located in other parts of the world, in

future editions of the research, in the years subsequent to the publication of this study.

Because of the number of foreign respondent companies being less than 10% of the research sample, it was not possible to generate comparisons of the responses between the Brazilian organizations and the organizations coming from abroad - this is a limitation of the research that future studies may clarify.

Despite the methodological rigor followed by the researcher in the adequacy of the scales, pre-test, structuring of the instrument of collection, qualification of respondents, and in the data treatment, the non-probability sampling for convenience is considered a limitation in this study, not allowing generalizations.

Future studies related to subsequent editions of this research, already having a preliminary base of qualified respondents, will be able to generate a new invitation for the respondent organizations of their first edition, generate a new updated response of the research questions, to allow an annual comparison of the evolution of their own ICT/IS activities.

It will also be possible from subsequent editions of this research to generate a new section in the Diagnostic report, titled 'industry benchmark', bringing a comparison with other responding organizations that were in the same ‘sector’ or ‘industry’ of that own organization that participates in the research.

Another important recommendation for future studies is to conduct more in-depth research on users' perceptions of the ICT/IS initiatives of the organizations where they work, which may help in the refinement of the scale indicators of the model studied, especially related to the growth process of UC (User Community).

7 CONCLUSION AND IMPLICATIONS

This research measured and analyzed the Stage Level of ICT/IS initiatives in organizations and their influence on organizational Innovation. The influence of the moderation of ‘data Analytics’ in this relationship was also measured, as well as its diffusion as technology in these organizations.

To measure the stage level of ICT/IS initiatives in organizations, also popularly known in applied company practices as the measurement of 'IT maturity', it was necessary to develop and structure a measurement scale from seminal studies of Richard Nolan (1973), which was formed by four growth processes rescued from the original theory (AP, IR, IM and UC), added by a new growth process (EG) created by the author.

The analyzes of these measurements with the sample of 107 respondent organizations of the research indicate that the growth processes of AP, IM, and EG are at the level of Stage V (Data Administration) in a group of 37 (34.6%), 33 (30.1%) and 47 (44%) of these organizations, while at Stage IV (Integration) level is the IR growth process, represented by the theory as ‘the resources’ (IT staff and technology) providing the organization with the ways (means) to use and apply ICT/IS initiatives in the business, in a total of 46 organizations (43% of the sample).

Also, the process of growth UC, which represents the ability of people in the organization (users) to effectively apply ICT/IS initiatives to their work, found in 42 organizations (39% of the sample) the positioning at the level of Stage II (Contagio), the second lowest level of stage level measurements ranging from 1 to 6 by the conceptual model studied, pointing out that this is still a way to be improved in more than half of the companies in the sample (55 organizations, 51% of the sample) if we add those that the maximum value of the UC process is identified at the level of Stage I (Initiation).

As a complement to the theory of stages of growth, this research identified that when moderation of ‘data Analytics’ technology is present in Stage IV (Integration), there is a 55% increase in the relationship between ICT/IS activities and organizational Innovation.

Findings also indicate that only 7.5% of the analyzed sample companies have the '6-Prescriptive' level of ‘data Analytics’ use in their structures, which occurs mostly in companies with annual revenue or budget above US$ 75 million.

It was also possible to observe that Stage IV (Integration) and Stage V (Data Administration) levels are those where most organizations are located, with few reaching the level of Stage VI (Maturity) – the findings corroborate with the literature, which highlights that 'Maturity' is still a stage that is hardly achieved, not only because of the difficulty of being complete in all the sets of organizational processes that are required by the theory of stages of growth, but for the simple reason that the very essence of reaching the top of an S-curve, when maturity is reached, already suggests (induces) that another S-curve already began to exist at that moment, and a new cycle for the whole procedure level of stages of growth will start in the organization, most likely influenced by a technological discontinuity, as well as by new organizational learning requirements related to ICT / IS activities.

There is an important challenge to be unveiled in the field of technology and innovation - achieving "maturity" traditionally presupposes that all the rules, procedures, processes of organizational ICT initiatives are already very well "resolved". And it is precisely in the 'counter-hand' of this path that 'Innovation' activities must move - so here there is a clear dilemma still to be clarified by researchers: if one day any organization can reach its maximum level of 'maturity', how will your "Innovation" actions be conducted? This already suggests the 'beginning' of a research question for a new doctoral thesis.

Implications of this research will help further understand the paradigm of stage of growth theory [in the field of Management Information Systems], about the stage levels of organizational ICT/IS initiatives, associated with the influence of organizational innovation and the level of ‘data Analytics’ use in organizations, clarifying aspects related to this subject for academics and practitioners who wish to focus their studies for academic-scientific and managerial purposes.

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APPENDICES

Appendix A – Bi-lingual scale for measuring the Stage Level of ICT/IS initiatives in Organizations (English and Portuguese)

Important: this full scale informed in this Appendix A was adapted from Favaretto (2015, p. 70). Please, find the full 117 references that are mentioned in this Appendix A in DOI link: https://doi.org/10.13140/RG.2.2.16844.82562 . The author purposely chose not to repeat all the references to scale construction in this document, considering that the theoretical reference informed in the development of this scale originally belongs to the preliminary work (available in the first DOI number mentioned on this page).

The categories of responses may vary from 1 to 6, following the sequence in Portuguese or English: Disagree Completely (1), Disagree (2), Disagree Slightly (3), Agree Slightly (4), Agree (5) or Agree Completely (6).

In the survey form, these assertions were arranged in a shuffled form, ranging from A001 to A123 - the researcher kept this codification registered in the database, along with the original coding of each assertion according to the theoretical support of the study. The respondents should answer each assertion, based on the question (English and Portuguese version):

English:

How would you rate the ICT/IS initiatives in your organization regarding the following items? *Evaluate each assertion below, between* ***Disagree Completely (1)*** *and* ***Agree Completely (6)*** *, to express the perception you have about the subject.*

Portuguese:

Como você avaliaria as iniciativas de TIC/SI de sua organização em relação aos seguintes itens? *Avaliar cada assertiva abaixo, entre* ***Discordo Completamente (1)*** *e* ***Concordo Completamente (6)*** *, para expressar a percepção que você tem sobre o assunto.*

Stage I Dimensions	**Stage I Item Codes / Assertions (English and Portuguese)**	**References**
Stage I Applications Portfolio (AP1)	AP11 – The systems applications portfolio is limited to the current needs of the Organization. AP11 – O portfólio de aplicações de sistemas é limitado para as necessidades atuais da Organização.	Nolan (1973, 1979); Nolan & Koot (1992); Mutsaers *et al.* (1998)
	AP12 – The systems applications portfolio is maintained	

	in a decentralized manner. AP12 – O portfólio de aplicações de sistemas é mantido de forma descentralizada.	
	AP13 – The systems applications portfolio is focused only on the level of operational support. AP13 – O portfólio de aplicações de sistemas é focado somente para o nível de suporte operacional.	Nolan (1973, 1979); Nolan & Koot (1992); Nolan *et al.* (1993); Li *et al.* (1994); Mutsaers *et al.* (1998)
	AP14 – The Organization's current systems applications are strictly directed to automate administrative tasks (e.g. reduce costs, replace manual labor, etc.). AP14 – As atuais aplicações de sistemas da Organização são estritamente direcionadas para automatizar tarefas administrativas (ex: reduzir custos, substituir trabalho manual, etc.).	Nolan (1975); Nolan & Koot (1992); Mutsaers *et al.* (1998)
Stage I ICT/IS Resources (IR1)	IR11 – The ICT activity operates exclusively with technical staff in a "closed group". IR11 – A atividade da TIC opera exclusivamente com pessoal técnico em um "grupo fechado".	Nolan (1979); Nolan & Koot (1992); Li *et al.* (1994)
	IR12 – Only the experts of ICT activity provide the services and determine exactly the support of the Organization's needs. IR12 – Apenas os especialistas da atividade da TIC fornecem os serviços e determinam exatamente o suporte às necessidades da Organização.	Nolan (1973, 1979); Nolan & Koot (1992); Mutsaers *et al.* (1998)
	IR13 – The ICT staff have been focused on achieving restricted objectives and defined by themselves. IR13 – O pessoal da TIC tem se concentrado em atingir objetivos restritos e definidos por eles mesmos.	Nolan (1975)
Stage I ICT/IS Management (IM1)	IM11 – The management of organizational ICT is decided only by those responsible for the ICT area. IM11 – A gestão da TIC organizacional é decidida apenas pelos responsáveis pela área da TIC.	Nolan (1973, 1979); Nolan & Koot (1992); Mutsaers *et al.* (1998); Li *et al.* (1994)
	IM12 – Currently in my Organization there is no planning and control to perform the management of ICT. IM12 – Atualmente na minha Organização não existe planejamento e controle para executar a gestão da TIC.	
	IM13 – The ICT management has the attention focused only on the technical occurrences that arise. IM13 – A gestão da TIC possui a atenção focada somente nas ocorrências técnicas que vão surgindo.	
	IM14 – The Organization is in a period of primary learning about how to use their ICT initiatives. IM14 – A Organização está em um período de aprendizagem primária sobre como utilizar as suas	Nolan (1975)

	iniciativas da TIC.	
	IM15 – The Organization traditionally follows the main recommendation to use ICT initiatives only to improve its efficiency. IM15 – A Organização segue tradicionalmente a orientação principal de utilizar as iniciativas da TIC somente para melhorar a sua eficiência.	Mutsaers *et al.* (1998)
Stage I User Community (UC1)	UC11 – The users are not involved by the Organization in the organizational ICT initiatives. UC11 – Os usuários não são envolvidos pela Organização nas iniciativas da TIC organizacional.	Nolan (1973, 1979); Nolan & Koot (1992); Mutsaers *et al.* (1998)
	UC12 – The users of the Organization do not want to get involved in organizational ICT initiatives. UC12 – Os usuários da Organização não querem se envolver nas iniciativas da TIC organizacional.	Nolan & Koot (1992); Li *et al.* (1994)
	UC13 – The Organization users are not aware of the benefits arising from the organizational ICT initiatives. UC13 – Os usuários da Organização não estão conscientes dos benefícios decorrentes das iniciativas da TIC organizacional.	Nolan & Koot (1992); Li *et al.* (1994)
	UC14 – The users have not yet cooperated with the Organization's ICT initiatives. UC14 – Os usuários ainda não colaboraram com as iniciativas da TIC da Organização.	Nolan & Koot (1992)
Stage I Emerging ICT/IS (EG1)	EG11 – The Organization recognizes that newly introduced technologies on the market are associated with problems. EG11 – A Organização reconhece que novas tecnologias recém-disponibilizadas no mercado tem associação com problemas.	Nolan (1984); Favaretto (2015)
	EG12 – The responsible for ICT activity has a tendency to be cautious towards new technologies and typically adopts an attitude of ‘wait and see’. EG12 – O responsável pela atividade da TIC tem uma tendência a ser cauteloso para as novas tecnologias e normalmente adota uma atitude de ‘esperar para ver’.	Grégoire & Lustman (1993); Favaretto (2015)
	EG13 – Even with repeated Organization system interruptions of up to 12 hours, there are no serious consequences. EG13 – Mesmo com repetidas interrupções do sistema da Organização de até 12 horas, não há consequências graves.	Nolan & McFarlan (2005); Favaretto (2015)
	EG14 – The Organization's website only provides information and form of contact, without the intention of being used with a strategic focus. EG14 – O website da Organização só fornece	Teo & Pian (2004), Favaretto (2015)

	informações e forma de contato, sem o intuito de ser utilizado com foco estratégico.	
	EG15 – The Organization has no interest in using emerging technologies (e.g. Analytics and Data-driven, AI, Blockchain, IoT, Cloud Computing, etc.) in their ICT initiatives. EG15 – A Organização não tem interesse em utilizar as tecnologias emergentes (ex: Analytics e Data-driven, AI, Blockchain, IoT, Cloud Computing, etc.) em suas iniciativas da TIC.	This Author (2019)

Stage II Dimensions	**Stage II Item Codes / Assertions (English and Portuguese)**	**References**
Stage II Applications Portfolio (AP2)	AP21 – Currently there is an intense proliferation of systems applications in all functional areas of the Organization. AP21 – Atualmente ocorre uma proliferação intensa de aplicações de sistemas em todas as áreas funcionais da Organização.	Nolan (1973, 1979); Gibson & Nolan (1974); Li *et al.* (1994)
	AP22 – At present, there is a rapid growth in the use of system applications in the Organization. AP22 – Neste momento, há um rápido crescimento do uso das aplicações de sistema na Organização.	Nolan & Koot (1992)
	AP23 – The system applications during its adequacy and implementation are seen exclusively as costs by the Organization. AP23 – As aplicações de sistemas no decorrer de sua adequação e implantação são vistos exclusivamente como custos pela Organização.	Nolan & Koot (1992)
Stage II ICT/IS Resources (IR2)	IR21 – The organizational ICT activity is maintained exclusively by technical personnel that meets the support of the users of each functional area. IR21 – A atividade da TIC organizacional é mantida exclusivamente por pessoal técnico que atende ao suporte dos usuários de cada área funcional.	Nolan (1973, 1979); Nolan & Koot (1992); Li *et al.* (1994)
	IR22 – At this time, the Organization focuses on the introduction of new ICT initiatives only at the operational level. IR22 – Neste momento, a Organização concentra-se na introdução de novas iniciativas da TIC somente no nível operacional.	Nolan *et al.* (1993)
	IR23 – The Organization devotes less and less attention about the efficient use of its existing ICT resources. IR23 – A Organização dedica cada vez menos atenção	Nolan *et al.* (1993)

	sobre o uso eficiente de seus existentes recursos da TIC.	
	IR24 – At this moment, even increasing the budget of my Organization's ICT initiatives, remain the delays in meeting the user needs. IR24 – Neste momento, mesmo aumentando o orçamento das iniciativas de TIC de minha Organização, permanecem os atrasos no atendimento das necessidades dos usuários.	Nolan & Koot (1992)
Stage II ICT/IS Management (IM2)	IM21 – The ICT management of my Organization is still decided by those responsible for the ICT area, now with top management support. IM21 – A gestão da TIC de minha Organização continua sendo decidida pelos responsáveis pela área da TIC, agora com apoio da alta gestão.	Nolan (1973, 1979); Nolan & Koot (1992); Nolan *et al.* (1993); Li *et al.* (1994); Mutsaers *et al.* (1998)
	IM22 – At this moment in my Organization, the use of ICT initiatives is growing rapidly in an inefficient and uncontrolled way. IM22 – Neste momento na minha Organização, o uso das iniciativas da TIC está crescendo rapidamente de modo ineficiente e descontrolado.	Nolan (1973, 1979); Nolan & Koot (1992); Nolan *et al.* (1993)
	IM23 – The management currently engages resources beyond what is necessary for the development of ICT initiatives. IM23 – A gestão atualmente empenha recursos além do necessário para o desenvolvimento das iniciativas da TIC.	Nolan & Koot (1992); Nolan *et al.* (1993)
	IM24 – At this moment, my Organization keeps under control in the area of ICT to stimulate innovation. IM24 – Neste momento, a minha Organização mantém baixo o controle na área da TIC para estimular a inovação.	Nolan (1979)
	IM25 – The top and middle management become frustrated in their attempts to obtain information of the Organization's systems to support decision-making. IM25 – A alta e média gerência ficam frustradas em suas tentativas de obter informações dos sistemas da Organização para apoio a tomada de decisão.	Nolan (1979)
Stage II User Community (UC2)	UC21 – With the ICT initiatives in progress, the Organization expects to stimulate the acquisition of user-experience. UC21 – Com as iniciativas da TIC em andamento, a Organização espera estimular a conquista da experiência do usuário.	Nolan & Koot (1992); Mutsaers *et al.* (1998)
	UC22 – The Organization users are enthusiastic to initiate their involvement in the ICT initiatives. UC22 – Os usuários da Organização estão entusiasmados para iniciar o envolvimento deles nas iniciativas da TIC.	Nolan (1979); Nolan & Koot (1992)

	UC23 – Satisfy the demand requested by users is the priority of the Organization with its ICT initiatives. UC23 – Satisfazer a demanda requisitada pelos usuários é a prioridade da Organização com suas iniciativas da TIC.	Mutsaers *et al.* (1998)
Stage II Emerging ICT/IS (EG2)	EG21 – The users in my Organization ignore ICT policies and seek for their own, new services and applications available in the cloud that meet their needs. EG21 – Os usuários de minha Organização ignoram as políticas da TIC e buscam por conta própria, novos serviços e aplicações disponíveis na nuvem que atendam as suas necessidades.	Cătinean & Cândea (2014); Meirelles (2019); Favaretto (2015)
	EG22 – Understanding on emerging technologies and new organizational design are current focuses of my Organization's ICT area. EG22 – Compreender sobre as tecnologias emergentes e o novo design organizacional são focos atuais da área da TIC de minha Organização.	Cătinean & Cândea (2014); Favaretto (2015)
	EG23 – The Organization is uncertain how to take advantage of emerging technologies (e.g. Analytics and Data-driven, AI, Blockchain, IoT, Cloud Computing, etc.) in its ICT initiatives. EG23 – A Organização está incerta de como também aproveitar as tecnologias emergentes (ex: Analytics e Data-driven, AI, Blockchain, IoT, Cloud Computing, etc.) em suas iniciativas da TIC.	Meirelles (2019); This Author (2019)
	EG24 – At this time, there is in my Organization the proliferation of emerging technologies in a relatively uncontrolled way. EG24 – Neste momento, ocorre na minha Organização a proliferação de tecnologias emergentes de modo relativamente não controlado.	Nolan & Bennigson (2002); Favaretto (2015)
	EG25 – To help the Organization, social media applications (e.g., blogs, Facebook, Twitter, Linkedin, Instagram) are used informally by users who have prior experience. EG25 – Para ajudar a Organização, aplicações de mídia social (ex:, blogs, Facebook, Twitter, Linkedin, Instagram) são usadas informalmente por usuários que têm experiência prévia.	Kaplan & Haenlein (2010); Mergel & Bretschneider (2013); This Author (2019)

Stage III Dimensions	**Stage III Item Codes / Assertions (English and Portuguese)**	**References**
Stage III Applications Portfolio (AP3)	AP31 – The Organization is currently restructuring applications of existing systems and makes the update of its documentation. AP31 – A Organização está atualmente reestruturando as aplicações de sistemas já existentes e faz a atualização de sua documentação.	Nolan & Koot (1992); Li *et al.* (1994)
	AP32 – The Organization that neglected to upgrade several system applications does so now. AP32 – A Organização que negligenciava a atualização de várias aplicações de sistemas faz isso agora.	Nolan (1973, 1979); Nolan & Koot (1992); Mutsaers *et al.* (1998)
	AP33 – Neste momento, o desenvolvimento de novas aplicações de sistemas está suspenso na minha Organização para aumentar o controle daquelas já existentes. AP33 – At this time, the development of new systems applications is suspended in my Organization to increase the control of those already existing.	Gibson & Nolan (1974)
	AP34 – The Organization is now starting to use shared database applications. AP34 – A Organização começa agora a utilizar aplicações de banco de dados com acesso compartilhado.	Nolan (1979); Li *et al.* (1994)
Stage III ICT/IS Resources (IR3)	IR31 – At present, the ICT activities of my Organization are accompanied by the middle management that seeks to remedy delays. IR31 – Na atualidade, as atividades da TIC de minha Organização são acompanhadas pela média gerência que busca sanar atrasos.	Nolan (1979); Nolan & Koot (1992); Li *et al.* (1994)
	IR32 – The top management and the ICT manager of my Organization at this time directly interfere with the pace of organizational learning. IR32 – A alta direção e o responsável pela TIC de minha Organização neste momento interferem diretamente no ritmo da aprendizagem organizacional.	Nolan (1973, 1979, 2001); Nolan & Koot (1992)
	IR33 – The activity of ICT is under reconstruction and professionalization, to better meet the needs of the Organization. IR33 – A atividade da TIC está em reconstrução e profissionalização, para melhor atender as necessidades da Organização.	Nolan (1979); Grégoire & Lustman (1993)
	IR34 – The responsible for ICT plays an intermediary role between the technical ICT personnel and the Organization's users. IR34 – O responsável pela TIC desempenha um papel de intermediário entre o pessoal técnico da TIC e os usuários da Organização.	Nolan & Koot (1992)

Stage III ICT/IS Management (IM3)	IM31 – The top management imposes a higher level of control, by restricting the budget and disciplining the management of ICT projects. IM31 – A alta direção impõe um maior nível de controle, ao restringir o orçamento e disciplinar o gerenciamento de projetos da TIC.	Nolan (1973, 1979); Gibson & Nolan (1974); Nolan & Koot (1992); Nolan *et al.* (1993); Li *et al.* (1994); Mutsaers *et al.* (1998)
	IM32 – The Steering Committee or the Organization formally decides the budget of the ICT activities of a planned and justified manner. IM32 – O Comitê Gestor ou a Organização decide formalmente o orçamento das atividades da TIC de uma maneira planejada e justificada.	Nolan (1979); Nolan & Koot (1992); Li *et al.* (1994)
	IM33 – Starts at this time the change of orientation of the management of my Organization, from management of the technology to the management of data resources. IM33 – Inicia neste momento a mudança de orientação da gestão de minha Organização, de gestão da tecnologia para a gestão dos recursos de dados.	Nolan (1979); Grégoire & Lustman (1993)
	IM34 – At this moment, my Organization is increasing the use of methods to benefit the ICT initiatives (e.g. setting priorities, standards and quality of systems, managing projects, etc.). IM34 – Neste momento, a minha Organização aumenta a utilização de métodos para beneficiar as iniciativas da TIC (ex: definição de prioridades, padrões e qualidade dos sistemas, gerenciamento de projetos, etc.).	Gibson & Nolan (1974); Nolan & Koot (1992); Li *et al.* (1994); Mutsaers *et al.* (1998)
	IM35 – The involvement of management in the diffusion of technology in my Organization now imposes a greater level of control in these organizational actions. IM35 – O envolvimento da gestão na difusão de tecnologia em minha Organização impõe agora maior nível de controle nestas ações organizacionais.	Nolan (1984)
Stage III User Community (UC3)	UC31 – The users have participation in project groups for the development of the Organization's ICT initiatives. UC31 – Os usuários tem participação em grupos de projeto para o desenvolvimento das iniciativas da TIC da Organização.	Nolan (1973, 1979); Nolan & Koot (1992); Mutsaers *et al.* (1998)
	UC32 – Currently, users of my Organization show frustration over the services provided by the ICT area. UC32 – Atualmente, os usuários de minha Organização demonstram frustração em relação aos serviços fornecidos pela área da TIC.	Nolan (1979); Li *et al.* (1994)

Stage III User Community (UC3)	UC33 – Initial attempts to develop the user accountability for the ICT expenses incurred are in progress. UC33 – As tentativas iniciais para desenvolver a prestação de contas do usuário para as despesas decorridas com a TIC estão em andamento.	Nolan (1979)
	UC34 – The users of my Organization do not identify progress in the adequacy of control systems carried out by the ICT area. UC34 – Os usuários de minha Organização não identificam progressos nas adequações de sistemas de controle realizadas pela área da TIC.	Nolan (1979)
Stage III Emerging ICT/IS (EG3)	EG31 – Are publicly available in the Organization's website the privacy policy and the terms of use of data and information that are collected. EG31 – Estão disponíveis publicamente no website da Organização a política de privacidade e os termos de uso de dados e informações que são coletadas.	Favaretto (2015)
	EG32 – Mobility is present in the daily tasks of the Organization´s people, supported strongly by the resources provided by ICT. EG32 – A mobilidade está presente nas tarefas diárias das pessoas da Organização, apoiada intensamente pelos recursos providos pela TIC.	Meirelles (2019); Favaretto (2015)
	EG33 – Data and information resources are now being used effectively and correctly by the Organization, complying with external regulatory frameworks. EG33 – Os recursos de dados e de informação começam agora a ser utilizados de forma eficaz e correta pela Organização, cumprindo marcos regulatórios externos.	Hollyhead & Robson (2012); This Author (2019)
	EG34 – The ICT activity has been dedicated to maintaining some standardized and centralized control over emerging technologies. EG34 – A atividade da TIC tem se dedicado a manter algum controle padronizado e centralizado sobre as tecnologias emergentes.	Cătinean & Cândea (2014); Favaretto (2015)
	EG35 – Top management of the Organization, together with those responsible for ICT, begin structuring procedures to mitigate problems involving exposure and risk (eg, security criteria, viruses, data privacy, etc.). EG35 – A alta direção da Organização, em conjunto com os responsáveis pela TIC, iniciam a estruturação de procedimentos para atenuar problemas que envolvem exposição e risco (ex: critérios de segurança, vírus, privacidade de dados, etc.).	Friedman (1994); Huff *et al.* (2006); This Author (2019)

Stage IV Dimensions	**Stage IV Item Codes / Assertions (English and Portuguese)**	**References**
Stage IV Applications Portfolio (AP4)	AP41– At this time, most systems applications had to be rebuilt to allow integration across all departments or divisions of the Organization. AP41– Neste momento, a maioria das aplicações de sistemas teve que ser reconstruída para permitir a integração entre todos os departamentos ou divisões da Organização.	Nolan (1973, 1979); Nolan & Koot (1992); Mutsaers *et al.* (1998)
	AP42– By focusing on a more data-oriented approach, the organization had to restructure their systems and databases. AP42– Ao concentrar-se em uma abordagem mais orientada para os dados, a organização precisou reestruturar seus sistemas e bancos de dados.	Nolan & Koot (1992); Li *et al.* (1994)
	AP43 – At this time, to facilitate the integration of my Organization's systems applications, old or outdated applications need to be replaced. AP43 – Neste momento, para facilitar a integração de aplicações de sistemas de minha Organização, as antigas ou desatualizadas precisam ser substituídas.	Mutsaers *et al.* (1998)
	AP44 – By promoting the integration of its systems and databases, the Organization obtained a better synchronism with your data and information. AP44 – Ao promover a integração de seus sistemas e bancos de dados, a Organização obteve um melhor sincronismo com seus dados e informações.	Li *et al.* (1994)
Stage IV ICT/IS Resources (IR4)	IR41– The ICT activity focuses on the management of technological capacity of the Organization and its usefulness among its users. IR41– A atividade da TIC tem como foco a gestão da capacidade tecnológica da Organização e sua utilidade junto aos seus usuários.	Nolan (1979); Li *et al.* (1994)
	IR42 – The ICT activity of my Organization uses the technology to integrate different platforms and applications. IR42 – A atividade da TIC de minha Organização utiliza a tecnologia para efetuar a integração de diferentes plataformas e aplicações.	Mutsaers *et al.* (1998)
	IR43 – The ICT activity delivers a service of high quality and reliability to the users of the organization. IR43 – A atividade da TIC entrega um serviço da alta qualidade e confiabilidade aos usuários da organização.	Li *et al.* (1994)

Stage IV ICT/IS Management (IM4)	IM41 – The Steering Committee or top management of the Organization engages in corporate orientation of the activities of ICT and ratified the guidelines and proposed standards. IM41 – O Comitê Gestor ou a alta direção da Organização envolve-se na orientação corporativa das atividades da TIC e ratifica as diretrizes e normas propostas.	Nolan (1984)
	IM42 – The Organization uses ICT initiatives for exploring new forms of revenue or business. IM42 – A Organização utiliza as iniciativas de TIC para prospectar novas formas de receitas ou negócios.	Mutsaers *et al.* (1998)
	IM43 – Management strives to adjust the balance between slack and control, while ICT initiatives are integrated into the Organization processes. IM43 – A gestão se esforça para adequar o equilíbrio entre a negligência e o controle, enquanto as iniciativas da TIC são integradas aos processos da Organização.	Nolan *et al.* (1993); Mutsaers *et al.* (1998)
Stage IV User Community (UC4)	UC41 – User has budget responsibility regarding the organizational ICT activities. UC41 – O usuário tem responsabilidade no orçamento relacionado às atividades da TIC organizacional.	Nolan (1973, 1979); Nolan & Koot (1992); Mutsaers *et al.* (1998)
	UC42 – Users are currently taking an active role in designing and developing of ICT initiatives to meet their needs. UC42 – Os usuários atualmente estão tendo um papel ativo na concepção e desenvolvimento de iniciativas da TIC para atender às suas necessidades.	Nolan *et al.* (1993); Mutsaers *et al.* (1998)
	UC43 – The user of my Organization is now also responsible for the quality of the data and the value added in its final use. UC43 – O usuário de minha Organização agora também é responsável pela qualidade dos dados e pelo valor agregado em seu uso final.	Nolan (1973, 1979); Nolan & Koot (1992); Mutsaers *et al.* (1998)
	UC44 – Users perceive the real value of ICT activity and demand more support from it. UC44 – Os usuários percebem o real valor da atividade da TIC e demandam mais apoio desta.	Li *et al.* (1994); Mutsaers *et al.* (1998)
	UC45 – High quality ICT services are provided to the users. UC45 – Serviços de TIC de alta qualidade são fornecidos aos usuários.	Grégoire & Lustman (1993)

Stage IV Emerging ICT/IS (EG4)	EG41 – The latest technological possibilities are used at the moment to build a highly advanced integrated system. EG41 – As mais recentes possibilidades tecnológicas são usadas no momento para construir um sistema integrado altamente avançado.	Nolan & Koot (1992)
	EG42 – Many of the required adaptations for applications modules are performed by the own users by simply changing its parameters. EG42 – Muitas das adaptações necessárias para os módulos das aplicações são realizadas pelos próprios usuários, simplesmente mudando seus parâmetros.	Mutsaers *et al.* (1998); Meirelles (2019)
	EG43 – New technologies are known and introduced in the Organization by the ICT activity. EG43 – Novas tecnologias são conhecidas e introduzidas na Organização pela atividade da TIC.	Nolan (1993, 2001); Nolan & Koot (1992); Mutsaers *et al.* (1998); McAfee (2011); Meirelles (2019)
	EG44 – Top management, now more involved, changes its role to bring the Organization technological trends of the knowledge economy. EG44 – A alta direção, agora mais envolvida, muda seu papel para trazer à Organização as tendências tecnológicas da economia do conhecimento.	Huff *et al*. (2006); McAfee (2011); Favaretto (2015)
	EG45 – The Organization has adopted a formal policy on availability, and has implemented effective controls to deal with potential interruptions (continuity plan). EG45 – A Organização adotou uma política formal de disponibilidade, e foram implementados controles eficazes para lidar com interrupções potenciais (plano de continuidade).	Huff *et al*. (2006); Favaretto (2015)

Stage V Constructs	**Stage V Item Codes / Assertions (English and Portuguese)**	**References**
Stage V Applications Portfolio (AP5)	AP51 –The system applications are developed offering external support to suppliers and customers. AP51 – As aplicações de sistema são desenvolvidas oferecendo apoio externo para fornecedores e clientes.	Nolan (1973, 1979); Nolan & Koot (1992); Mutsaers *et al.* (1998)
	AP52 – To expand the integration of applications and databases, my Organization is currently investing in sophisticated tools. AP52 – Para ampliar a integração de aplicações e bancos de dados, atualmente a minha Organização investe em ferramentas sofisticadas.	Li *et al.* (1994); Mutsaers *et al.* (1998)
	AP53 – The Organization systems demonstrate good flexibility when you need to get data and information. AP53 – Os sistemas da Organização demonstram boa flexibilidade quando se precisa obter dados e informações.	Li *et al.* (1994)
	AP54 – There is an increase in the use of decision models and decision support systems. AP54 – Há um incremento na utilização de modelos de decisão e sistemas de apoio a decisão.	Li *et al.* (1994)
Stage V ICT/IS Resources (IR5)	IR51 – The Organizational ICT activity focuses on initiatives to improve data administration. IR51 – A atividade da TIC Organizacional centra-se em iniciativas para aperfeiçoar a administração de dados.	Nolan (1979); Li *et al.* (1994)
	IR52 – Currently the Organization makes high investments in database technology. IR52 – Atualmente a Organização realiza altos investimentos em tecnologia de banco de dados.	Grégoire & Lustman (1993)
	IR53 – The data administrator role has become relevant in my Organization to make data management a strategic resource. IR53 – O papel do administrador de dados passou a ser relevante na minha Organização ao fazer a gestão dos dados um recurso estratégico.	Mutsaers *et al.* (1998)
	IR54 – At this moment, the ICT activity of my organization initiates changes from an internal orientation activity to an external orientation activity in order to support suppliers and clients. IR54 – Neste momento, a atividade da TIC de minha Organização inicia mudanças de uma atividade de orientação interna, para uma atividade de orientação externa, a fim de apoiar fornecedores e clientes.	Nolan & Koot (1992); Nolan (2012, p. 99)
Stage V ICT/IS Management	IM51 – Top management of the Organization also assumes the responsibility for ICT activities, now considering its management as strategic. IM51 – A alta direção da Organização também assume as	Nolan (1973, 1979); Nolan & Koot (1992); Mutsaers *et al.* (1998); McAfee (2006); Huff *et*

(IM5)	responsabilidades sobre as atividades da TIC, agora considerando a sua gestão como estratégica.	*al.* (2006)
	IM52 – Top management increasingly sees the possibilities for using ICT initiatives to achieve strategic objectives. IM52 – A alta direção enxerga cada vez mais as possibilidades de utilizar as iniciativas da TIC para alcançar objetivos estratégicos.	Nolan & Koot (1992)
	IM53 – The Organization is committed to formalize standards and policies to be employed in the practice of their ICT initiatives. IM53 – A Organização empenha-se em formalizar padrões e políticas para serem empregadas na prática de suas iniciativas da TIC.	Nolan & Koot (1992); Li *et al.* (1994)
	IM54 – There is an organizational learning process to organize and manage a specialized data resource activity. IM54 – Há um processo de aprendizagem organizacional para organizar e gerir uma atividade especializada de recursos de dados.	Nolan (1975)
Stage V User Community (UC5)	UC51 – The users now enhance the specifications of the systems with the support of ICT personnel. UC51 – Os usuários agora aprimoram as especificações dos sistemas contando com o apoio do pessoal da TIC.	Nolan (1973, 1979); Nolan & Koot (1992); Mutsaers *et al.* (1998)
	UC52 – End user and ICT staff are jointly accountable for data and information quality. UC52 – O usuário final e a equipe da TIC são solidariamente responsáveis pela qualidade dos dados e da informação.	Nolan (1979); Nolan (1993, 2001); Nolan & Koot (1992); Li *et al.* (1994)
	UC53 – The users can get information directly from the enterprise system, avoiding the proliferation of spreadsheets and databases developed by them. UC53 – Os usuários podem obter informações diretamente do sistema corporativo, evitando a proliferação de planilhas e bancos de dados desenvolvidos por eles.	Davenport (2006); Favaretto (2015)
Stage V Emerging ICT/IS (EG5)	EG51 – The enterprise system is platform independent of the type of hardware, i.e., it can be accessed by micro desktops, laptops, tablets and smartphones. EG51 – O sistema corporativo possui plataforma independente do tipo do hardware, ou seja, ele pode ser acessado por micro desktops, laptops, tablets e smartphones.	Mutsaers *et al.* (1998); McAfee (2011); Favaretto (2015)
	EG52 – The enterprise system is accessible to employees	McAfee (2011); This Author

	even when they are not in the Organization's facilities (e.g. home, traffic, travel, etc.), using a web browser or APP. EG52 – O sistema corporativo é acessível aos funcionários mesmo quando não estão nas instalações da Organização (ex: de casa, no trânsito, em viagem, etc.), utilizando um navegador web ou APP.	(2019)
	EG53 – In my Organization now ICT is ubiquitous, that is, it is everywhere, playing multiple roles in operations and strategies. EG53 – Na minha Organização agora a TIC é ubíqua, isto é, está em todos os lugares, desempenhando papéis múltiplos nas operações e estratégias.	Nolan (2012, p. 91); Meirelles (2019)
	EG54 – Top management recognizes as a high priority the development and maintenance of analytical capabilities by the Organization. EG54 – A alta direção reconhece como uma importante prioridade o desenvolvimento e a manutenção de capacidades analíticas pela Organização.	Davenport (2006); Davenport & Patil (2012); Grossman & Siegel (2014); Meirelles (2019); Favaretto (2015)
	EG55 – The Organization is using the emerging technologies to gain flexibility and responsiveness in meeting customer demands. EG55 – A Organização está usando as tecnologias emergentes para ganhar flexibilidade e capacidade de resposta no atendimento às demandas dos clientes.	Bradley & Nolan (1998); Meirelles (2019)

Stage VI Constructs	**Stage VI Item Codes / Assertions (English and Portuguese)**	**References**
Stage VI Applications Portfolio (AP6)	AP61 – There are in the Organization high-quality information systems, flexible, integrated and constantly updated. AP61 – Existem na Organização sistemas de informação de alta qualidade, flexíveis, integrados e permanentemente atualizados.	Mutsaers *et al.* (1998); Meirelles (2019);
	AP62 – The systems applications portfolio structure reflects the Organization and its information flows. AP62 – A estrutura do portfólio de aplicações de sistemas reflete a Organização e seus fluxos de informação.	Nolan (1979); Grégoire & Lustman (1993); Li *et al.* (1994)
	AP63 – The enterprise system is a top layer application "controlled" by parameters that allow to change its functionalities or workflow. AP63 – O sistema corporativo é uma aplicação de camada superior "controlada" por parâmetros que permitem mudar suas funcionalidades ou o fluxo de trabalho.	Mutsaers *et al.* (1998); Meirelles (2019)
Stage VI ICT/IS Resources	IR61 – The ICT activity has been transferred completely to the top management level. IR61 – A atividade da TIC foi transferida por completo para o nível da alta direção.	Nolan (1979); Li *et al.* (1994)

(IR6)	IR62 – The ICT activity focuses on data resource management with the information available in real time. IR62 – A atividade da TIC se concentra na gestão de recursos de dados com a informação disponibilizada em tempo real.	Nolan (1979); Li *et al.* (1994); Mutsaers *et al.* (1998)
	IR63 – The ICT activity, as a weapon for competition, is considered extremely important for the Organization. IR63 – A atividade da TIC, como um armamento para competição, é considerada de importância extrema para a Organização.	Li *et al.* (1994); Mutsaers *et al.* (1998)
	IR64 – The ICT activity receives daily demands to enhance and maintain functional technical structure of the Organization. IR64 – A atividade da TIC recebe demandas diárias para aprimorar e manter a estrutura técnica funcional da Organização.	Mutsaers *et al.* (1998)
Stage VI ICT/IS Management (IM6)	IM61 – New technologies are used by management to directly exploit information as a resource to add value to the product or service. IM61 – Novas tecnologias são utilizadas pela administração para explorar diretamente a informação como um recurso para adicionar valor ao produto ou serviço.	Nolan (1993, 2001); Gottschalk (2002a); Nolan & Koot (1992); Mutsaers *et al.* (1998)
	IM62 – The Organization taking advantage of their ICT initiatives, constantly and quickly responds to competitive market pressures. IM62 – A Organização aproveitando de suas iniciativas de TIC, constantemente e de forma rápida responde as pressões competitivas de mercado.	Mutsaers *et al.* (1998)
Stage VI ICT/IS Management (IM6)	IM63 – The Organization ICT activity changes from a technology-driven phenomenon to a strategy-driven management resource. IM63 – A atividade da TIC Organizacional muda de um fenômeno orientado pela tecnologia para um recurso de gestão orientado pela estratégia.	Nolan & Koot (1992); Mutsaers *et al.* (1998)
	IM64 – In the participation of high-level discussion on the strategic orientation of my Organization, the presence of the top ICT leadership has become essential. IM64 – Na participação de discussão de alto nível sobre a orientação estratégica de minha Organização, a presença da alta direção da TIC tornou-se imprescindível.	Nolan & Bennigson (2002)
Stage VI User Community (UC6)	UC61 – The Organization users are responsible for the acquiring and use of technology, with the support of the ICT staff. UC61 – Os usuários da organização são responsáveis pela aquisição e uso da tecnologia, com o apoio da equipe da TIC.	Nolan (1973, 1979); Nolan & Koot (1992); Mutsaers *et al.* (1998)
	UC62 – The Organization user takes care about its own workstation (local or mobile) with some support of the ICT staff. UC62 – O usuário da organização cuida de sua própria estação de trabalho (local ou móvel) com algum apoio da equipe da TIC.	Mutsaers *et al.* (1998); Meirelles (2019)

	UC63 – The users and the Organization ICT staff are jointly responsible for the effectiveness of projects that use ICT initiatives. UC63 – Os usuários e a equipe da TIC da Organização são solidariamente responsáveis pela eficácia de projetos que utilizam iniciativas da TIC.	Nolan (1979); Li *et al.* (1994)
	UC64 – The users have condition and ability to adjust parameters in the enterprise system, because there is often no time to ask for help to the ICT staff. UC64 – Os usuários possuem condição e capacidade de adequar parâmetros no sistema corporativo, pois muitas vezes não há tempo para pedir ajuda ao pessoal da TIC.	Mutsaers *et al.* (1998); Favaretto (2015)
Stage VI Emerging ICT/IS (EG6)	EG61 – The Organization can also open the access to its applications systems to people outside the organization, such as contractors, suppliers, or other external partners. EG61 – Organização também pode abrir o acesso aos seus sistemas de aplicações para pessoas de fora da organização, tais como contratados, fornecedores ou outros parceiros externos.	McAfee (2011); Favaretto (2015)
	EG62 – The Organization uses the emerging technologies to go beyond the boundaries of its walls, to monitor customers continuously, not merely sensing their needs, but actually anticipating their needs unrecognized yet. EG62 – A Organização utiliza as tecnologias emergentes para ir além dos limites de suas paredes, para monitorar os clientes de forma contínua, não apenas sentindo as suas necessidades, mas, na verdade, antecipando as necessidades por eles ainda não reconhecidas.	Bradley & Nolan (1998); Favaretto (2015)
	EG63 – The Organization has already implemented technological resources that allow it to monitor its management activities online and in real time. EG63 – A Organização já implantou recursos tecnológicos que permitem monitorar as suas atividades de gestão de maneira on-line e em tempo real.	Mutsaers *et al.* (1998); Favaretto (2015)
Stage VI Emerging ICT/IS (EG6)	EG64 – To create continuous innovation based on real-time information, the Organization efficiently, effectively and creatively uses the best skills and knowledge that are in your network. EG64 – Para criar inovação contínua com base em informações em tempo real, a Organização de forma eficiente, eficaz e criativa utiliza as melhores competências e conhecimentos que estão em sua rede.	Mutsaers *et al.* (1998); Favaretto (2015)
	EG65 – If Organizational systems fail for some minutes, there's an immediate loss of business. EG65 – Se os sistemas Organizacionais falham por alguns minutos, há uma perda imediata do negócio.	Nolan & McFarlan (2005); Favaretto (2015)

Appendix B – Bi-lingual scale for measuring the Exploratory Innovation and Exploitative Innovation (English and Portuguese)

As defined by the original scale adapted from Jansen et al. (2006, p. 1672), the word 'unit' referred to 'Organization Unit', as organizations seek to became ambidextrous to simultaneously develop exploratory and exploitative innovation, normally, in different organizational units.

Exploratory Innovation (Exploration)	
Item Codes	**Assertions (English and Portuguese)**
INEX01	Our unit accepts demands that go beyond existing products and services. Nossa unidade aceita demandas que vão além dos produtos e serviços que já existem.
INEX02	We invent new products and services. Nós inventamos novos produtos e serviços.
INEX03	We experiment with new products and services in our local market. Nós lançamos novos produtos e serviços em nosso mercado local.
INEX04	We commercialize products and services that are completely new to our unit. Nós comercializamos produtos e serviços que são completamente novos para a nossa unidade.
INEX05	We frequently utilize new opportunities in new markets. Nós frequentemente identificamos novas oportunidades em novos mercados.
INEX06	Our unit regularly uses new distribution channels. Nossa unidade regularmente utiliza-se de novos canais de distribuição.
Exploitative Innovation (Exploitation)	
Item Codes	**Assertions (English and Portuguese)**
INEP01	We frequently refine the provision of existing products and services. Nós refinamos com frequência a oferta de produtos e serviços existentes.
INEP02	We regularly implement small adaptations to existing products and services. Nós regularmente implementamos pequenas adaptações nos produtos e serviços existentes.
INEP03	We introduce improved, but existing products and services for our local market. Nós introduzimos melhorias apenas nos produtos e serviços existentes em nosso mercado local.
INEP04	We improve our provision's efficiency of products and services. Nós melhoramos a nossa eficiência de provisão de produtos e serviços.
INEP05	We increase economies of scales in existing markets. Nós aumentamos a economia de escala nos mercados existentes.
INEP06	Our unit expands services for existing clients. Nossa unidade expande serviços para clientes existentes.

Note: All indicators were measured on a five-point Likert scale, anchored by: 1-Disagree Completely, 2-Disagree, 3-Neither Disagree or Agree, 4-Agree, 5-Agree Completely.

Source: Adapted by the Author from Jansen et al. (2006, p. 1672).

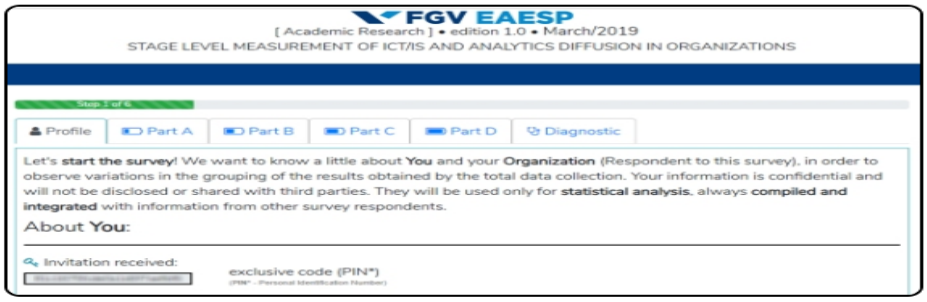
Appendix C – Invitation letter template sent by e-mail (English and Portuguese)

FGV EAESP **INVITATION - ACADEMIC RESEARCH**

in(prospec_mensagem)
in(prospecDateTime)

in(prospec_contato)

You are our guest to participate in a FGV EAESP survey which measures the Stage Level of ICT/IS in Organizations and the diffusion of technologies.



Your Exclusive Invitation PIN* is: **in(prospec_sessao)** , and it will be automatically enabled on initial access to the survey online form. (PIN* - Personal Identification Number)
»» Do it now!

Get involved and receive a real-time Diagnostic.

When you complete your survey responses in full (estimated time of about 20 minutes), you **will get a Report and Diagnostic (in real time)** containing 6 pages (A4) regarding the ICT initiatives of your Organization, based on the academic studies field of Information Systems (IS).

Take the Survey

We would appreciate your return in **up to 2 (two) days** of receiving this message.
Visit the Research site to know more about it, or to contact the Researchers.

Thank you in advance **for your valuable participation!**

Jose Eduardo Ricciardi Favaretto
Fernando de Souza Meirelles

Useful links:

Exclusive Invitation
Research site
Contact via website

Contact the Researchers:

Phone:
+55 (11) 9-4245.5413
Email and Website:
jose.favaretto@gvmail.br
www.favaretto.net

Fundacao Getulio Vargas | Sao Paulo School of Business Administration (FGV EAESP)

Triple Accreditation: merit of less than 1% of World Business Schools.
• Association to Advance Collegiate School of Business (AACSB),
• European Foundation for Management Development (Equis-EFMD) and
• Association of MBAs (AMBA).

https://eaesp.fgv.br/en - Technology and Data Science Department (TDS) • Sao Paulo, Brazil

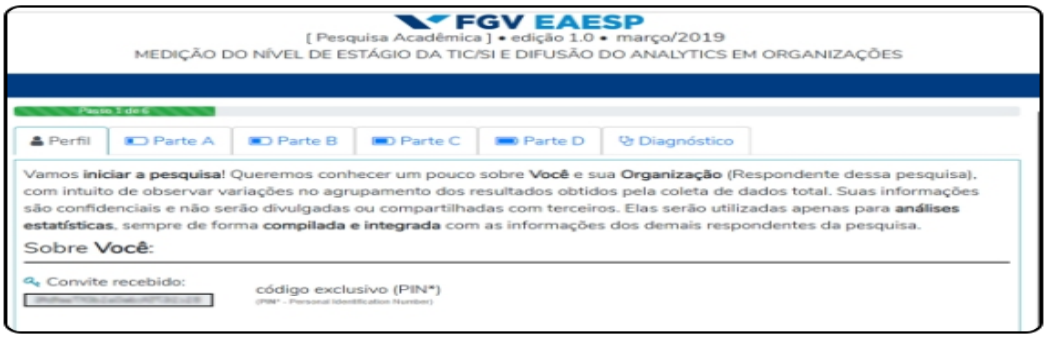
Share | Researchers | Portuguese

FGV EAESP **CONVITE - PESQUISA ACADÊMICA**

in(prospec_mensagem)
in(prospecDateTime)

in(prospec_contato)

Você é in(MeuGenero) para participar de pesquisa da FGV EAESP que mensura o Nível de Estágio da TIC/SI em Organizações e a difusão de tecnologias.



O seu Convite Exclusivo PIN* é: **in(prospec_sessao)** , e este será ativado automaticamente no acesso inicial ao formulário on-line da Pesquisa. (PIN* - Personal Identification Number)
»» Faça isso agora!

Participe e receba um Diagnóstico em tempo real.

Ao finalizar as respostas da Pesquisa por completo (tempo previsto de cerca de 20 minutos), você **obterá um Relatório e Diagnóstico (em tempo real)** contendo 6 páginas (A4) a respeito das iniciativas da TIC de sua Organização, baseado no campo de estudos acadêmicos de Sistemas de Informação (SI).

Responder a Pesquisa!

Apreciaríamos contar com o seu retorno em **até 2 (dois) dias** do recebimento dessa mensagem.
Visite o site da Pesquisa para conhecer mais a respeito, ou entre em contato com os Pesquisadores.

Agradecemos antecipadamente **a sua valiosa participação!**

José Eduardo Ricciardi Favaretto
Fernando de Souza Meirelles

Links úteis:

Convite Exclusivo
Site da Pesquisa
Contato via Site

Fale com os Pesquisadores:

Fone:
+55 (11) 9-4245.5413
Email e Website:
jose.favaretto@gvmail.br
www.favaretto.net

Fundação Getulio Vargas | Escola de Administração de Empresas de São Paulo (FGV EAESP)

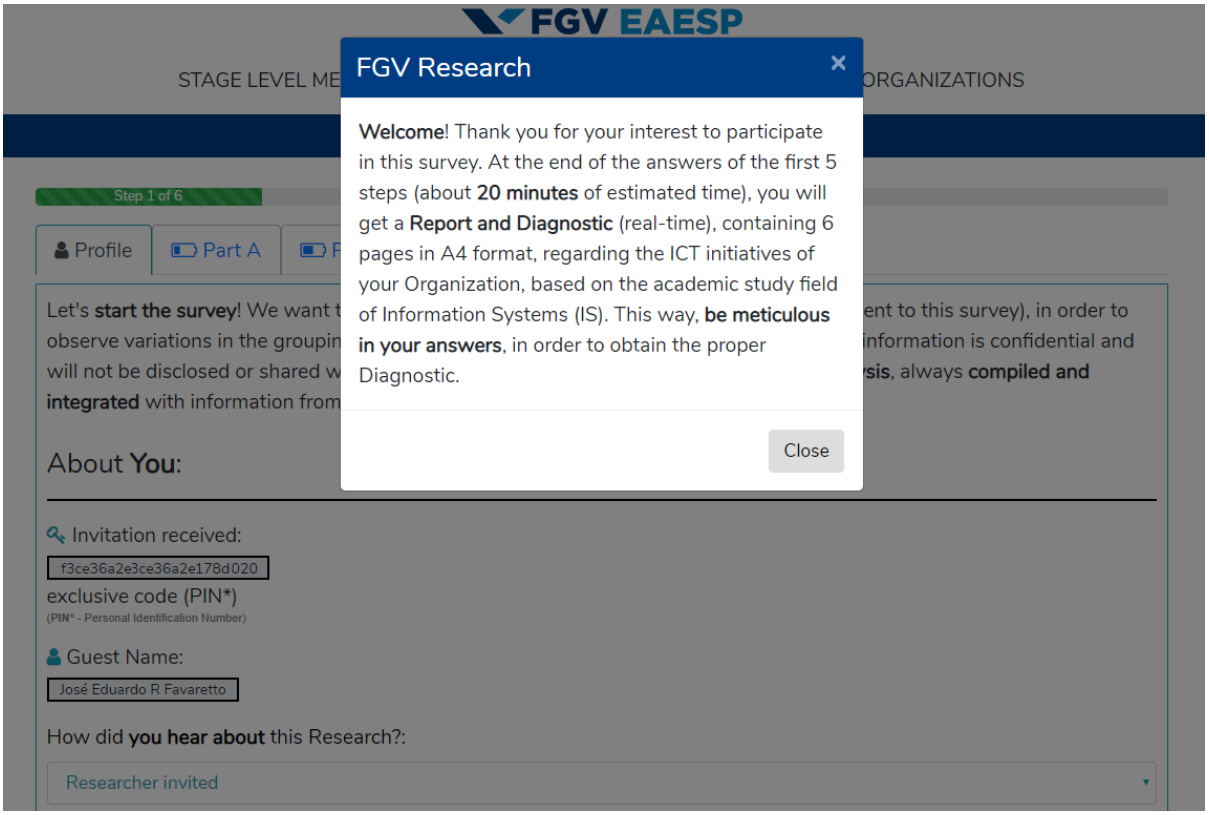
Tripla Acreditação: mérito de menos de 1% das Escolas de Negócios do mundo.
• Association to Advance Collegiate School of Business (AACSB),
• European Foundation for Management Development (Equis-EFMD) e
• Association of MBAs (AMBA).

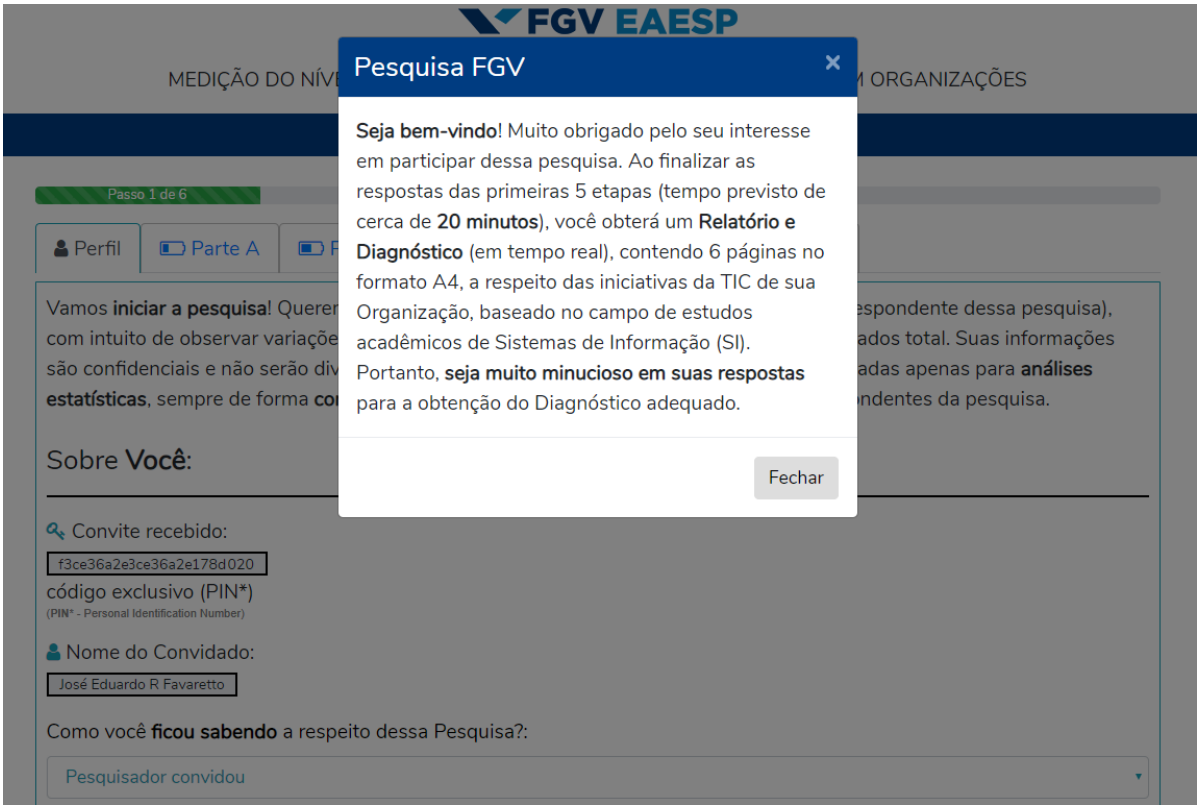
https://eaesp.fgv.br - Departamento de Tecnologia e Ciência de Dados (TDS) • São Paulo, Brasil

Compartilhe | Pesquisadores | English

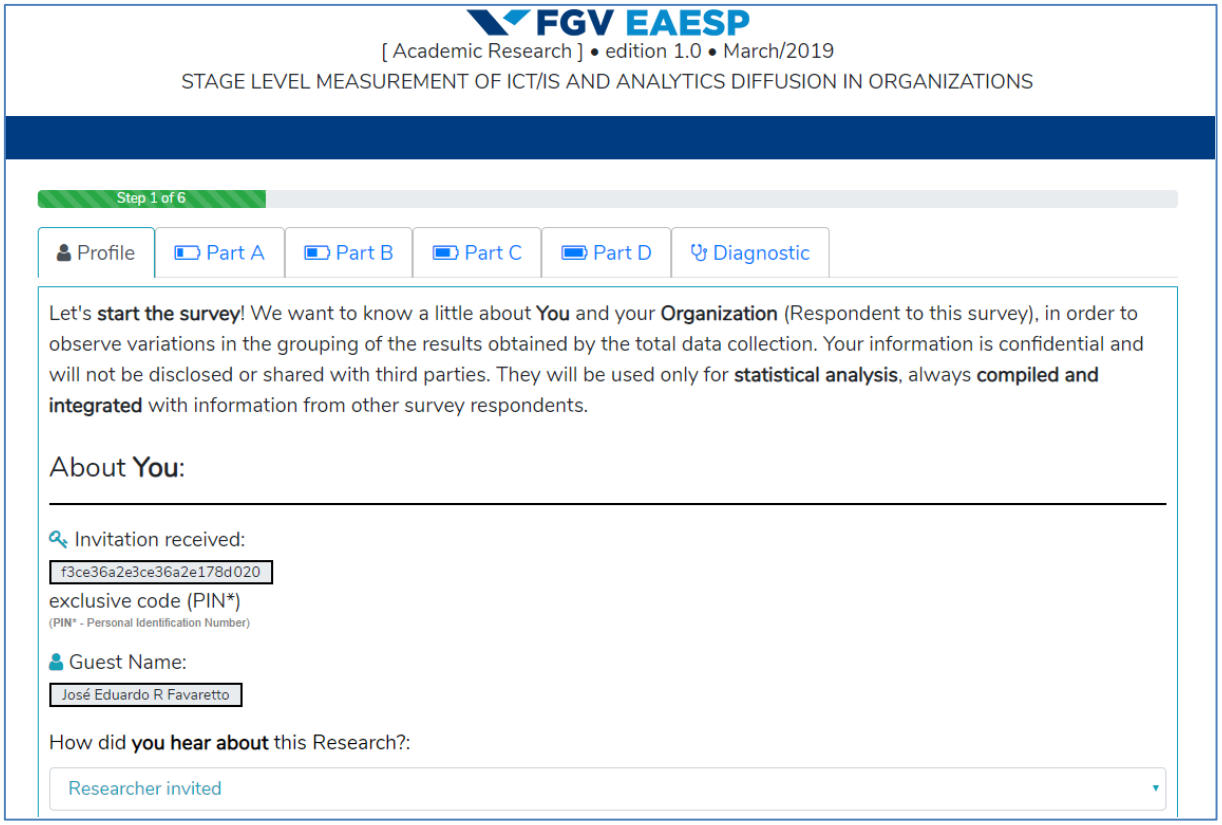
Appendix D – On-line Form Survey (questionnaire) utilized to data collection routine (English and Portuguese)

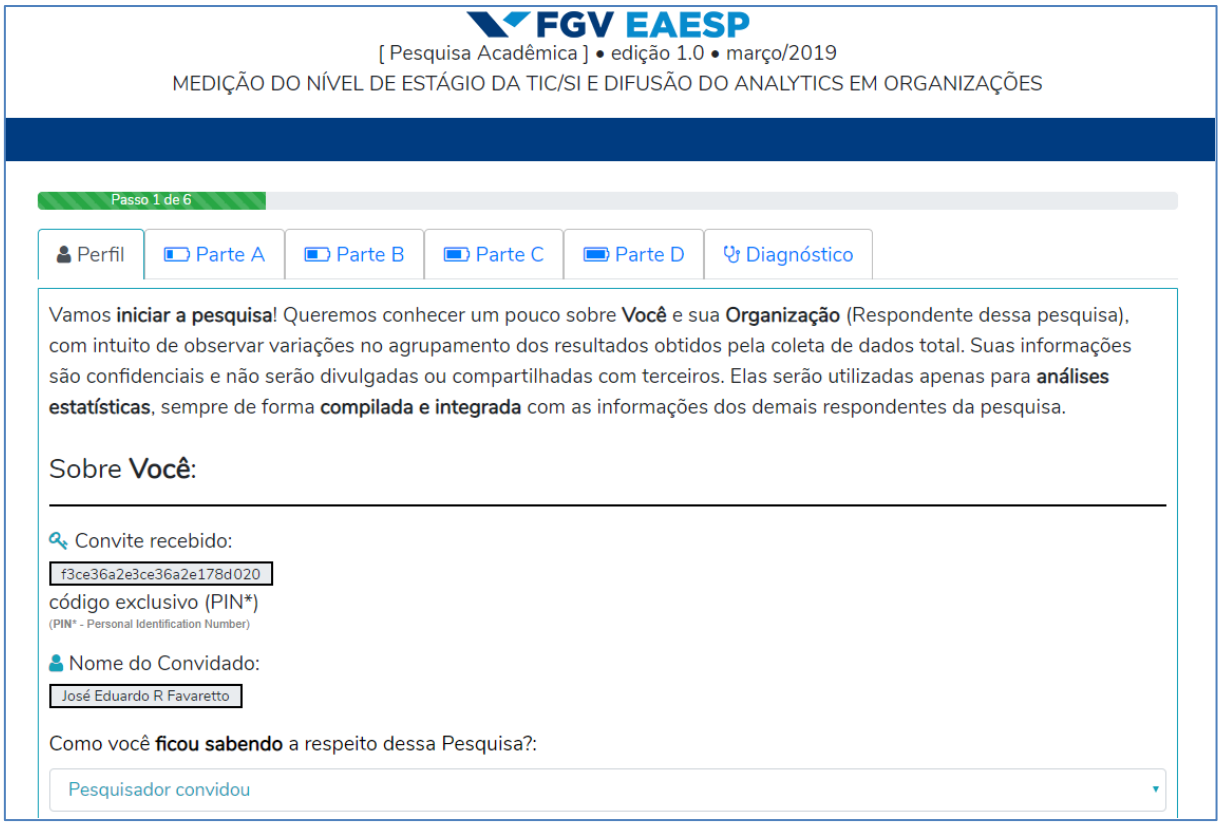
Start page – opening message boxbox



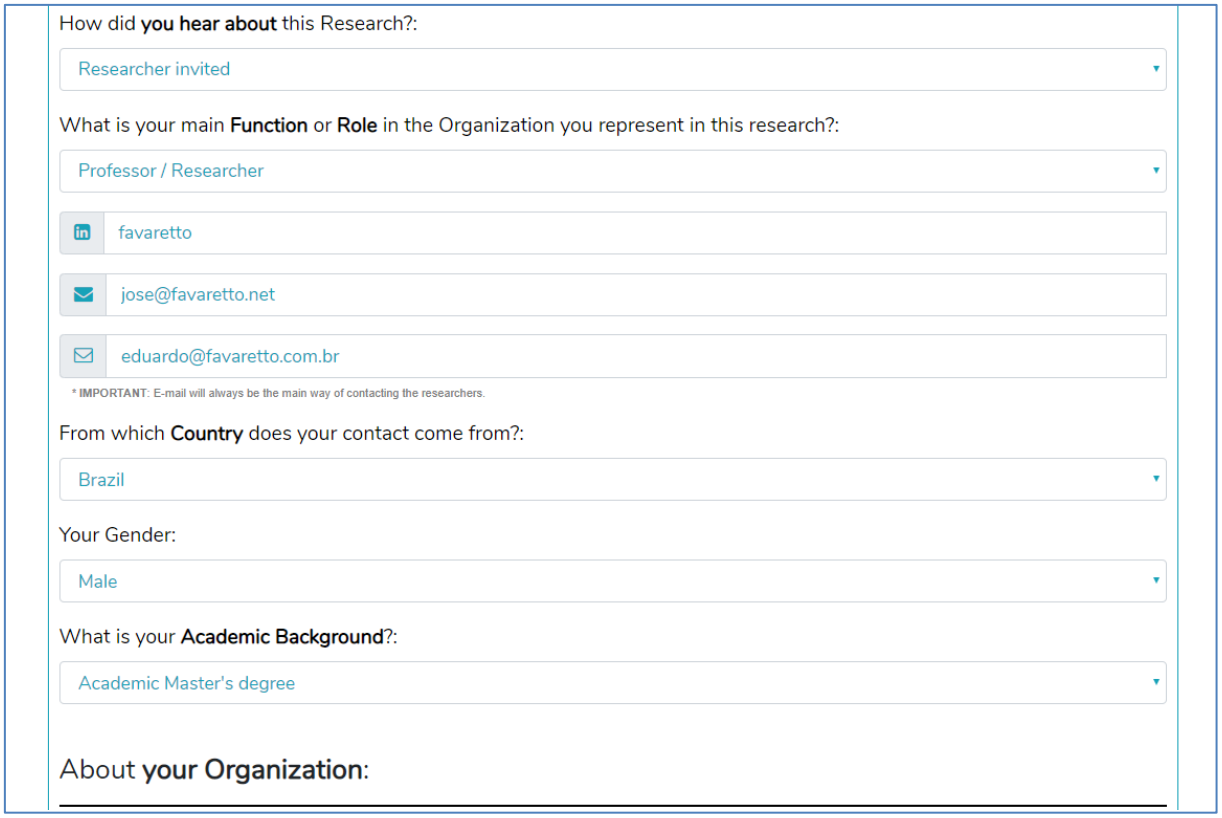


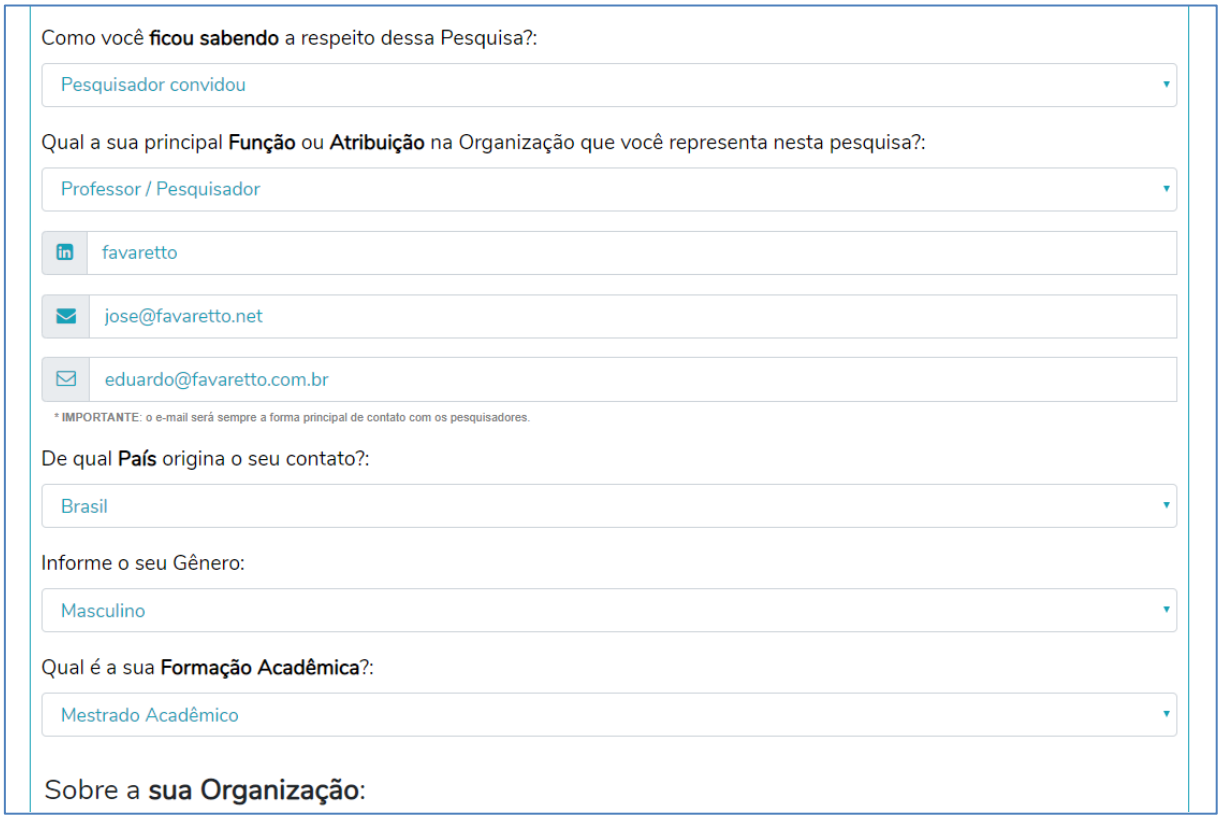
Profile #1/4 - First tab of the Survey Form (English and Portuguese)



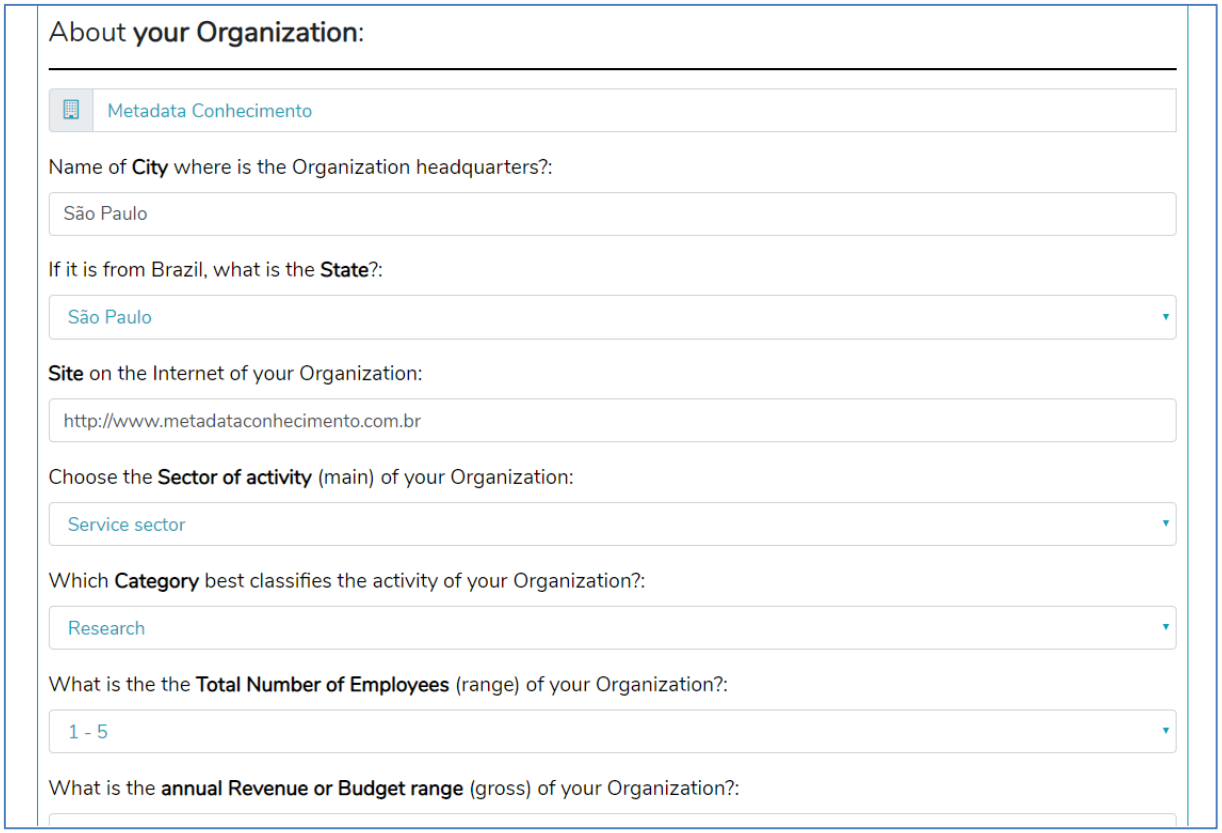


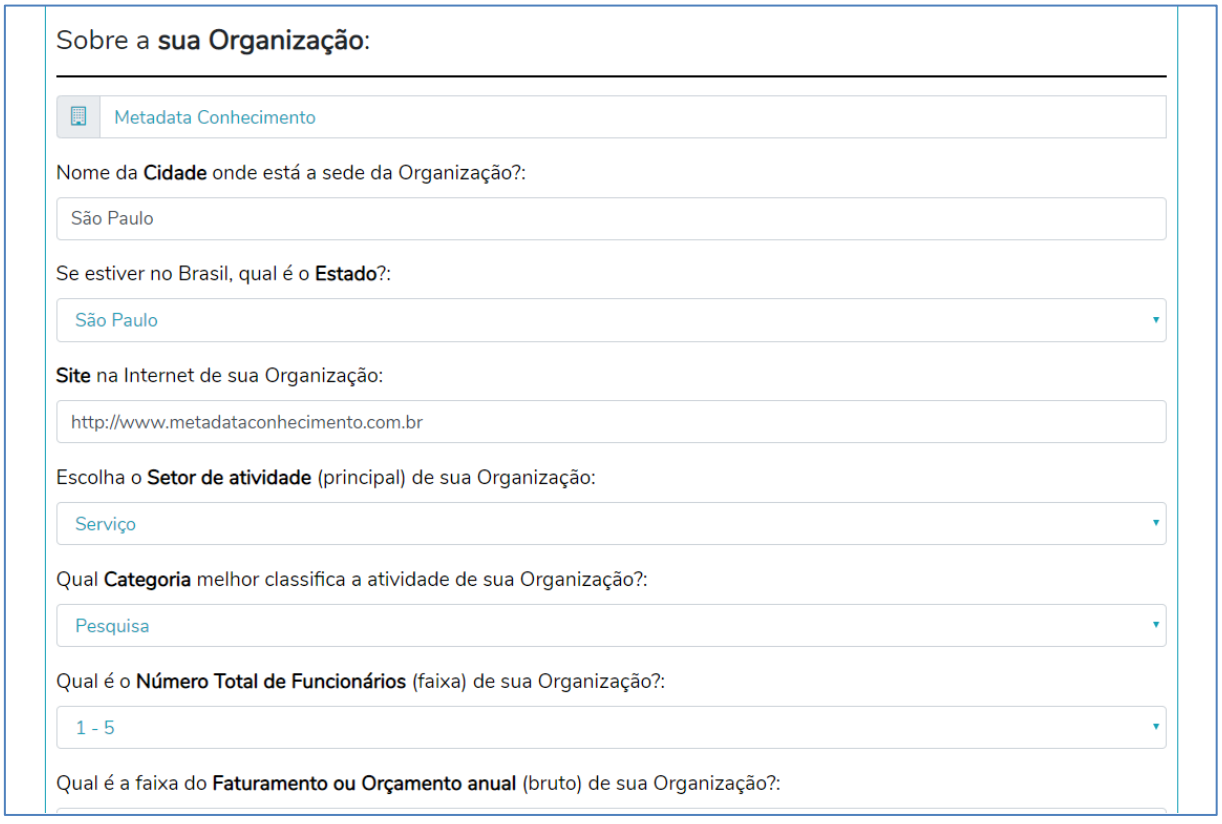
Profile #2/4 - First tab of the Survey Form (English and Portuguese)



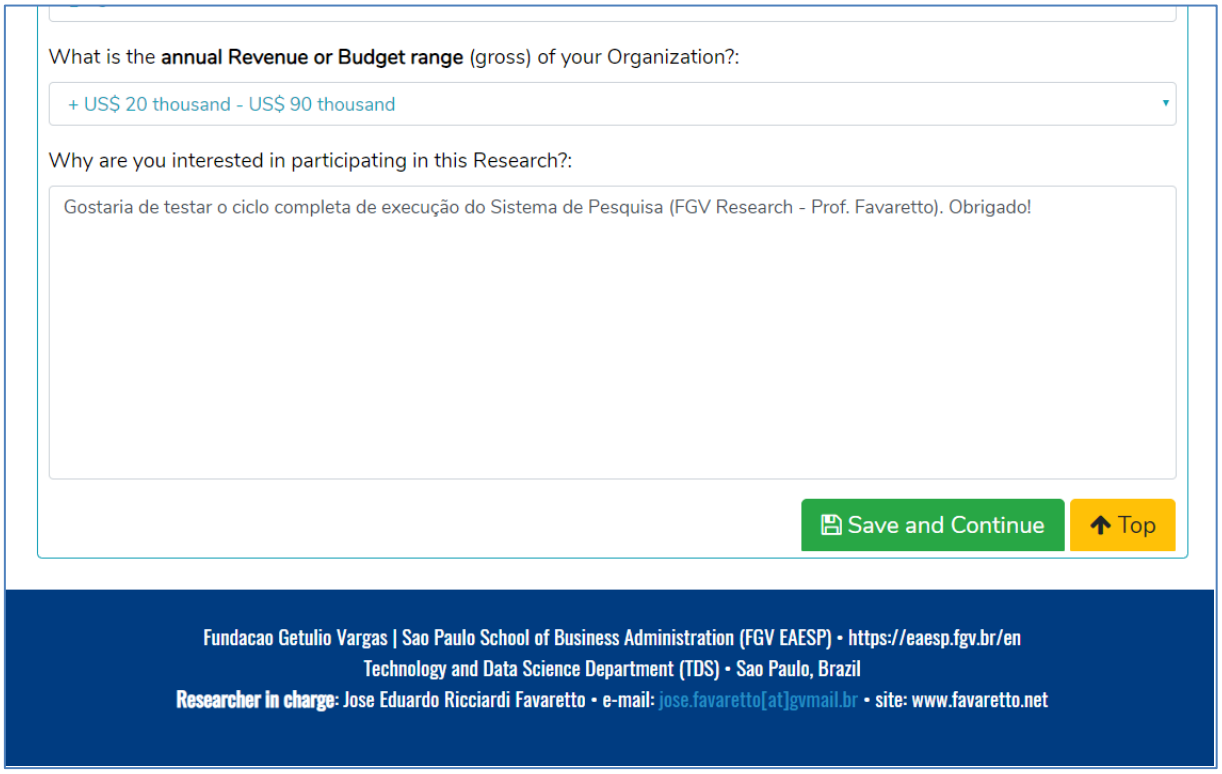


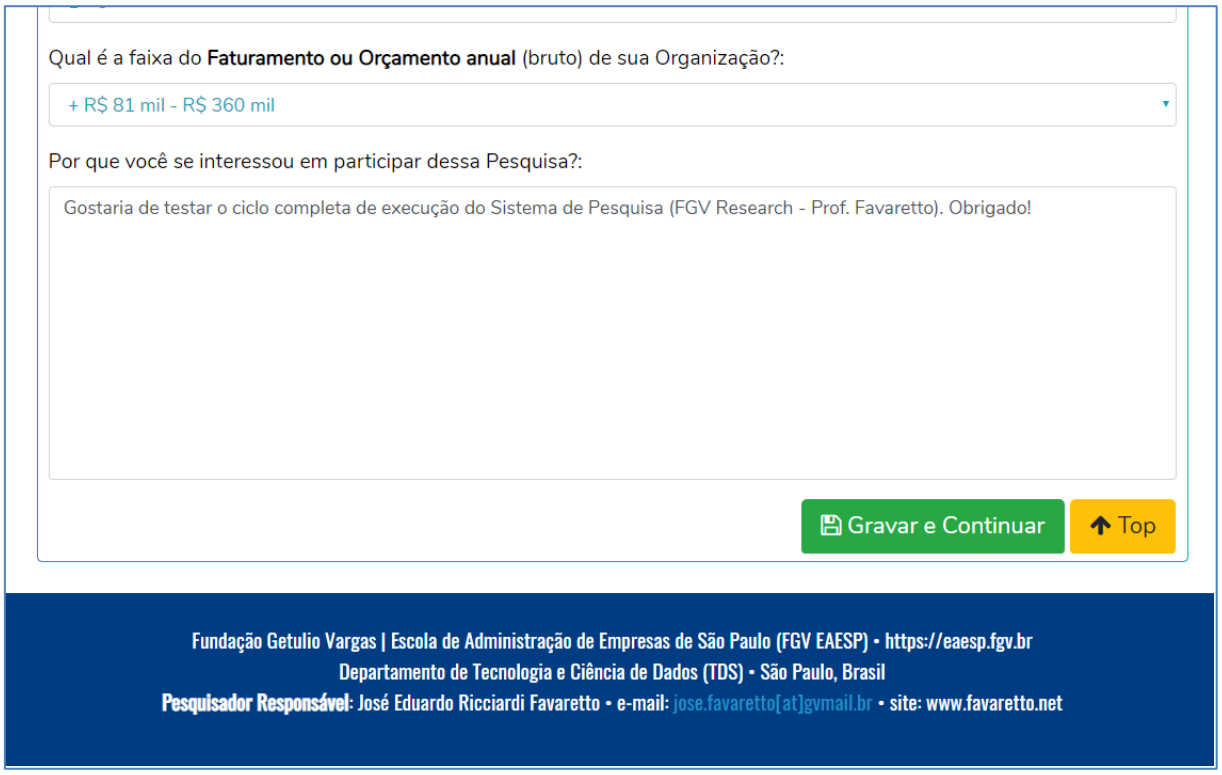
Profile #3/4 - First tab of the Survey Form (English and Portuguese)



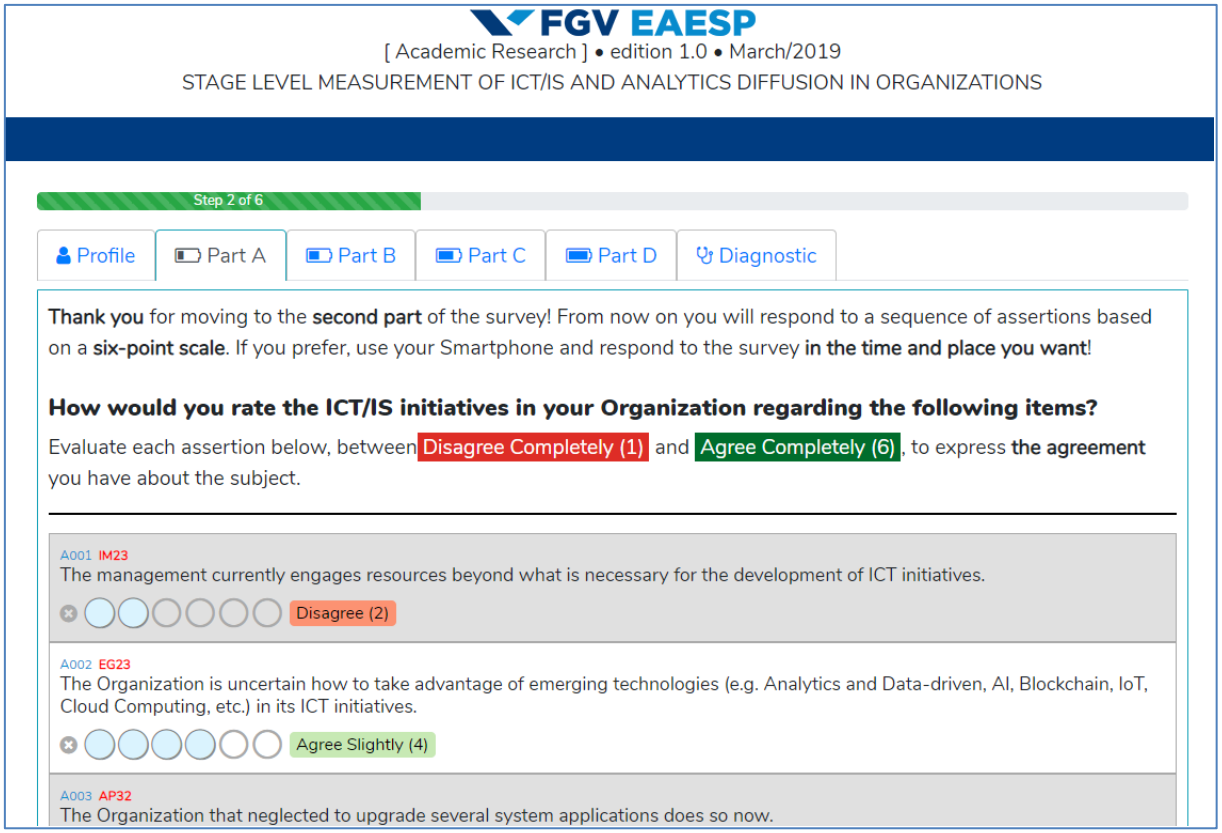


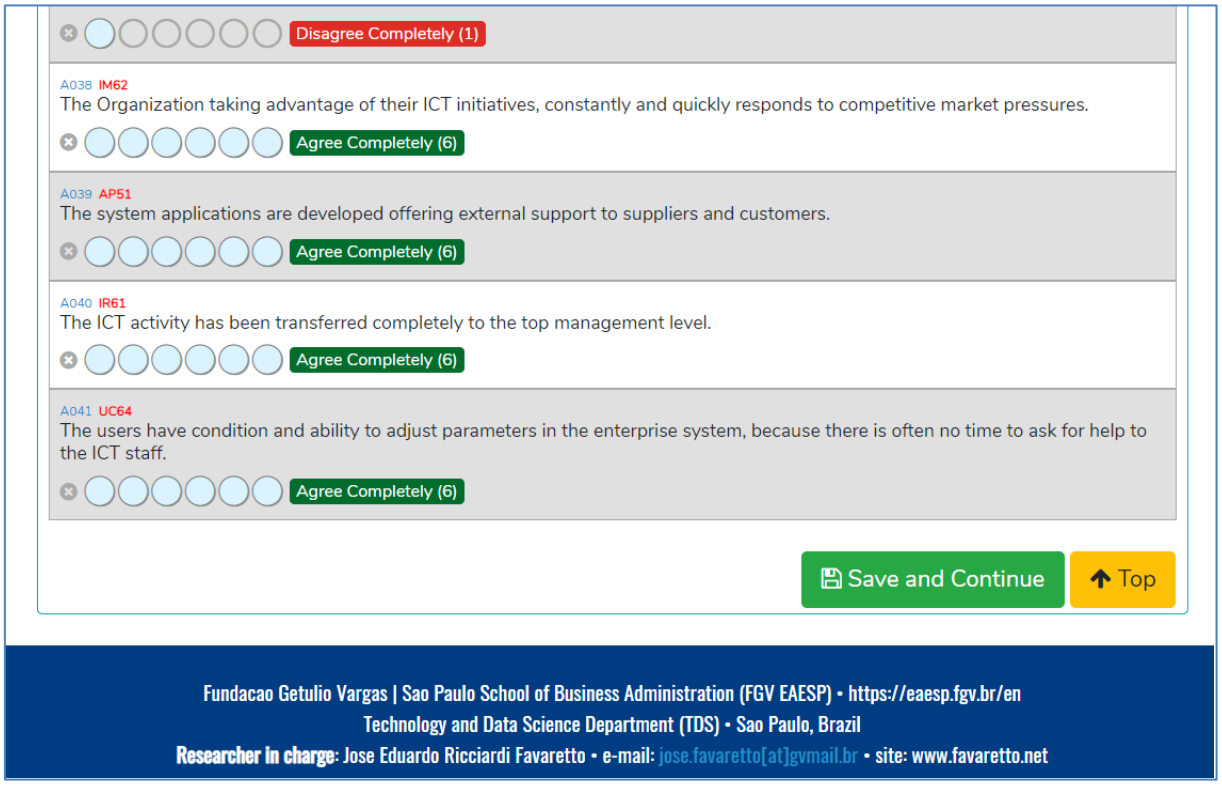
Profile #4/4 - First tab of the Survey Form (English and Portuguese)



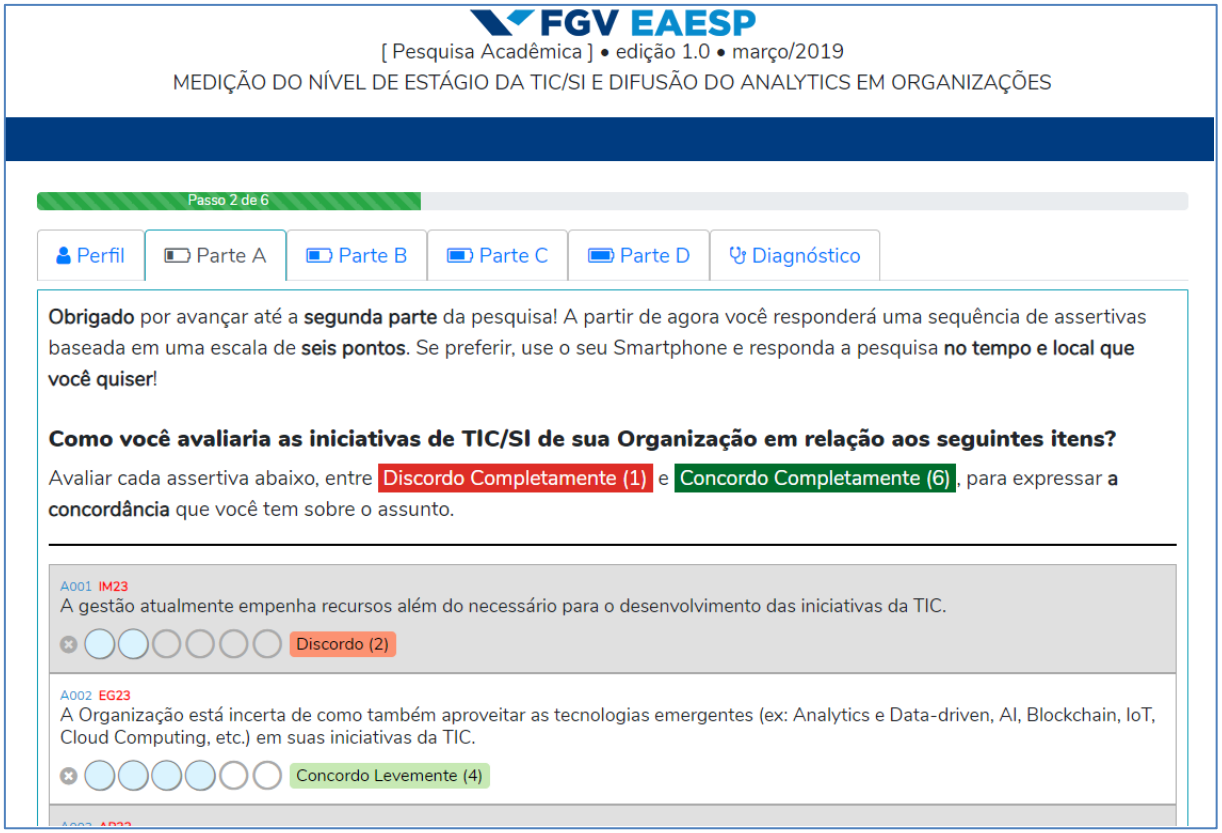


Part A (example, English version) - Second tab of the Survey Form with first 41 assertions

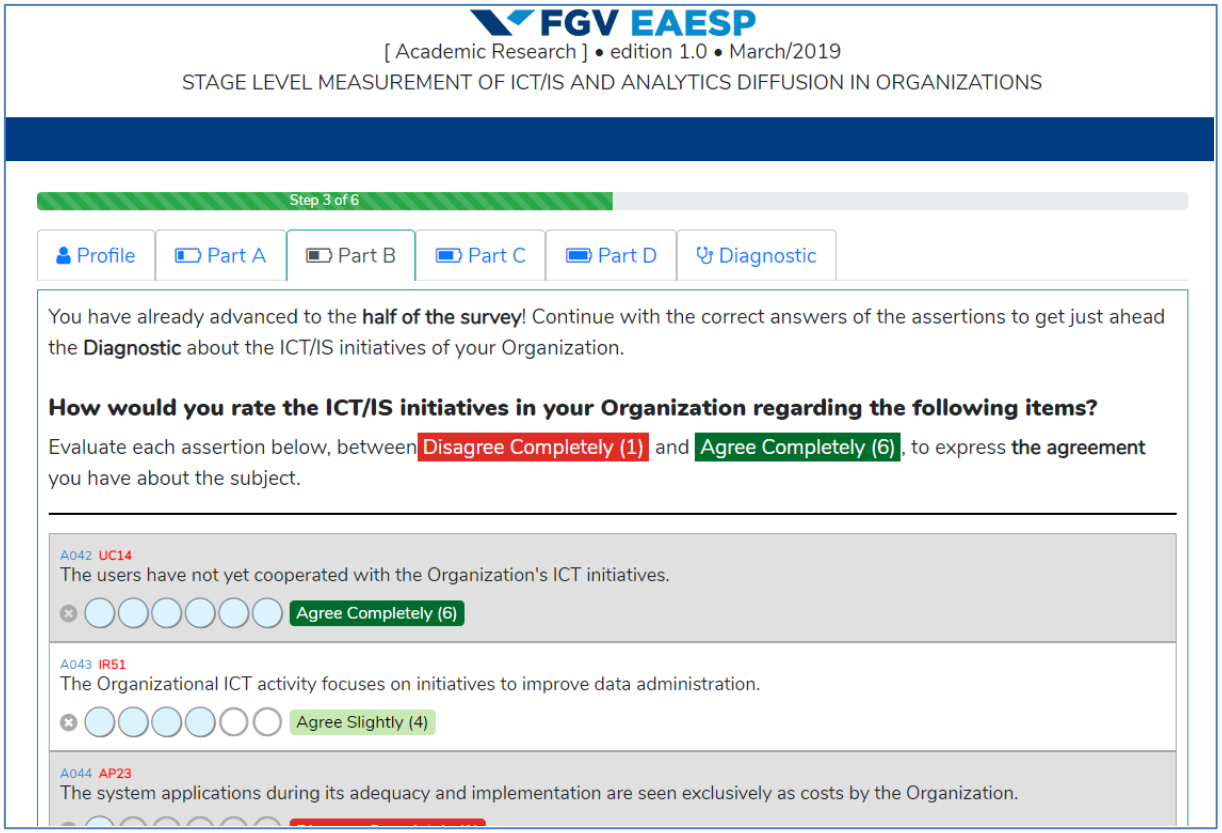


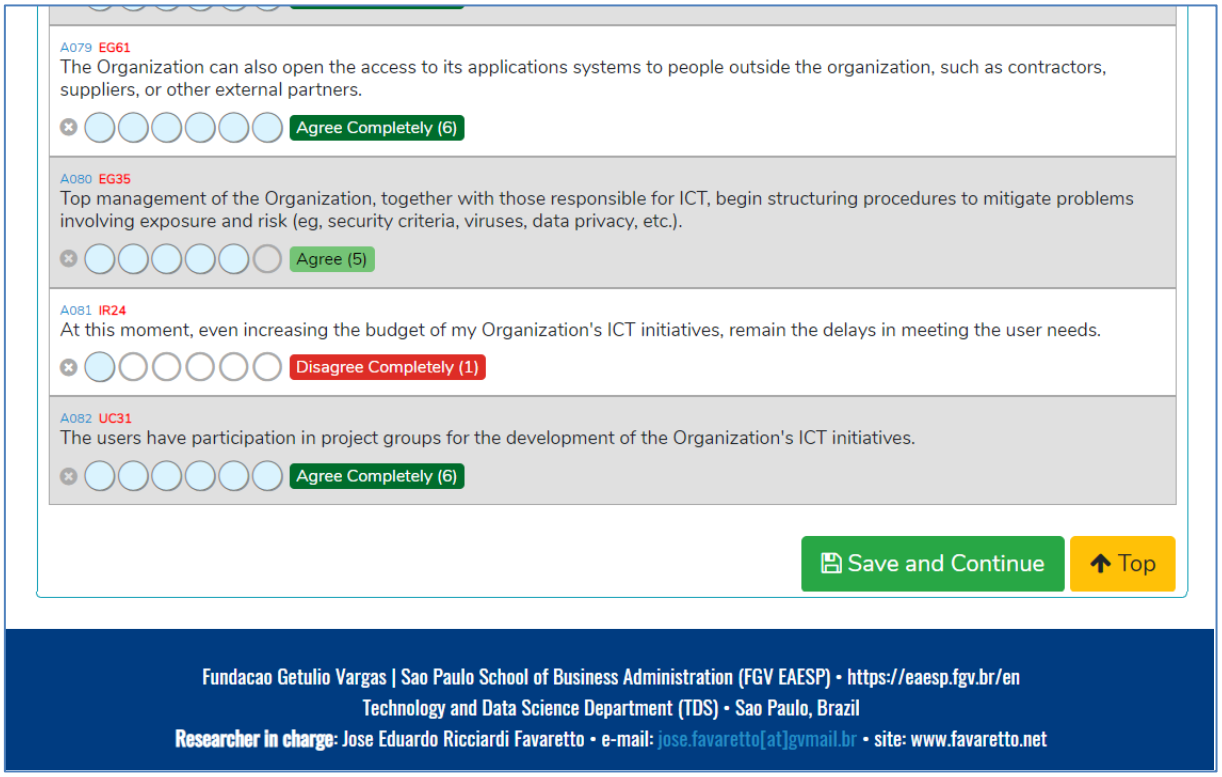


Part A (example, Portuguese version) - Second tab of the Survey Form with first 41 assertions

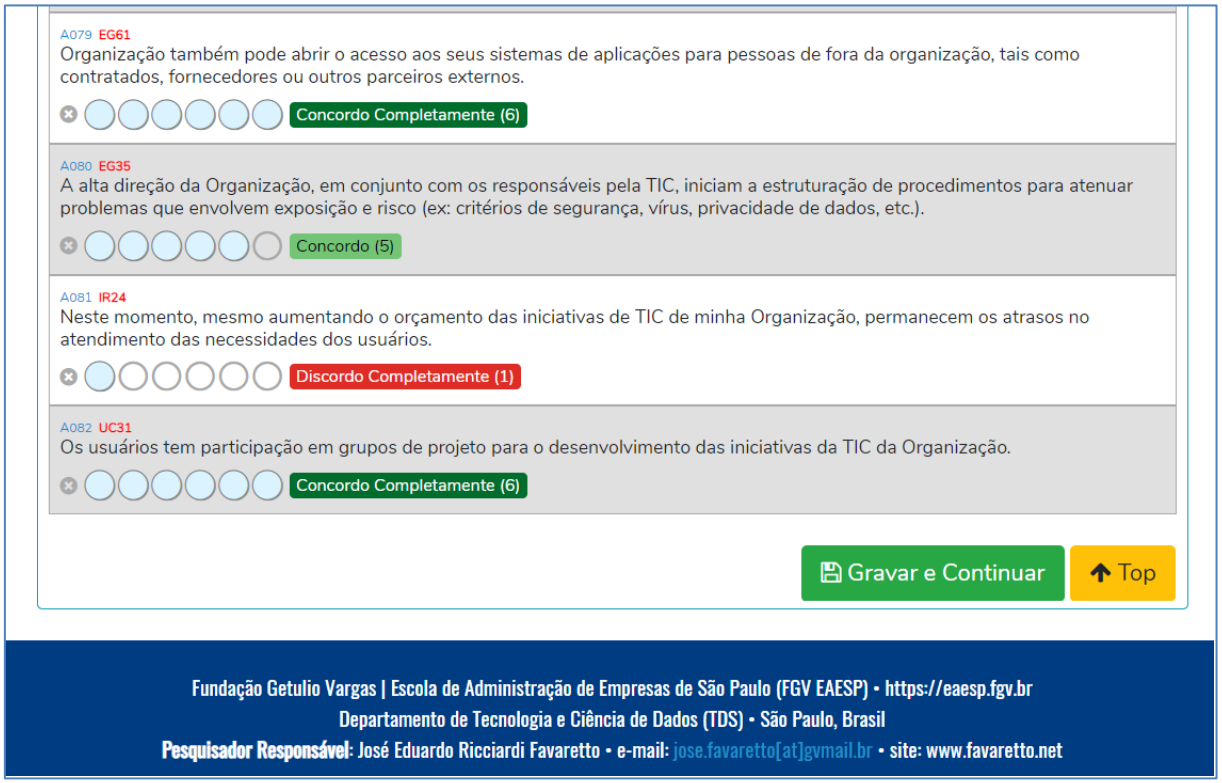


Part B (example, English version) - Third tab of the Survey Form with other 41 assertions

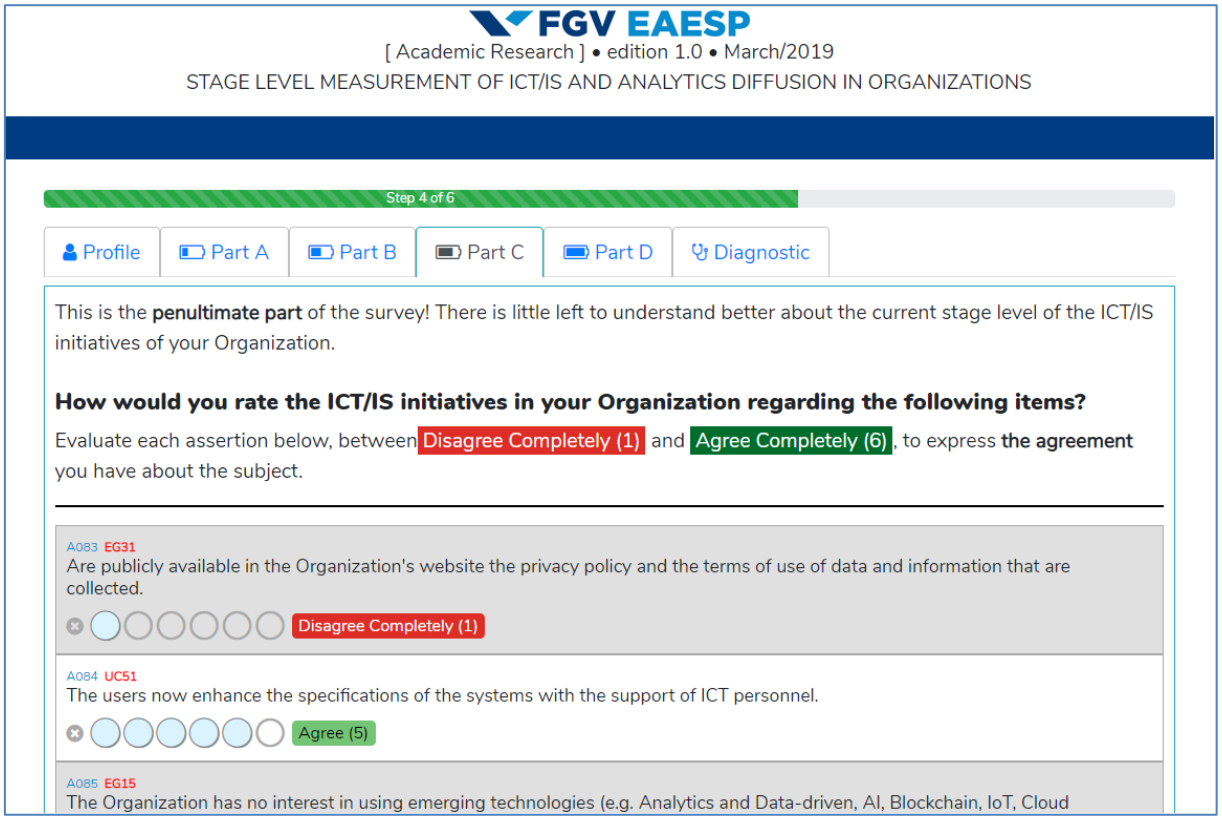


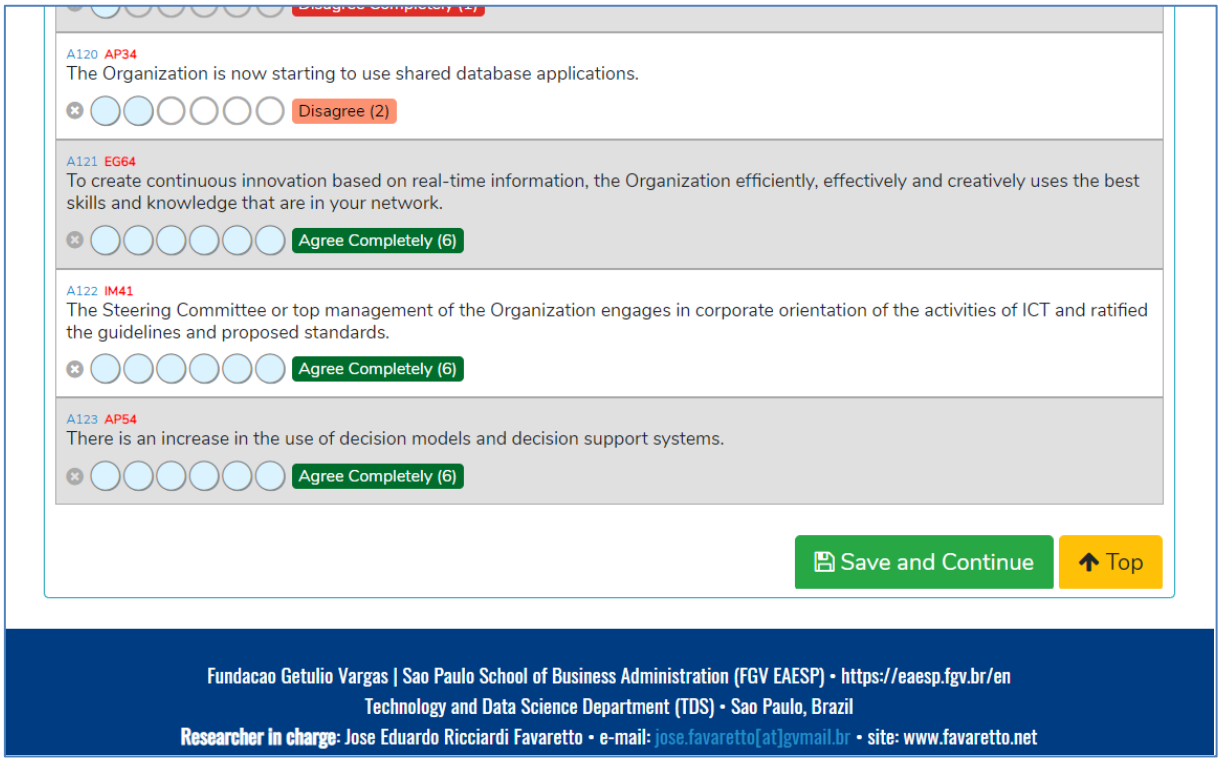


Part B (example, Portuguese version) - Third tab of the Survey Form with other 41 assertions

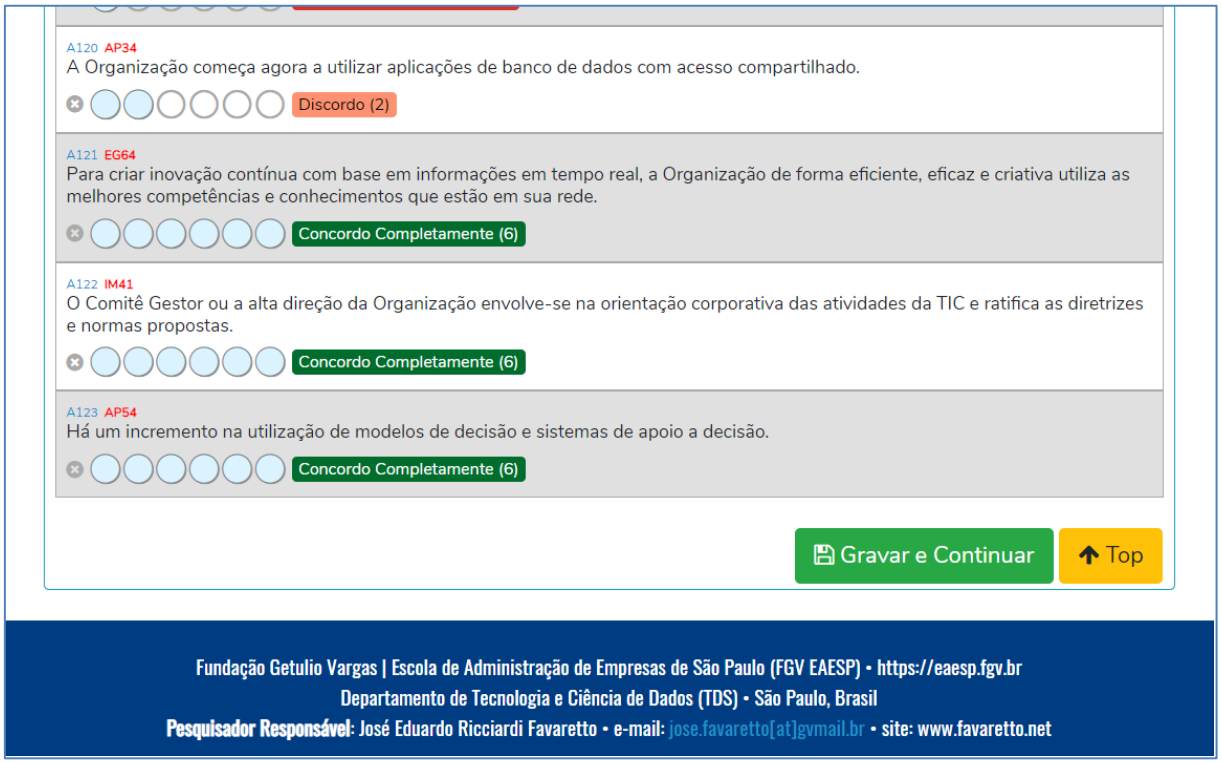


Part C (example, English version) – Fourth tab of the Survey Form with the last 41 assertions to measure the Stage Level of ICT/IS in Organizations (total of 123 assertions)

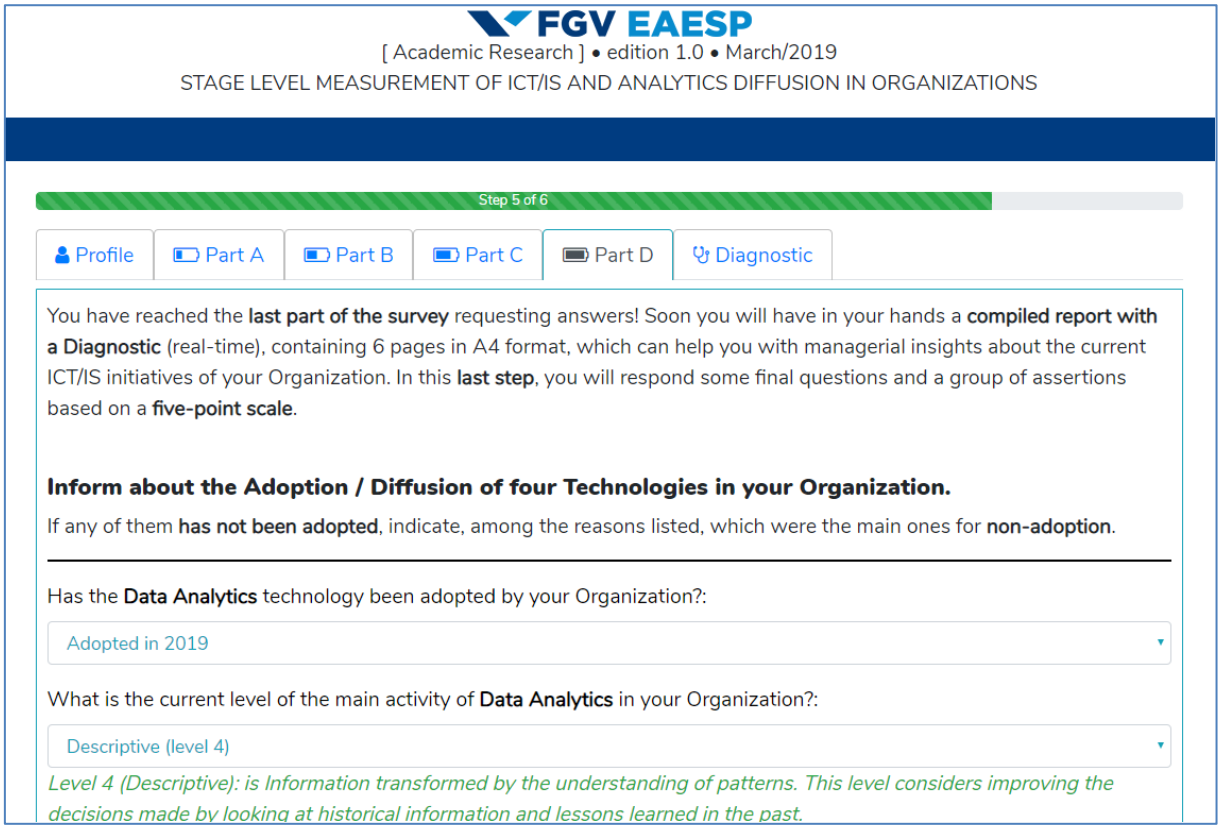


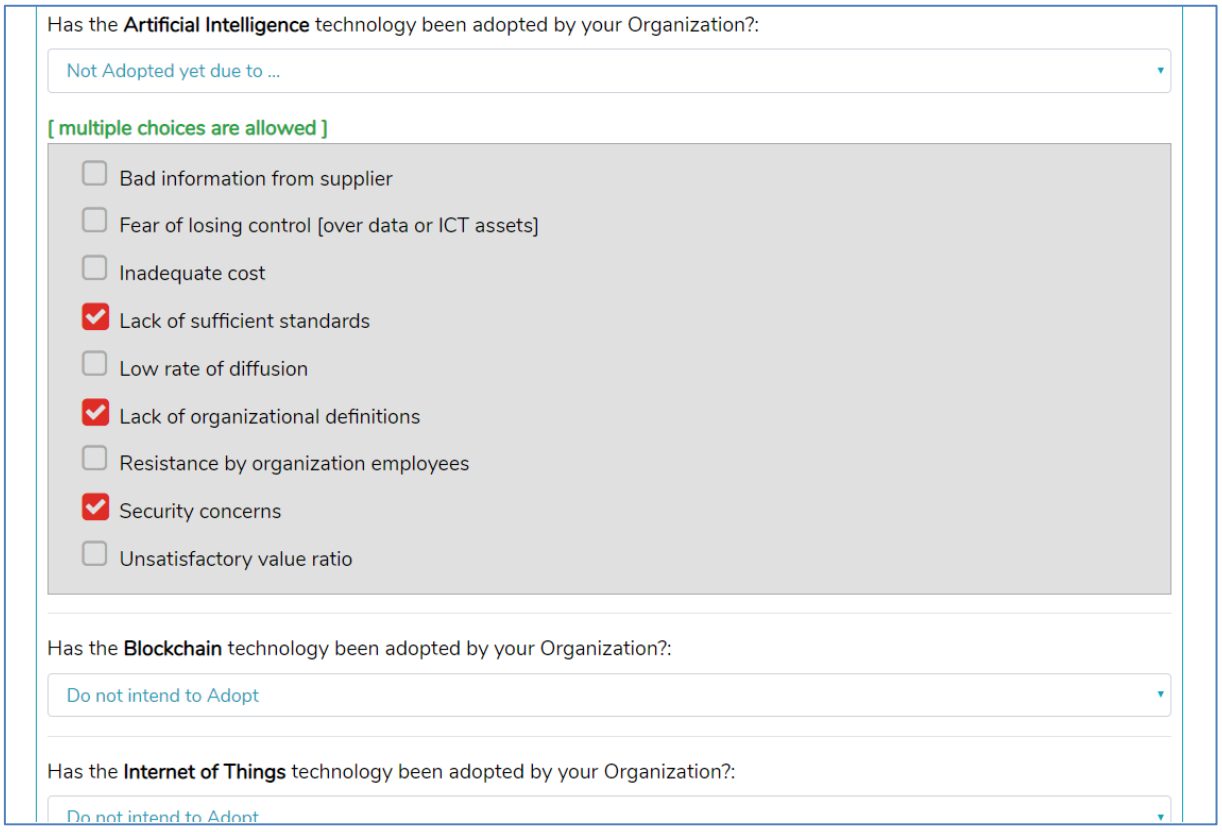


Part C (example, Portuguese version) – Fourth tab of the Survey Form with the last 41 assertions to measure the Stage Level of ICT/IS in Organizations (total of 123 assertions)

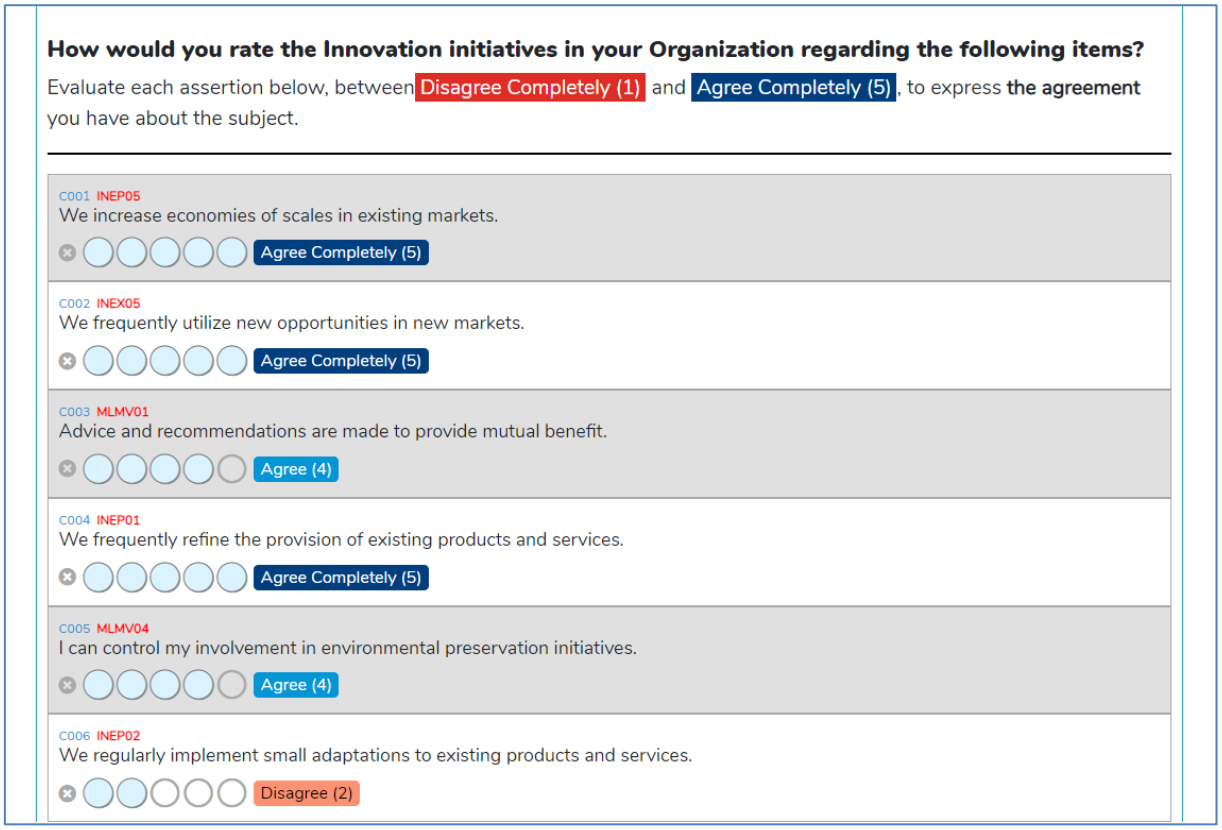


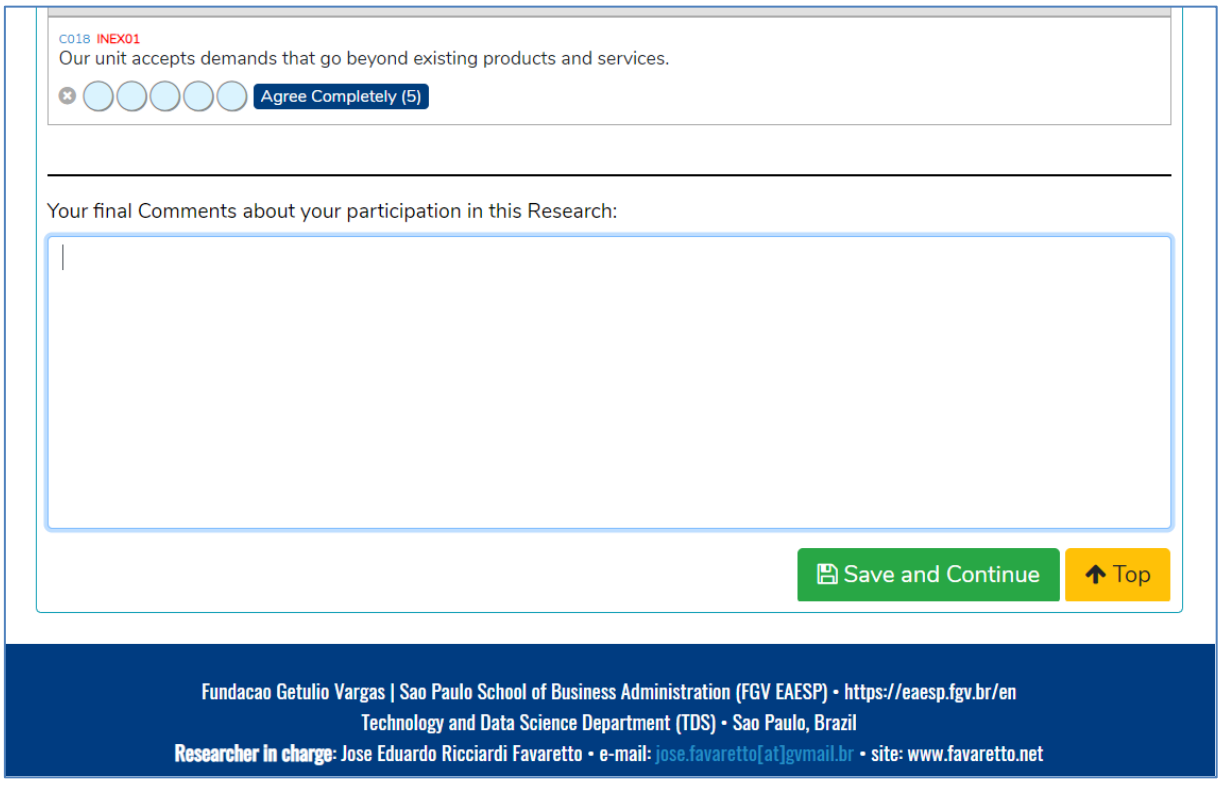
Part D first block (English version) – Fifth tab of the Survey Form with questions about Adoption / Diffusion of Data Analytics in Organization



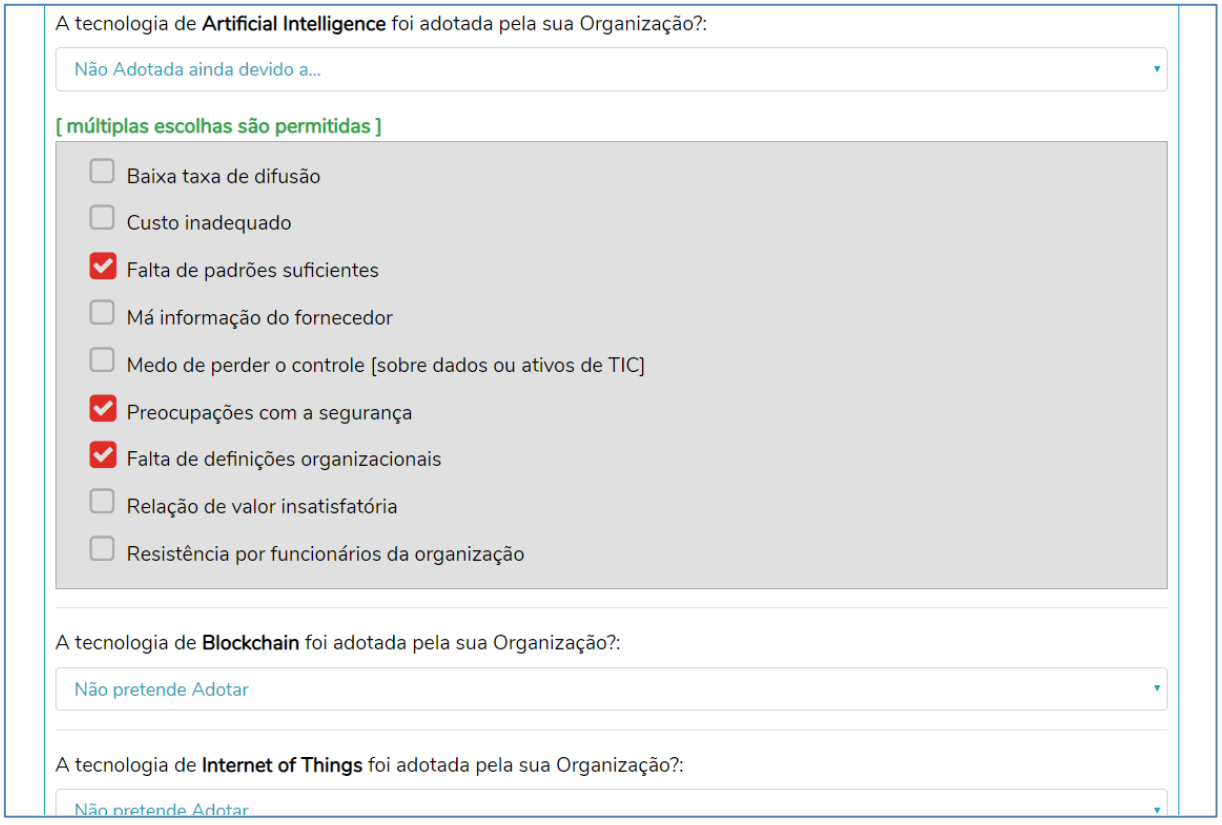


Part D second block (English version) – Fifth tab of the Survey Form, with 18 assertions of Innovation (Exploration and Exploitation scale) and 6 assertions of the MLMV variable

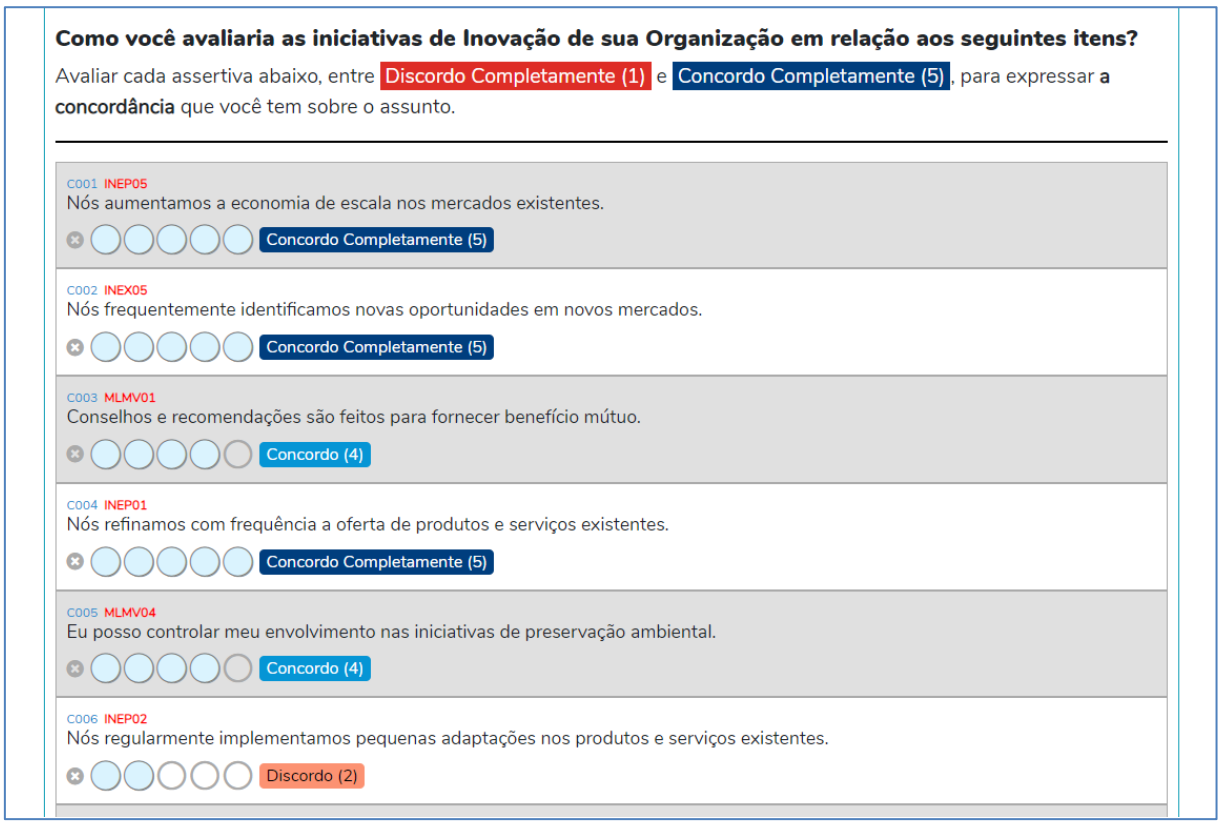


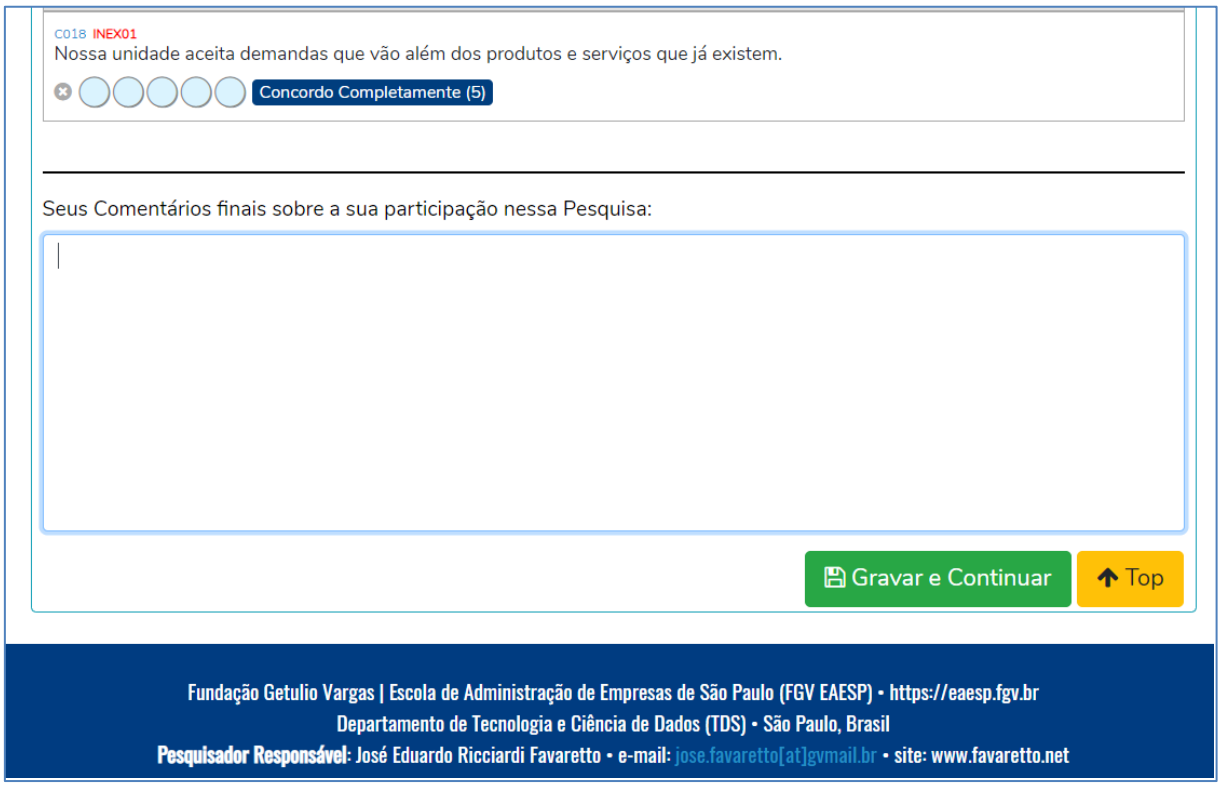


Part D first block (Portuguese version) – Fifth tab of the Survey Form with questions about Adoption / Diffusion of Data Analytics in Organization

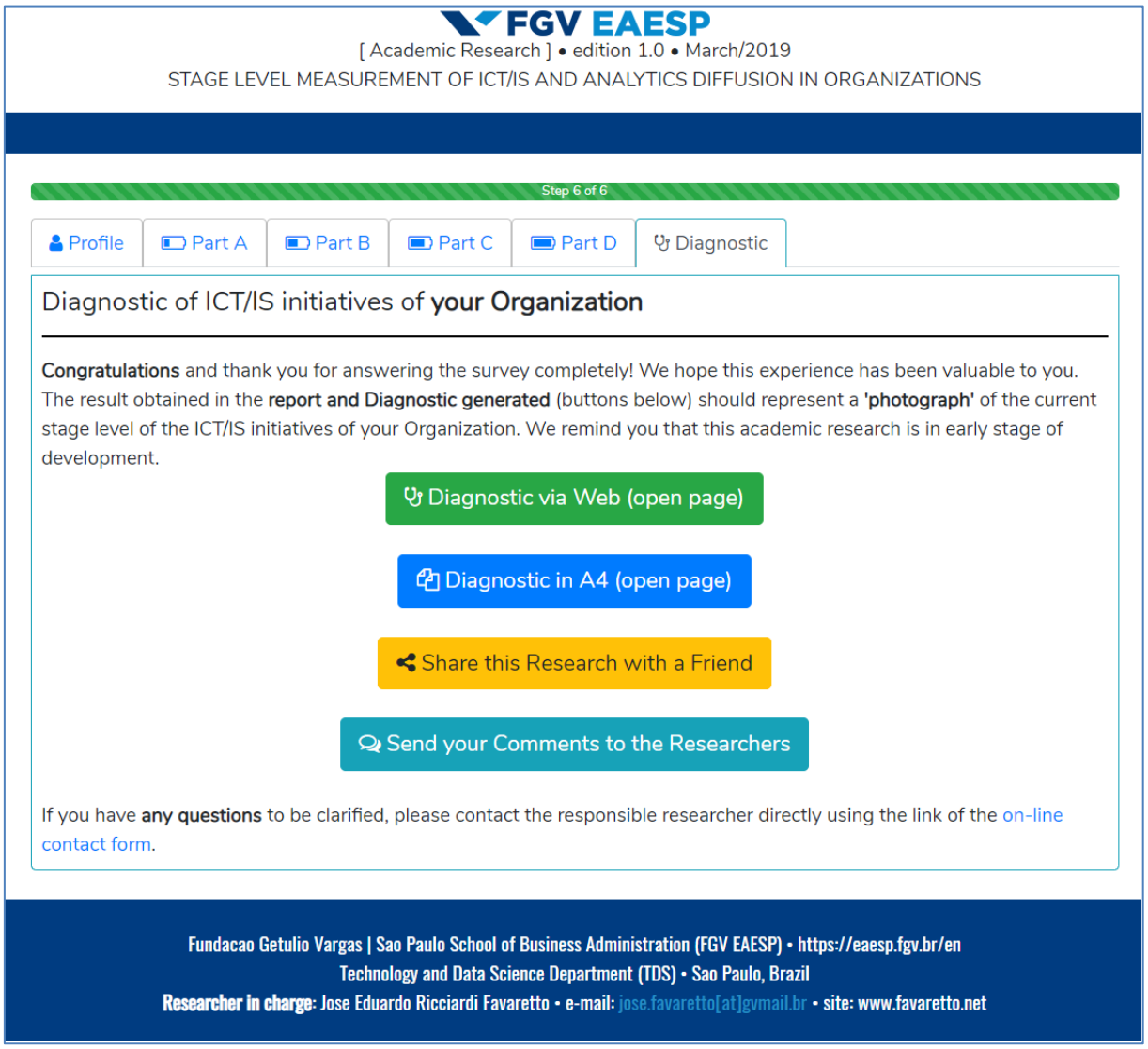


Part D second block (Portuguese version) – Fifth tab of the Survey Form, with 18 assertions of Innovation (Exploration and Exploitation scale)





Sixth and last tab of the Survey Form (English version) – Displays 4 access buttons to generate the Report and Diagnostic, to share the research on social media or to get in touch with the main researcher



Sixth and last tab of the Survey Form (Portuguese version) – Displays 4 access buttons to generate the Report and Diagnostic, to share the research on social media or to get in touch with the main researcher

Appendix E – Diagnostic and Report (English version) about the Stage Level of ICT/IS in Organizations

page #1/6 (English version) - pages of Report and Diagnostic as an example

FGV EAESP

[Academic Research] • edition 1.0 • March/2019

STAGE LEVEL MEASUREMENT OF ICT/IS AND ANALYTICS DIFFUSION IN ORGANIZATIONS

Introduction - Report and Diagnostic on the ICT/IS* Organizational Stage Level

This report and diagnostic measures the Stage Levels of Information and Communication Technology initiatives (ICT/IS*) in your Organization, based on academic studies (Favaretto, 2015; Favaretto & Meirelles, 2015), and supported by the Stages of Growth Theory, native to the study field of Management Information Systems (MIS) (Nolan, 1973, 1979).

Important Notice: The use of this Report and Diagnostic is part of an empirical academic study (in progress), in which you and your Organization were invited to participate spontaneously. No implicit or explicit warranty is given in these results.

Organization ID: [redacted] **Organization Name:** [redacted]

Exclusive use of: José Eduardo R Favaretto **Invitation PIN:** [redacted]

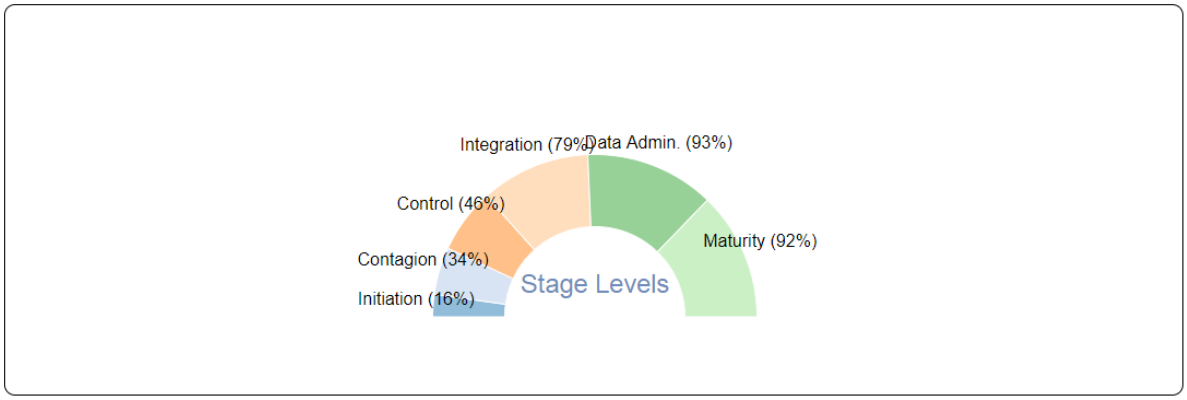
Diagnostic issued on April [redacted] from IP number 189.38.214.112 .

* ICT/IS = Information and Communication Technology / Information Systems

Level (%)	Stage with highest Level	Level marking
93%	Stage V (Data Admin.)	Very High

The Organization informs that the Stage with highest Level is the Stage V (Data Admin.), with Level marking of 93% (Very

About the 'level meter' of Stages of Growth.



The 'level meter' image shows how the five Growth Processes of your Organization's ICT/IS* initiatives are currently integrated into each of the six Stages of Growth Levels, obtained by measuring the assertions of the scale used in the Survey.

Section 1 - Stages of Growth Levels

The Organization reports that its highest level is in the Stage V (Data Admin.), with 93% of level, and its lower level is in the Stage I (Initiation), with 16% of level.

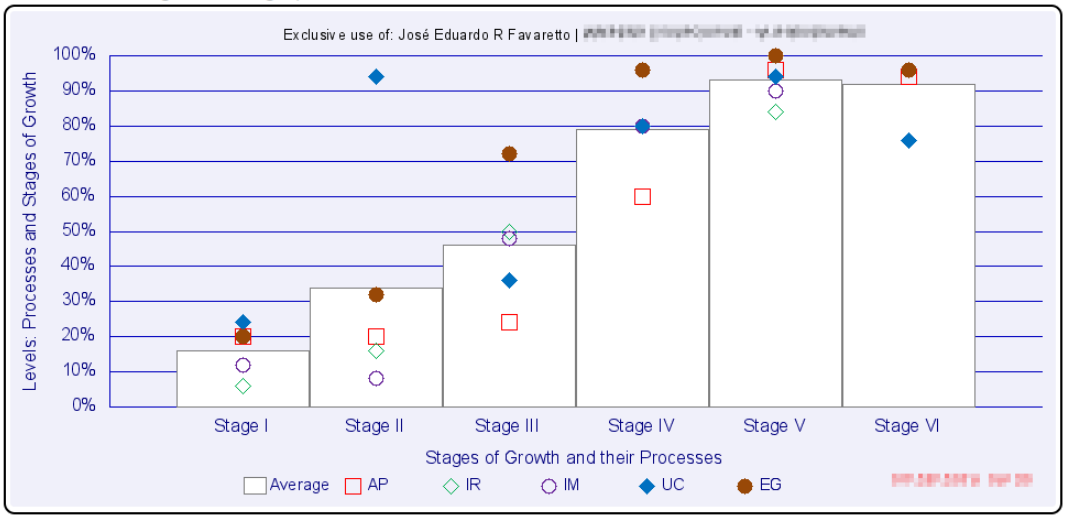
About the Stages Levels graph.

page #2/6 (English version) - pages of Report and Diagnostic as an example

Section 1 - Stages of Growth Levels

The Organization reports that its highest level is in the Stage V (Data Admin.), with 93% of level, and its lower level is in the Stage I (Initiation), with 16% of level.

About the Stages Levels graph.



About the table of the Average Levels of Stages and Processes.

Stages of Growth	Your Avg. Level (%)	AP Level (%)	IR Level (%)	IM Level (%)	UC Level (%)	EG Level (%)
I	16	20	6	12	24	20
II	34	20	16	8	94	32
III	46	24	50	48	36	72
IV	79	60	80	80	80	96
V	93	96	84	90	94	100
VI	92	94	96	96	76	96

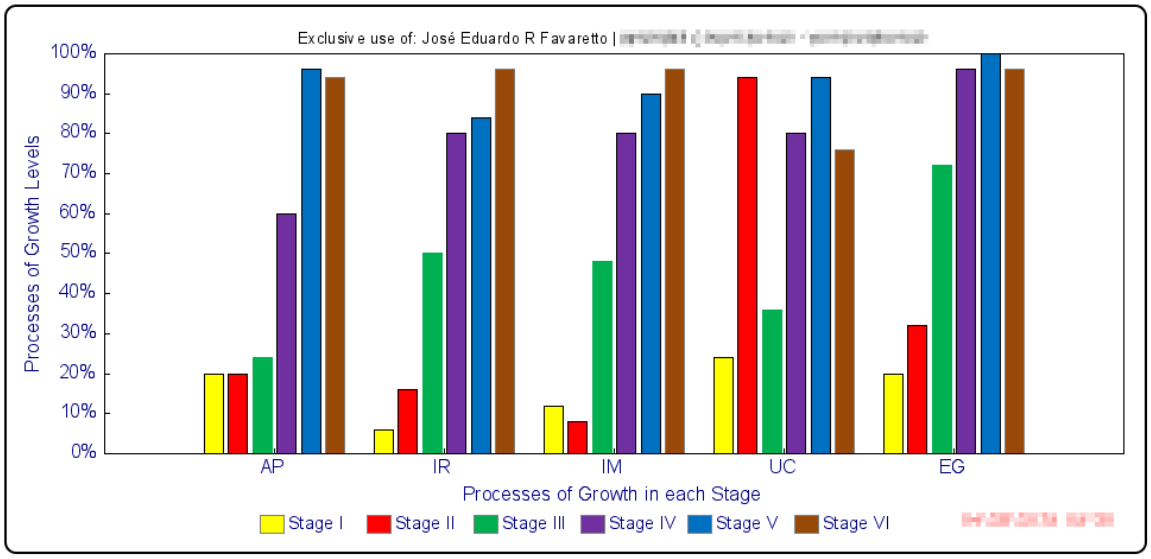
In the second column of the Table are reported the Average values of the Levels of the 5 Growth Processes (integrated), for each of the 6 Stages of Growth. In the following columns, the Average Levels (individual) of each Growth Process (AP, IR, IM, UC e EG), for each of the Stages (I, II, III, IV, V, VI).

page #3/6 (English version) - pages of Report and Diagnostic as an example

Section 2 - Growth Processes Levels

The Organization Growth Process with lower level is the IR with 6% of level, in Stage I (Initiation).

About the Processes Levels graph.



About the Growth Processes with lower Levels.

Types of Processes	Markings / Levels of Processes	Processes with lower Levels (%) according to the Stage
AP	Very Low	**20%** Stage I (Initiation)
IR	Very Low	**6%** Stage I (Initiation)
IM	Very Low	**8%** Stage II (Contagion)
UC	Low	**24%** Stage I (Initiation)
EG	Very Low	**20%** Stage I (Initiation)

page #4/6 (English version) - pages of Report and Diagnostic as an example

Section 3 - Processes that affect the current Stage Levels

Below are reported two assertions about the initiatives of ICT/IS* (among the other assertions of this Research), which influenced the current stage levels of your Organization.

About the current Stage Levels of the Organization's ICT/IS* initiatives.

Stage I	• The users have not yet cooperated with the Organization's ICT initiatives. (UC14=6) • The Organization has no interest in using emerging technologies (e.g. Analytics and Data-driven, AI, Blockchain, IoT, Cloud Computing, etc.) in their ICT initiatives. (EG15=6)	**Level 16%**
Stage II	• The Organization users are enthusiastic to initiate their involvement in the ICT initiatives. (UC22=6) • Satisfy the demand requested by users is the priority of the Organization with its ICT initiatives. (UC23=6)	**Level 34%**
Stage III	• The top management and the ICT manager of my Organization at this time directly interfere with the pace of organizational learning. (IR32=6) • The users have participation in project groups for the development of the Organization's ICT initiatives. (UC31=6)	**Level 46%**
Stage IV	• By focusing on a more data-oriented approach, the organization had to restructure their systems and the relationships between the various databases. (AP42=6) • The ICT activity delivers a service of high quality and reliability to the users of the organization. (IR43=6)	**Level 79%**
Stage V	• The system applications are developed offering external support to suppliers and customers. (AP51=6) • To expand the integration of applications and databases, my Organization is currently investing in sophisticated tools. (AP52=6)	**Level 93%**
Stage VI	• There are in the Organization high-quality information systems, flexible, integrated and constantly updated. (AP61=6) • The enterprise system is a top layer application "controlled" by parameters that allow to change its functionalities or workflow. (AP63=6)	**Level 92%**

Section 4 - Summarized Theoretical understanding on Stages and Processes

About this Stages of Growth table.

Types of Stages	Description of Stages of Growth
Initiation	**Stage I** = Characterized by limited investment and contained experimentation for proving the value of the technology in the organization. ICT/IS personnel are learning regarding the new technology. There is no clear direction for the organization's ICT/IS initiatives.

page #5/6 (English version) - pages of Report and Diagnostic as an example

About this Stages of Growth table.

Types of Stages	Description of Stages of Growth
Initiation	**Stage I** = Characterized by limited investment and contained experimentation for proving the value of the technology in the organization. ICT/IS personnel are learning regarding the new technology. There is no clear direction for the organization's ICT/IS initiatives.
Contagion	**Stage II** = Also known as "Expansion" stage. A period of high learning in the organization whereby the technology proliferated in a relatively uncontrolled manner. ICT/IS initiatives are increasingly considered to be an important component of the organization's business.
Control	**Stage III** = Also known as "Formalization" stage. Management reacts to impose controls on the ICT/IS initiatives and to discipline related costs. Due to the growing use of automation activities, they are considered an important component of the organization's business.
Integration	**Stage IV** = The accumulated learning led to a balance of managed controls and growth. Organization dominates certain current technologies, providing a foundation to introduce the next order of magnitude of progress, seeking new improvements.
Data Admin.	**Stage V** = Integration between traditional business processes and activities and the ICT/IS initiatives, create seamless communication and the flow of processes within the organization. ICT/IS initiatives aim to provide strategic benefits by building strategic systems.
Maturity	**Stage VI** = ICT/IS initiatives are deeply embedded throughout every aspect of the organization. There is a strong integration between the ICT/IS processes and business processes within the organization as well as with those of its suppliers and business partners.

About the markings and level ranges.

Very Low	Low	Medium	High	Very High
up to 20%	from 21% to 40%	from 41% to 60%	from 61% to 80%	more than 80%

About this Growth Processes table.

Types of Processes	Description of Growth Processes
AP	**Applications Portfolio** = The existing base of information systems that support the business functions. The set of applications which the information systems must support. For example: financial planning, order processing, on-line customer enquiries.
IR	**ICT/IS Resources** = The resources (staff and technology) providing the organization with the ways (means) to use and apply ICT/IS initiatives in the business. Involves the position of the ICT/IS unit in the organizational chart, its areas of activities (technical services, databases for queries, maintenance, etc.), the skills and relevant knowledge of the ICT personnel.
IM	**ICT/IS Management** = The instruments, procedures and controls that management uses to facilitate effective and efficient use and provision of ICT/IS activities (i.e, its practices). For example: level of control, formalization

page #6/6 (English version) - pages of Report and Diagnostic as an example

About this Growth Processes table.

Types of Processes	Description of Growth Processes
AP	**Applications Portfolio** = The existing base of information systems that support the business functions. The set of applications which the information systems must support. For example: financial planning, order processing, on-line customer enquiries.
IR	**ICT/IS Resources** = The resources (staff and technology) providing the organization with the ways (means) to use and apply ICT/IS initiatives in the business. Involves the position of the ICT/IS unit in the organizational chart, its areas of activities (technical services, databases for queries, maintenance, etc.), the skills and relevant knowledge of the ICT personnel.
IM	**ICT/IS Management** = The instruments, procedures and controls that management uses to facilitate effective and efficient use and provision of ICT/IS activities (i.e, its practices). For example: level of control, formalization of planning process, management of projects, and extent of strategic plans.
UC	**User Community** = The ability of users to effectively apply ICT/IS initiatives to their work. This process represents the amplitude to which users (people in the organization using ICT/IS; users skills) develop an understanding and awareness of the opportunities and limitations of ICT/IS initiatives.
EG	**Emerging ICT/IS** = New and emerging ICT/IS influencers that will introduce, induce and promote organizational discontinuity regarding the new "Big Data Era". Connection full time, on-line databases, real-time messaging and transactions, data warehousing, cloud computing services, mobile technologies, the power of the social media/network sites, Analytics and Data-driven, Artificial Inteligence (AI), Blockchain, Internet of Things (IoT), etc. influencing popular use of different technologies by organizations and its users.

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Favaretto, J. E. R. (2015). *Stage Level Measurement of Information and Communication Technology in Organizations.* (Unpublished master's thesis). Fundacao Getulio Vargas, Sao Paulo School of Business Administration (FGV EAESP). Sao Paulo, Brazil. https://doi.org/10.13140/RG.2.2.16844.82562

Favaretto, J. E. R., & Meirelles, F. S. (2015). Nolan´s stage level measurement of Information and Communication Technology in modern organizations. In: *46th Annual Southwest Decision Sciences Institute (SWDSI) Conference*, pp.410-418. Houston, USA.

Nolan, R. L. (1973). Managing the computer resource: A stage hypothesis. *Communications of the ACM*, 16(7), 399-405. doi:10.1145/362280.362284

Nolan, R. L. (1979). Managing the Crises in Data Processing. *Harvard Business Review*, 57(2), 115–126.

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Technology and Data Science Department (TDS) • Sao Paulo, Brazil
Researcher in charge: Jose Eduardo Ricciardi Favaretto • e-mail: jose.favaretto[at]gvmail.br • site: www.favaretto.net

Appendix F – Diagnostic and Report (Portuguese version) about the Stage Level of ICT/IS in Organizations

page #1/6 (Portuguese version) – pages of Report and Diagnostic as an example

FGV EAESP

[Pesquisa Acadêmica] • edição 1.0 • março/2019

MEDIÇÃO DO NÍVEL DE ESTÁGIO DA TIC/SI E DIFUSÃO DO ANALYTICS EM ORGANIZAÇÕES

Apresentação - Relatório e Diagnóstico do Nível de Estágio da TIC/SI* Organizacional

Esse relatório e diagnóstico mensura os Níveis de Estágios das iniciativas da Tecnologia de Informação e Comunicação (TIC/SI*) em sua Organização, com base em estudos acadêmicos (Favaretto, 2015; Favaretto & Meirelles, 2015), e apoiados pela Teoria dos Estágios de Crescimento (Stages of Growth Theory), nativa do campo de estudos de Administração de Sistemas de Informação (ADI) (Nolan, 1973, 1979).

Aviso Importante: O uso deste Relatório e Diagnóstico é parte integrante de estudo acadêmico empírico (em andamento), no qual você e sua Organização foram convidados a participar de forma espontânea. Nenhuma garantia implícita ou explícita é oferecida nestes resultados.

ID da Organização: [redacted] **Nome da Organização:** [redacted]

Uso exclusivo de: José Eduardo R Favaretto **Convite PIN:** [redacted]

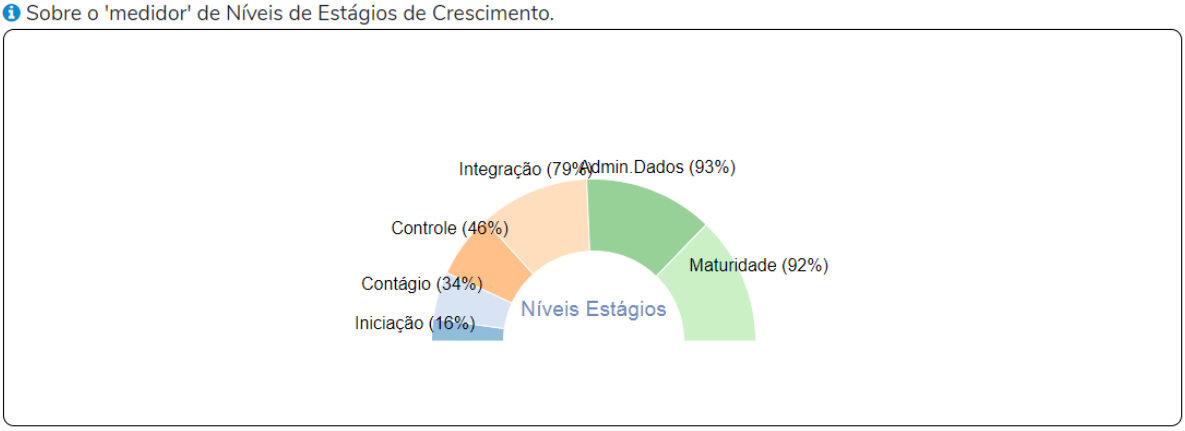
Diagnóstico emitido em [redacted] do número IP 189.38.214.112 .

* TIC/SI = Tecnologia de Informação e Comunicação / Sistemas de Informação

Nível (%)	Estágio com Nível mais alto	Marcação de Nível
93%	Estágio V (Admin.Dados)	Muito Alto

A Organização informa que o Estágio com Nível mais alto é o Estágio V (Admin.Dados), com Marcação de Nível de 93% (Muito Alto).

Sobre o 'medidor' de Níveis de Estágios de Crescimento.



A imagem do 'medidor de nível' informa como estão atualmente integrados todos os cinco Processos de Crescimento das iniciativas da TIC/SI* de sua Organização, em cada um dos seis Níveis de Estágios de Crescimento, obtidos através da mensuração das assertivas da escala utilizada na Pesquisa.

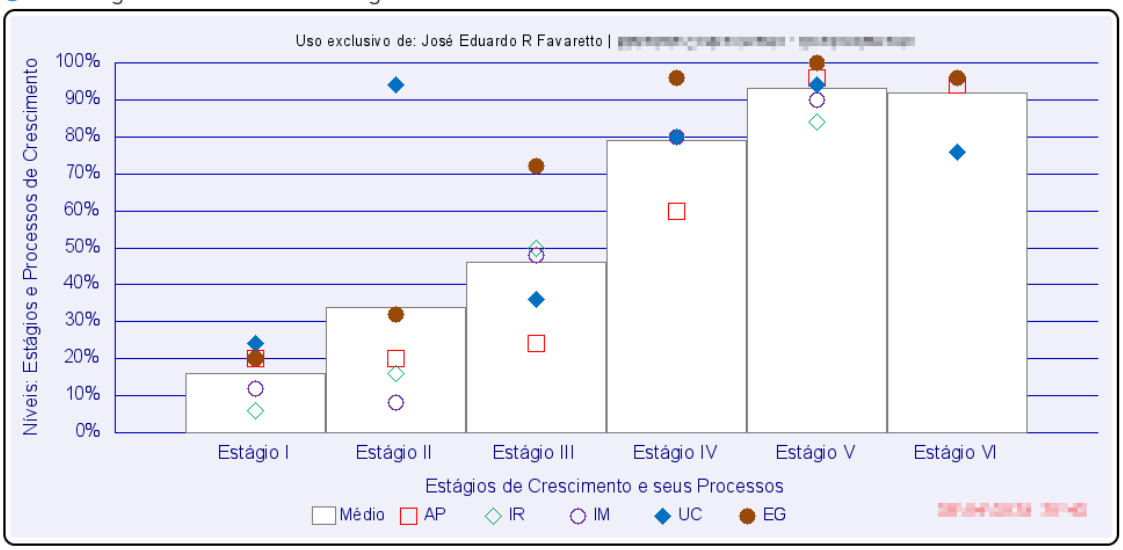
Seção 1 - Níveis de Estágios de Crescimento

page #2/6 (Portuguese version) - pages of Report and Diagnostic as an example

Seção 1 - Níveis de Estágios de Crescimento

A Organização reporta que seu maior nível é no Estágio V (Admin.Dados), com 93% de nível, e menor nível no Estágio I (Iniciação), com 16% de nível.

Sobre o gráfico dos Níveis de Estágios.



Sobre a tabela dos Níveis Médios dos Estágios e Processos.

Estágios de Crescimento	Seu Nível Médio (%)	AP Nível (%)	IR Nível (%)	IM Nível (%)	UC Nível (%)	EG Nível (%)
I	16	20	6	12	24	20
II	34	20	16	8	94	32
III	46	24	50	48	36	72
IV	79	60	80	80	80	96
V	93	96	84	90	94	100
VI	92	94	96	96	76	96

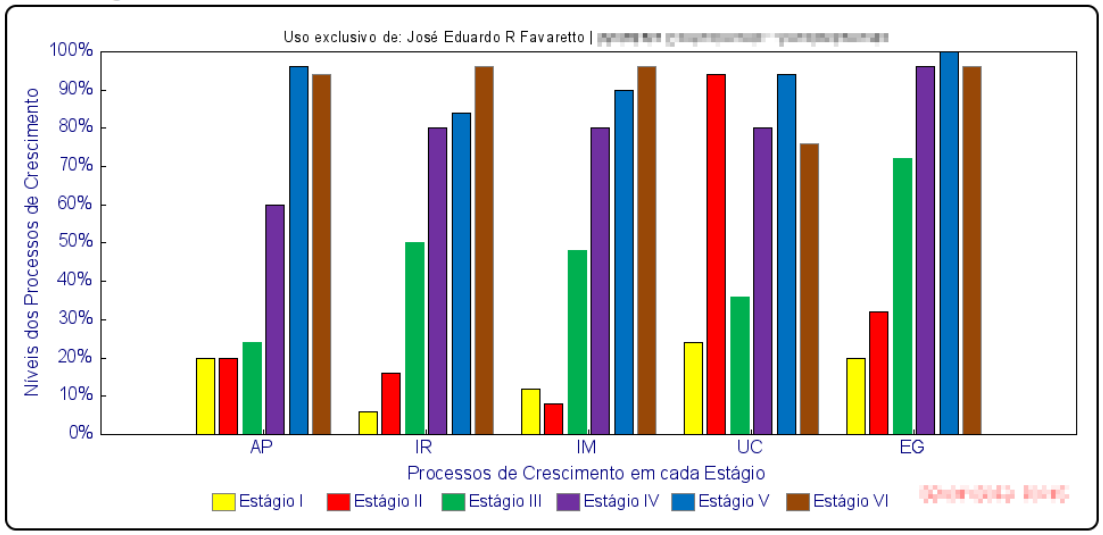
Na segunda coluna da Tabela são informados os valores Médios dos Níveis dos 5 Processos de Crescimento (integrados), para cada um dos 6 Estágios de Crescimento. Nas colunas seguintes, os Níveis Médios (individuais) de cada Processo de Crescimento (AP, IR, IM, UC e EG), para cada um dos Estágios (I, II, III, IV, V, VI).

page #3/6 (Portuguese version) - pages of Report and Diagnostic as an example

Seção 2 - Níveis dos Processos de Crescimento

O Processo de Crescimento da Organização com o nível mais baixo é o IR com 6% de nível, no Estágio I (Iniciação).

Sobre o gráfico dos Níveis dos Processos.



Sobre os Processos de Crescimento com Níveis mais baixos.

Tipos de Processos	Marcas / Níveis dos Processos	Processos com Níveis (%) mais baixos conforme o Estágio
AP	Muito baixo	**20%** Estágio I (Iniciação)
IR	Muito baixo	**6%** Estágio I (Iniciação)
IM	Muito baixo	**8%** Estágio II (Contágio)
UC	Baixo	**24%** Estágio I (Iniciação)
EG	Muito baixo	**20%** Estágio I (Iniciação)

page #4/6 (Portuguese version) - pages of Report and Diagnostic as an example

Seção 3 - Processos que afetam os atuais Níveis de Estágios

Abaixo são informadas duas assertivas sobre as iniciativas da TIC/SI* (dentre as demais assertivas dessa Pesquisa), que influenciaram os atuais níveis de estágio de sua Organização.

Sobre os atuais Níveis de Estágio das iniciativas de TI/SI* da Organização.

Estágio I	• Os usuários ainda não colaboraram com as iniciativas da TIC da Organização. (UC14=6) • A Organização não tem interesse em utilizar as tecnologias emergentes (ex: Analytics e Data-driven, AI, Blockchain, IoT, Cloud Computing, etc.) em suas iniciativas da TIC. (EG15=6)	**Nível 16%**
Estágio II	• Os usuários da Organização estão entusiasmados para iniciar o envolvimento deles nas iniciativas da TIC. (UC22=6) • Satisfazer a demanda requisitada pelos usuários é a prioridade da Organização com suas iniciativas da TIC. (UC23=6)	**Nível 34%**
Estágio III	• A alta direção e o responsável pela TIC de minha Organização neste momento interferem diretamente no ritmo da aprendizagem organizacional. (IR32=6) • Os usuários tem participação em grupos de projeto para o desenvolvimento das iniciativas da TIC da Organização. (UC31=6)	**Nível 46%**
Estágio IV	• Ao concentrar-se em uma abordagem mais orientada para os dados, a organização precisou reestruturar seus sistemas e os relacionamentos entre os diversos bancos de dados. (AP42=6) • A atividade da TIC entrega um serviço da alta qualidade e confiabilidade aos usuários da organização. (IR43=6)	**Nível 79%**
Estágio V	• As aplicações de sistema são desenvolvidas oferecendo apoio externo para fornecedores e clientes. (AP51=6) • Para ampliar a integração de aplicações e bancos de dados, atualmente a minha Organização investe em ferramentas sofisticadas. (AP52=6)	**Nível 93%**
Estágio VI	• Existem na Organização sistemas de informação de alta qualidade, flexíveis, integrados e permanentemente atualizados. (AP61=6) • O sistema corporativo é uma aplicação de camada superior "controlada" por parâmetros que permitem mudar suas funcionalidades ou o fluxo de trabalho. (AP63=6)	**Nível 92%**

Seção 4 - Compreensão teórica resumida sobre os Estágios e Processos

Sobre essa tabela de Estágios de Crescimento.

Tipos de Estágios	Descrição dos Estágios de Crescimento
Iniciação	**Iniciação** = Caracterizado por um investimento limitado e experimentação restrita para comprovar o valor da tecnologia na organização. O pessoal de TIC/SI está aprendendo sobre a nova tecnologia. Não há clara direção para as iniciativas da TIC/SI da organização.
Contágio	**Contágio** = Também conhecido como "Expansão". Um período de alta aprendizagem pela qual a tecnologia proliferou de uma forma relativamente não controlada. As iniciativas da TIC/SI estão

page #5/6 (Portuguese version) - pages of Report and Diagnostic as an example

Seção 4 - Compreensão teórica resumida sobre os Estágios e Processos

Sobre essa tabela de Estágios de Crescimento.

Tipos de Estágios	Descrição dos Estágios de Crescimento
Iniciação	**Iniciação** = Caracterizado por um investimento limitado e experimentação restrita para comprovar o valor da tecnologia na organização. O pessoal de TIC/SI está aprendendo sobre a nova tecnologia. Não há clara direção para as iniciativas da TIC/SI da organização.
Contágio	**Contágio** = Também conhecido como "Expansão". Um período de alta aprendizagem pela qual a tecnologia proliferou de uma forma relativamente não controlada. As iniciativas da TIC/SI estão crescentemente consideradas uma componente importante dos negócios da organização.
Controle	**Controle** = Também conhecido como o "Formalização". A gestão reage ao impor controles sobre as iniciativas de TIC/SI e disciplinar os custos relacionados. Devido ao crescente uso de atividades de automação, elas são consideradas um componente importante dos negócios da organização.
Integração	**Integração** = O aprendizado acumulado levou a um equilíbrio de controles gerenciados e crescimento. A organização domina certas tecnologias atuais, proporcionando uma base para introduzir a próxima ordem de magnitude do progresso, em busca de novas melhorias.
Admin.Dados	**Administração de Dados** = As atividades e os processos de negócios tradicionais integrados e as iniciativas de TIC/SI, criam uma comunicação contínua e o fluxo dos processos dentro da organização. As iniciativas de TIC/SI visam proporcionar benefícios estratégicos através da construção de sistemas estratégicos
Maturidade	**Maturidade** = As iniciativas de TIC/SI estão profundamente enraizadas em cada aspecto da organização. Há uma forte integração entre os processos da TIC/SI e os processos de negócios dentro da organização, bem como com os de seus fornecedores e parceiros de negócios.

Sobre as marcações e intervalos de Níveis.

Muito baixo	Baixo	Médio	Alto	Muito Alto
até 20%	de 21% até 40%	de 41% até 60%	de 61% até 80%	acima de 80%

Sobre essa tabela de Processos de Crescimento.

Tipos de Processos	Descrição dos Processos de Crescimento
AP	**Applications Portfolio** = A base existente de sistemas de informação que suportam as funções do negócio. O conjunto de aplicações que os sistemas de informação devem apoiar. Por exemplo: planejamento financeiro, processamento de pedidos, solicitações on-line de clientes.
IR	**ICT/IS Resources** = Os recursos (humanos e tecnológicos), que proporcionam à organização as formas (meios) de usar e aplicar as iniciativas de TIC/SI nos negócios. Envolve a posição da unidade de TIC/SI no

page #6/6 (Portuguese version) - pages of Report and Diagnostic as an example

Tipos de Processos	Descrição dos Processos de Crescimento
AP	**Applications Portfolio** = A base existente de sistemas de informação que suportam as funções do negócio. O conjunto de aplicações que os sistemas de informação devem apoiar. Por exemplo: planejamento financeiro, processamento de pedidos, solicitações on-line de clientes.
IR	**ICT/IS Resources** = Os recursos (humanos e tecnológicos), que proporcionam à organização as formas (meios) de usar e aplicar as iniciativas de TIC/SI nos negócios. Envolve a posição da unidade de TIC/SI no organograma, suas áreas de atividades (serviços técnicos, bancos de dados para consulta, manutenção, etc.), as habilidades e o conhecimento relevante do pessoal de TIC.
IM	**ICT/IS Management** = Os instrumentos, procedimentos e controles que a gerência usa para facilitar o uso efetivo e eficiente e o fornecimento de atividades de TIC/SI (ou seja, as suas práticas). Por exemplo: nível de controle, formalização do processo de planejamento, gerenciamento de projetos e extensão dos planos estratégicos.
UC	**User Community** = A capacidade dos usuários de aplicar efetivamente as iniciativas de TIC/SI em seu trabalho. Esse processo representa a amplitude na qual os usuários (pessoas na organização utilizando as TIC/SI; as habilidades dos usuários) desenvolvem o entendimento e conscientização para as oportunidades e para as limitações das iniciativas da TIC/SI.
EG	**Emerging ICT/IS** = Novos e emergentes influenciadores da TIC/SI que irão introduzir, induzir e promover a descontinuidade organizacional em relação a nova "Era do Big Data". Conexão em tempo integral, bases de dados online, mensagens e transações em tempo real, data warehousing, serviços de computação em nuvem, tecnologias móveis, o poder das mídias sociais / sites de redes, Analytics e Data-driven, Inteligência Artificial (AI), Blockchain, Internet das Coisas (IoT), etc. influenciando o uso popular de diferentes tecnologias pelas organizações e seus usuários.

Referências

Favaretto, J. E. R. (2015). *Stage Level Measurement of Information and Communication Technology in Organizations.* (Unpublished master's thesis). Fundacao Getulio Vargas, Sao Paulo School of Business Administration (FGV EAESP). Sao Paulo, Brazil. https://doi.org/10.13140/RG.2.2.16844.82562

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Nolan, R. L. (1979). Managing the Crises in Data Processing. *Harvard Business Review*, 57(2), 115–126.

Fundação Getulio Vargas | Escola de Administração de Empresas de São Paulo (FGV EAESP) • https://eaesp.fgv.br
Departamento de Tecnologia e Ciência de Dados (TDS) • São Paulo, Brasil
Pesquisador Responsável: José Eduardo Ricciardi Favaretto • e-mail: jose.favaretto[at]gvmail.br • site: www.favaretto.net

Appendix G – Form (English version) to request exclusive invitation to the survey participation

FGV EAESP

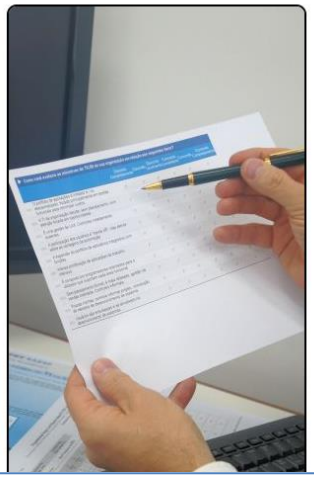
[Academic Research] • edition 1.0 • March/2019

STAGE LEVEL MEASUREMENT OF ICT/IS AND ANALYTICS DIFFUSION IN ORGANIZATIONS

HOME | INVITATION | SURVEY | DIAGNOSTIC | HISTORIC | RESEARCHERS | CONTACT

Request Exclusive Invitation

Participation in this survey is restricted to **guests only**. To apply to receive an invitation, please enter the data and click the **[»» Request Invitation]** button below. After reviewing your request, you will receive an answering e-mail from the responsible researcher.



Your full Name

Name of your Organization

How did **you hear about** this Research?:

-- Select --

What is your main **Function** or **Role** in the Organization you represent in this research?:

-- Select --

Your LinkedIn address

Your Main E-mail

Alternative E-mail

* **IMPORTANT**: E-mail will always be the main way of contacting the researchers.

From which **Country** does your contact come from?:

-- Select --

Your Gender:

-- Select --

What is your **Academic Background**?:

-- Select --

Why are you interested in participating in this Research?:

»» Request Invitation

Fundacao Getulio Vargas | Sao Paulo School of Business Administration (FGV EAESP) • https://eaesp.fgv.br/en

Triple Accreditation: merit of less than 1% of World Business Schools.

AACSB ACCREDITED | EFMD EQUIS ACCREDITED | ASSOCIATION OF MBAS ACCREDITED

Technology and Data Science Department (TDS) • Sao Paulo, Brazil

Researcher in charge: Jose Eduardo Ricciardi Favaretto • e-mail: jose.favaretto[at]gvmail.br • site: www.favaretto.net Share.

Appendix H – Form (Portuguese version) to request exclusive invitation to the survey participation

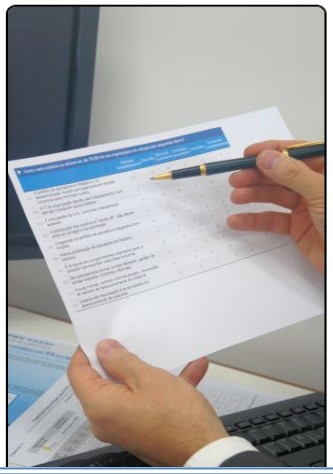
FGV EAESP

[Pesquisa Acadêmica] • edição 1.0 • março/2019

MEDIÇÃO DO NÍVEL DE ESTÁGIO DA TIC/SI E DIFUSÃO DO ANALYTICS EM ORGANIZAÇÕES

HOME | CONVITE | RESPONDER | DIAGNÓSTICO | HISTÓRICO | PESQUISADORES | CONTATO

Solicitar Convite exclusivo



A participação nessa pesquisa é restrita **apenas para convidados**. Para se candidatar a receber um convite, favor informar os dados e clicar no botão **[»» Solicitar Convite]** abaixo. Após análise de sua solicitação, você receberá e-mail de resposta do pesquisador responsável.

Seu Nome completo

Nome de sua Organização

Como você **ficou sabendo** a respeito dessa Pesquisa?:

-- Selecione --

Qual a sua principal **Função** ou **Atribuição** na Organização que você representa nesta pesquisa?:

-- Selecione --

Seu endereço no LinkedIn

Seu E-mail Principal

E-mail Alternativo

* **IMPORTANTE**: o e-mail será sempre a forma principal de contato com os pesquisadores.

De qual **País** origina o seu contato?:

-- Selecione --

Informe o seu Gênero:

-- Selecione --

Qual é a sua **Formação Acadêmica**?:

-- Selecione --

Por que você se interessou em participar dessa Pesquisa?:

»» Solicitar Convite

Fundação Getulio Vargas | Escola de Administração de Empresas de São Paulo (FGV EAESP) • https://eaesp.fgv.br

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Departamento de Tecnologia e Ciência de Dados (TDS) • São Paulo, Brasil

Pesquisador Responsável: José Eduardo Ricciardi Favaretto • e-mail: jose.favaretto[at]gvmail.br • site: www.favaretto.net

Appendix I – Research website (English version) at www.favaretto.net >> Research part #1/3 (English version) - some website pages only as an example

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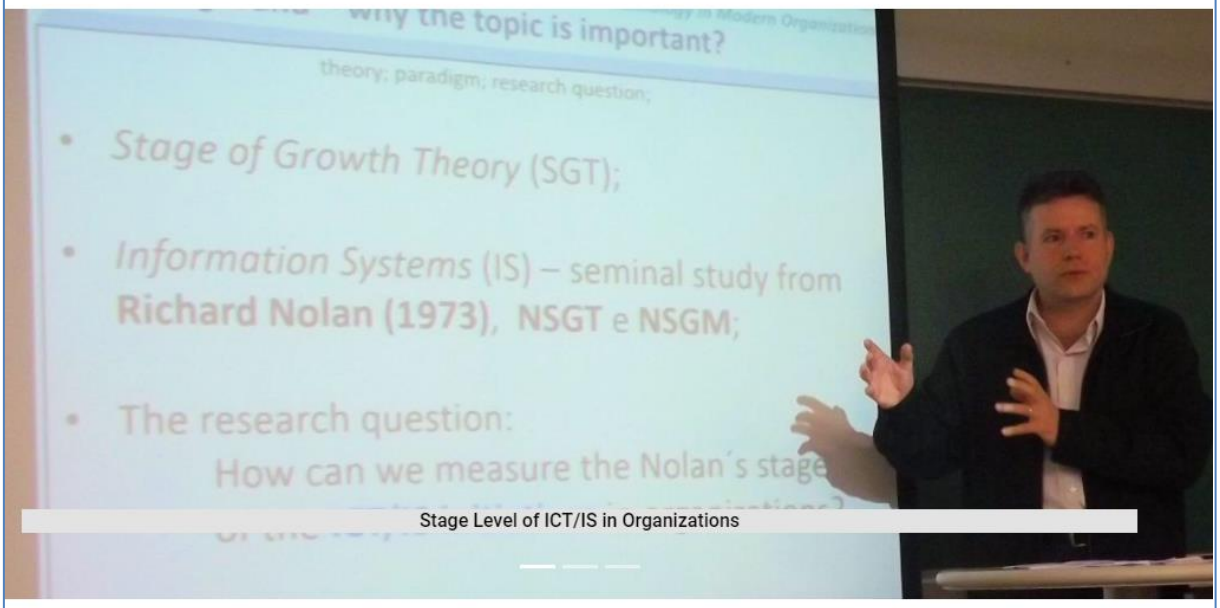
[Academic Research] • edition 1.0 • March/2019

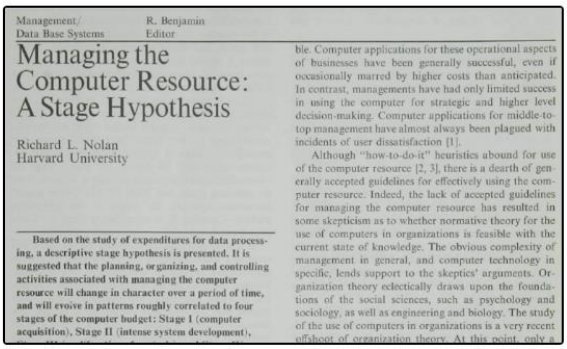
STAGE LEVEL MEASUREMENT OF ICT/IS AND ANALYTICS DIFFUSION IN ORGANIZATIONS

HOME | INVITATION | SURVEY | DIAGNOSTIC | HISTORIC | RESEARCHERS | CONTACT



OBJECTIVE OF THIS RESEARCH AND THEORETICAL CORPUS

This study has the objective to measure and explain the Stage Level of Information and Communication Technology/Information Systems (ICT/IS) initiatives in Organizations and its influence in Organizational Innovation (exploration and exploitation), moderated by the level of Analytics in use in Organizations. The theoretical body that guide this Research is based on seminal studies and subsequent contributions regarding three corpus of knowledge: Stages of Growth Theory in Management Information Systems (SGT/MIS) (Nolan, 1973, 1979), Organizational Innovation studies (exploration and exploitation) (Jansen, Bosch, Van Den, & Volberda, 2006), and Diffusion of Innovation Theory (Rogers, 2003).



Management/ Data Base Systems — R. Benjamin Editor

Managing the Computer Resource: A Stage Hypothesis

Richard L. Nolan
Harvard University

Based on the study of expenditures for data processing, a descriptive stage hypothesis is presented. It is suggested that the planning, organizing, and controlling activities associated with managing the computer resource will change in character over a period of time, and will evolve in patterns roughly correlated to four stages of the computer budget: Stage I (computer acquisition), Stage II (intense system development),

ble. Computer applications for these operational aspects of businesses have been generally successful, even if occasionally marred by higher costs than anticipated. In contrast, managements have had only limited success in using the computer for strategic and higher level decision-making. Computer applications for middle-to-top management have almost always been plagued with incidents of user dissatisfaction [1].

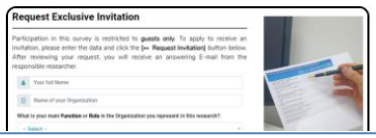
Although "how-to-do-it" heuristics abound for use of the computer resource [2, 3], there is a dearth of generally accepted guidelines for effectively using the computer resource. Indeed, the lack of accepted guidelines for managing the computer resource has resulted in some skepticism as to whether normative theory for the use of computers in organizations is feasible with the current state of knowledge. The obvious complexity of management in general, and computer technology in specific, lends support to the skeptics' arguments. Organization theory eclectically draws upon the foundations of the social sciences, such as psychology and sociology, as well as engineering and biology. The study of the use of computers in organizations is a very recent offshoot of organization theory. At this point, only a

STAGES OF GROWTH PARADIGM IN MANAGEMENT INFORMATION SYSTEMS

The root of the studies regarding SGT/MIS comes from the research conducted at Harvard Business School by Professor Neil C. Churchill, James L. McKenney, F. Warren McFarlan and Richard L. Nolan, in the 1970s. The original concepts behind the Nolan´s Stages of Growth Theory (NSGT) were proposed by Richard L. Nolan in 1973 by the article "Managing the Computer Resource: A Stage Hypothesis", published in Communications of ACM journal, where a descriptive stage hypothesis was presented, based on the study of expenditures for Data Processing (DP).

READ MORE ...

THREE STEPS TO PARTICIPATE IN THIS RESEARCH



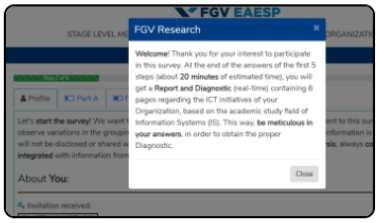
part #2/3 (English version) - some website pages only as an example

THREE STEPS TO PARTICIPATE IN THIS RESEARCH

Request Invitation

Step 1

Participation in this survey is restricted to guests only. To apply for an invitation, request yours here.



Respond to the Survey

Step 2

This research analyzes the ICT initiatives of its Organization, based on the academic field of studies of Information Systems (IS).

Issue the Diagnostic

Step 3

Be meticulous in your answers, to obtain the proper Diagnostic (real-time) regarding the ICT/IS initiatives of your Organization.

STEP EVOLUTION IN RESPONDING TO THE SURVEY

[click on images to enlarge]

Respondent Profile

Part A (2/5)

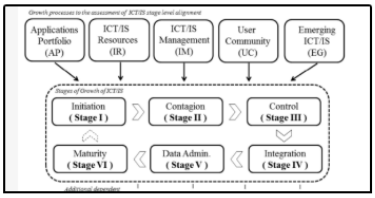
Part B (3/5)

Part C (4/5)

Part D (5/5)

Generate the Diagnostic

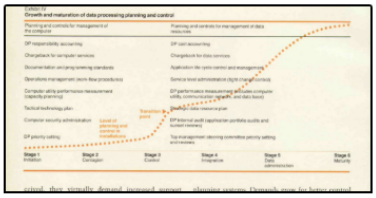
DISCUSSIONS ABOUT THIS RESEARCH



STAGE LEVELS OF ICT/IS IN ORGANIZATIONS (2015)

As a theoretical contribution, the framework creation to this study and the development of a scale instrument with the purpose of making the measurement of the ICT/IS initiatives stage level in modern organizations, adapted for ...

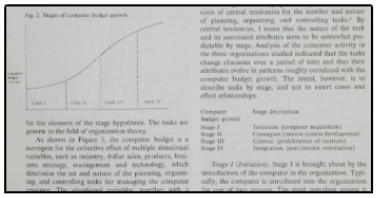
READ MORE ...



6 STAGES OF ICT/IS - NOLAN´s SEMINAL PAPER (1979)

In the later version of Nolan´s Stages of Growth Model (NSGM), preliminarily presented in 1975, the stage III was divided to include two other stages, thus totalizing six stages. In 1979, another paper reinforced the same 6 stages ...

READ MORE ...



4 STAGES OF ICT/IS - NOLAN´s SEMINAL PAPER (1973)

In the academic field of the Management Information Systems (MIS), Nolan´s Stages of Growth Theory (NSGT) first appeared in 1973 as probably the most well-known and widespread theoretical framework for the assimilation ...

READ MORE ...

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Technology and Data Science Department (TDS) • Sao Paulo, Brazil
Researcher in charge: Jose Eduardo Ricciardi Favaretto • e-mail: jose.favaretto[at]gvmail.br • site: www.favaretto.net
Share.

part #3/3 (English version) - some website pages only as an example

FGV EAESP

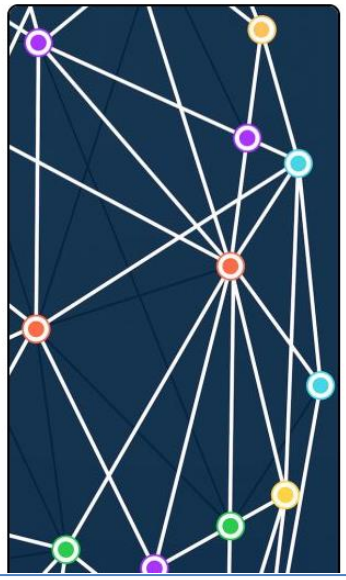
[Academic Research] • edition 1.0 • March/2019

STAGE LEVEL MEASUREMENT OF ICT/IS AND ANALYTICS DIFFUSION IN ORGANIZATIONS

HOME INVITATION SURVEY DIAGNOSTIC HISTORIC RESEARCHERS CONTACT

Contact the Researchers

Contact the responsible researcher directly using this contact form. Please, fill in the field data, objectively inform the reason/interest of your contact and click on the button **[»» Contact Researcher]** below. Wait for the message reply.



Your full Name

Name of your Organization

Your LinkedIn address

Your Main E-mail

From which **Country** does your contact come from?:

-- Select --

Describe in a concise and objective manner the reason for your contact:

Share this research with your contacts

For your convenience, **before accessing the links to the social media** below (Linkedin, Xing, Facebook or Twitter), use the Research divulgation phrases that are reported in the 3 examples beside, and the **area available to adjust** / write a short text with your own words.

FGV survey, restricted to guests, makes the measurement of the Organizational ICT Stage Level. Available at: http://busc.us/fgv2

What is the current ICT Stage Level of your Organization? Find out by replying to FGV survey. Request your invitation: http://busc.us/fgv2

Pesquisa FGV generates Diagnostic (real time, with 6 A4 pages), about the ICT initiatives of your Company. Invitations: http://busc.us/fgv2

or write a text here with your words ...

140 remaining / 140

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Triple Accreditation: merit of less than 1% of World Business Schools.

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Appendix J – Research website (Portuguese version) at www.favaretto.net >> Pesquisa part #1/3 (Portuguese version) - some website pages only as an example

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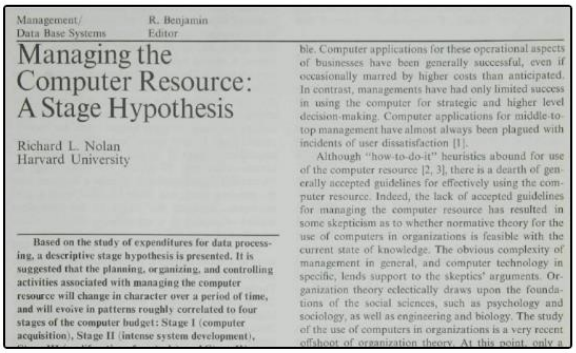
[Pesquisa Acadêmica] • edição 1.0 • março/2019

MEDIÇÃO DO NÍVEL DE ESTÁGIO DA TIC/SI E DIFUSÃO DO ANALYTICS EM ORGANIZAÇÕES

HOME | CONVITE | RESPONDER | DIAGNÓSTICO | HISTÓRICO | PESQUISADORES | CONTATO

OBJETIVO DA PESQUISA E *CORPUS* TEÓRICO

Esse estudo tem como objetivo medir e explicar o Nível de Estágio das iniciativas de Tecnologia de Informação e Comunicação/Sistemas de Informação (TIC/SI) nas Organizações e sua influência na Inovação Organizacional ('exploration' e 'exploitation'), moderado pelo nível do Analytics em uso nas Organizações. O corpo teórico que orienta essa Pesquisa baseia-se em estudos seminais e contribuições subsequentes sobre três *corpus* de conhecimento: Teoria de Estágios de Crescimento em Administração de Sistemas de Informação (SGT/MIS) (Nolan, 1973, 1979), estudos de Inovação Organizacional ('exploration' e 'exploitation') (Jansen, Bosch, Van Den, & Volberda, 2006), e Teoria da Difusão de Inovação (Rogers, 2003).



Management/ Data Base Systems — R. Benjamin Editor

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ble. Computer applications for these operational aspects of businesses have been generally successful, even if occasionally marred by higher costs than anticipated. In contrast, managements have had only limited success in using the computer for strategic and higher level decision-making. Computer applications for middle-to-top management have almost always been plagued with incidents of user dissatisfaction [1].

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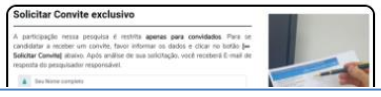
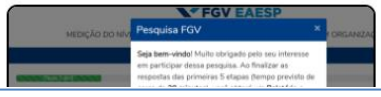
PARADIGMA DE ESTÁGIOS DE CRESCIMENTO EM ADMINISTRAÇÃO DE SISTEMAS DE INFORMAÇÃO

A raiz dos estudos sobre SGT/MIS vem da pesquisa conduzida na Harvard Business School pelos professores Neil C. Churchill, James L. McKenney, F. Warren McFarlan e por Richard L. Nolan, nos anos 70. Os conceitos originais por trás da Teoria dos Estágios de Crescimento de Nolan (NSGT) foram propostos por Richard L. Nolan em 1973 no artigo "Managing the Computer Resource: A Stage Hypothesis", publicado no periódico acadêmico Communications of ACM, quando a hipótese da descrição dos estágios foi apresentada, tomando como base um estudo com despesas em Processamento de Dados (PD).

LER MAIS ...

COMO PARTICIPAR DESTA PESQUISA EM TRÊS PASSOS





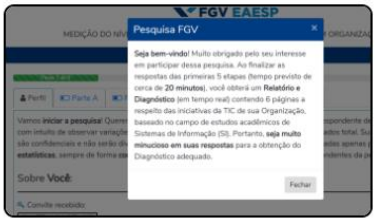
part #2/3 (Portuguese version) - some website pages only as an example

COMO PARTICIPAR DESTA PESQUISA EM TRÊS PASSOS

Solicitar Convite

Passo 1

A participação nessa pesquisa é restrita apenas para convidados. Para se candidatar a receber um convite, solicite o seu aqui.



Responder a Pesquisa

Passo 2

Essa pesquisa analisa as iniciativas da TIC de sua Organização, baseado no campo de estudos acadêmicos de Sistemas de Informação (SI).

Emitir o Diagnóstico

Passo 3

Seja minucioso em suas respostas para obter o Diagnóstico adequado (tempo real) das iniciativas da TIC/SI de sua Organização.

EVOLUÇÃO DAS ETAPAS AO RESPONDER A PESQUISA

[clique nas imagens para ampliar]


Perfil do Respondente


Parte A (2/5)

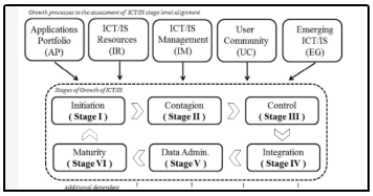

Parte B (3/5)


Parte C (4/5)


Parte D (5/5)


Gerar o Diagnóstico

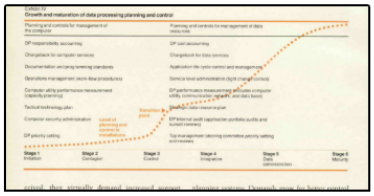
DISCUSSÕES SOBRE ESSA PESQUISA



NÍVEIS DE ESTÁGIO DA TIC/SI EM ORGANIZAÇÕES (2015)

Como uma contribuição teórica, a criação de um *framework* para este estudo e o desenvolvimento de um instrumento de escala com o objetivo de fazer a medição do nível de estágio das iniciativas de TIC/SI em Organizações modernas, adaptadas para ...

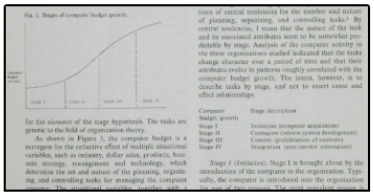
LER MAIS ...



6 ESTÁGIOS DA TIC/SI - ARTIGO SEMINAL DE NOLAN (1979)

Na versão posterior do Modelo de Estágios de Crescimento de Nolan (NSGM), apresentada preliminarmente em 1975, o estágio III foi dividido para incluir dois outros estágios, totalizando seis estágios. Em 1979, outro trabalho reforçou os mesmos 6 estágios ...

LER MAIS ...



4 ESTÁGIOS DA TIC/SI - ARTIGO SEMINAL DE NOLAN (1973)

No campo acadêmico de Administração de Sistemas de Informação (MIS), a Teoria dos Estágios de Crescimento de Nolan (NSGT) apareceu pela primeira vez em 1973, como provavelmente o arcabouço teórico mais conhecido e difundido para a assimilação ...

LER MAIS ...

part #3/3 (Portuguese version) - some website pages only as an example

FGV EAESP

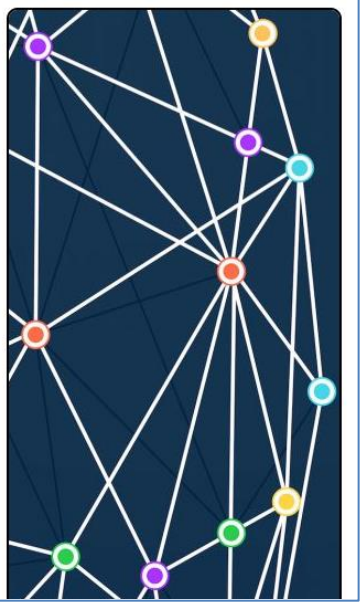
[Pesquisa Acadêmica] • edição 1.0 • março/2019

MEDIÇÃO DO NÍVEL DE ESTÁGIO DA TIC/SI E DIFUSÃO DO ANALYTICS EM ORGANIZAÇÕES

HOME CONVITE RESPONDER DIAGNÓSTICO HISTÓRICO PESQUISADORES CONTATO

Contate os Pesquisadores

Entre em contato diretamente com o pesquisador responsável utilizando esse formulário de contato. Por favor, preencha os dados dos campos, informe objetivamente o motivo/interesse de seu contato e clique no botão **[»» Contatar Pesquisador]** abaixo. Aguarde a mensagem de resposta.



Seu Nome completo

Nome de sua Organização

Seu endereço no LinkedIn

Seu E-mail Principal

De qual **País** origina o seu contato?:

-- Selecione --

Descreva de forma sintética e objetiva o motivo desse seu contato:

Compartilhe essa pesquisa com seus contatos

Para a sua conveniência, **antes de acessar os links para as mídias sociais** abaixo (Linkedin, Xing, Facebook ou Twitter), aproveite as frases de divulgação da Pesquisa que são informadas nos 3 exemplos ao lado, e a **área disponível para adequar** / escrever um texto curto com as suas póprias palavras.

Pesquisa FGV, restrita para convidados, faz a medição do nível de estágio da TIC organizacional. Disponível em: http://busc.us/fgv1

Qual é o atual nível de estágio da TIC de sua Organização? Descubra respondendo a Pesquisa FGV. Solicite seu convite: http://busc.us/fgv1

Pesquisa FGV gera Diagnóstico (tempo real, com 6 páginas A4), sobre as iniciativas da TIC de sua Empresa. Convites em: http://busc.us/fgv1

Escreva um texto aqui com as suas palavras...

140 restantes / 140

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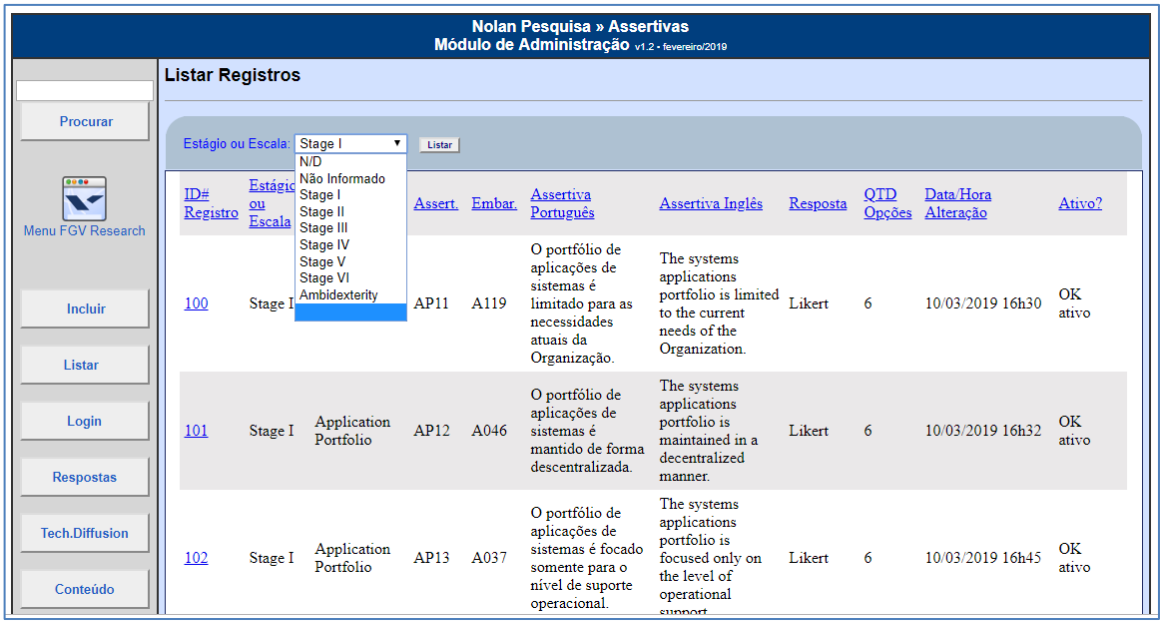
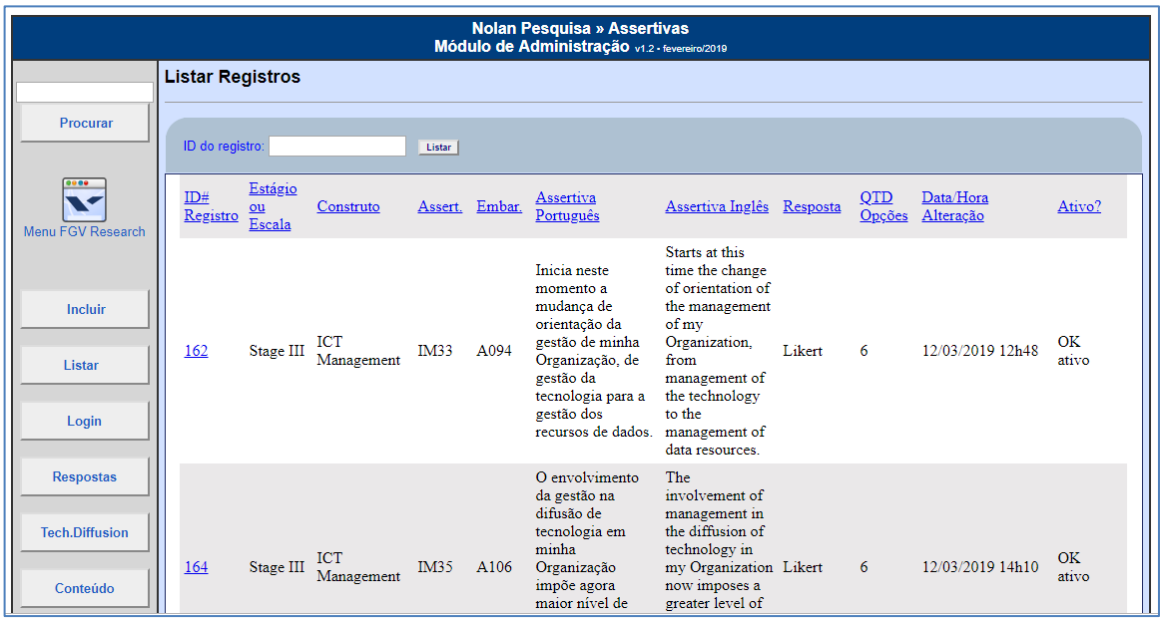
Appendix K – Research Information Systems (Portuguese version) at www.favaretto1.net (restricted access only to the researcher)

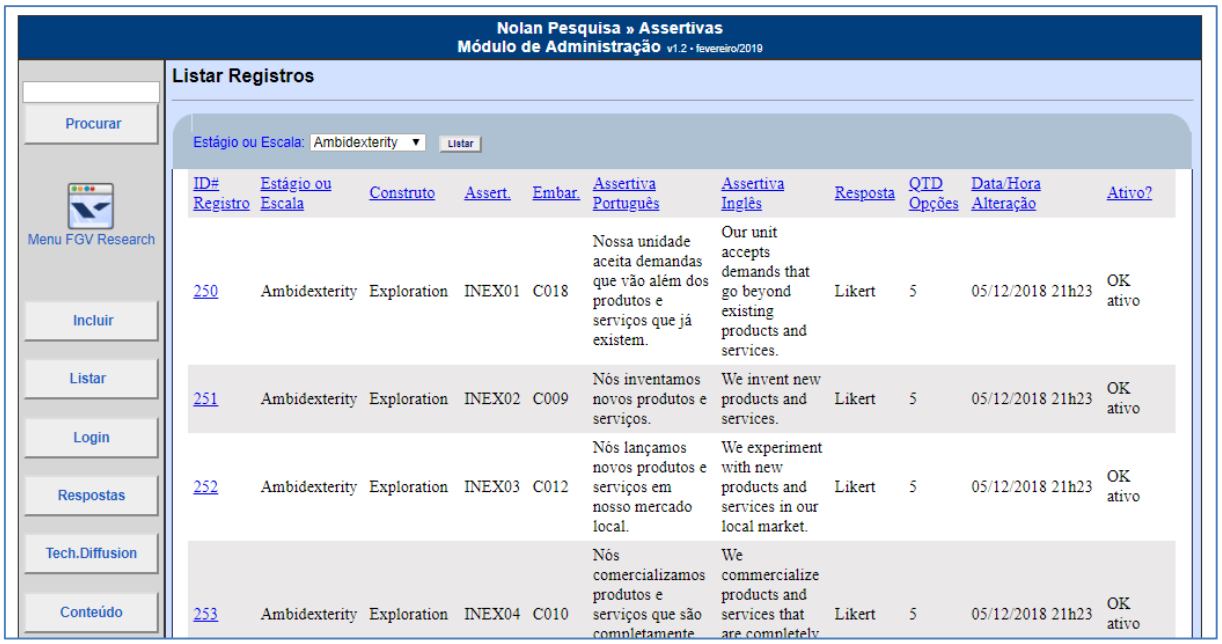
part #1/3 (Portuguese version) - some pages of the research information systems (example)

part #2/3 (Portuguese version) - some pages of the research information systems (example)





part #3/3 (Portuguese version) - some pages of the research information systems (example)



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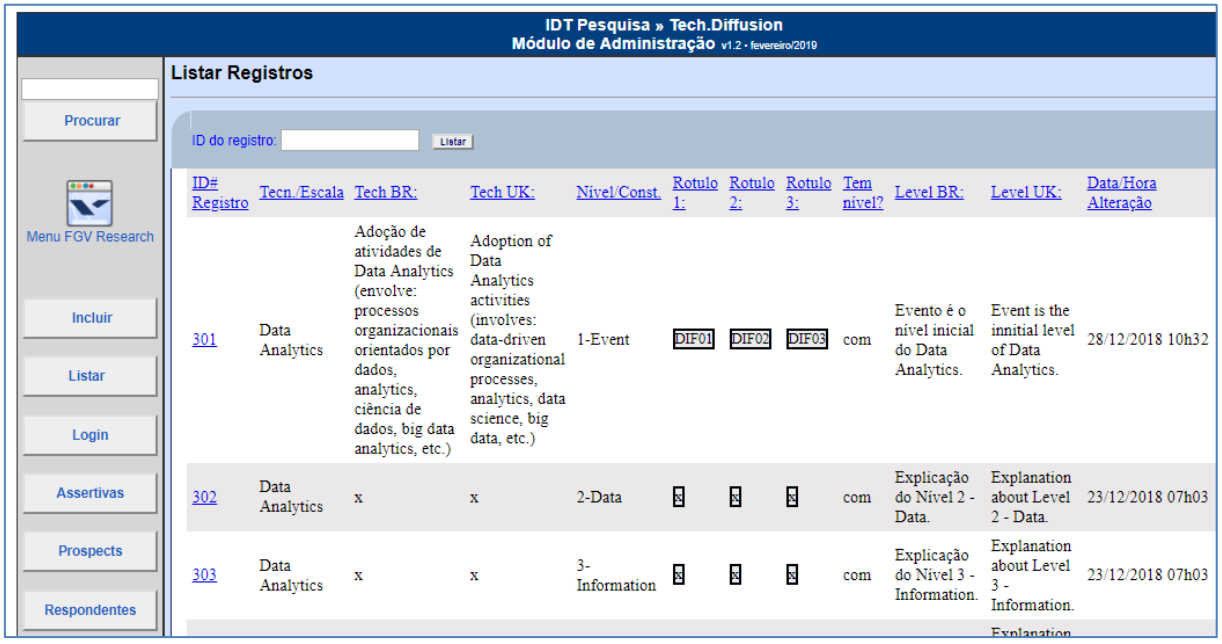
ID# Registro	Estágio ou Escala	Construto	Assert.	Embar.	Assertiva Português	Assertiva Inglês	Resposta	QTD Opções	Data/Hora Alteração	Ativo?
250	Ambidexterity	Exploration	INEX01	C018	Nossa unidade aceita demandas que vão além dos produtos e serviços que já existem.	Our unit accepts demands that go beyond existing products and services.	Likert	5	05/12/2018 21h23	OK ativo
251	Ambidexterity	Exploration	INEX02	C009	Nós inventamos novos produtos e serviços.	We invent new products and services.	Likert	5	05/12/2018 21h23	OK ativo
252	Ambidexterity	Exploration	INEX03	C012	Nós lançamos novos produtos e serviços em nosso mercado local.	We experiment with new products and services in our local market.	Likert	5	05/12/2018 21h23	OK ativo
253	Ambidexterity	Exploration	INEX04	C010	Nós comercializamos produtos e serviços que são completamente	We commercialize products and services that are completely	Likert	5	05/12/2018 21h23	OK ativo



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301	Data Analytics	Adoção de atividades de Data Analytics (envolve: processos organizacionais orientados por dados, analytics, ciência de dados, big data analytics, etc.)	Adoption of Data Analytics activities (involves: data-driven organizational processes, analytics, data science, big data, etc.)	1-Event	DIF01	DIF02	DIF03	com	Evento é o nível inicial do Data Analytics.	Event is the innitial level of Data Analytics.	28/12/2018 10h32
302	Data Analytics	x	x	2-Data	☒	☒	☒	com	Explicação do Nível 2 - Data.	Explanation about Level 2 - Data.	23/12/2018 07h03
303	Data Analytics	x	x	3-Information	☒	☒	☒	com	Explicação do Nível 3 - Information.	Explanation about Level 3 - Information.	23/12/2018 07h03

Appendix L – AP-Applications Portfolio (growth process) in all stages level

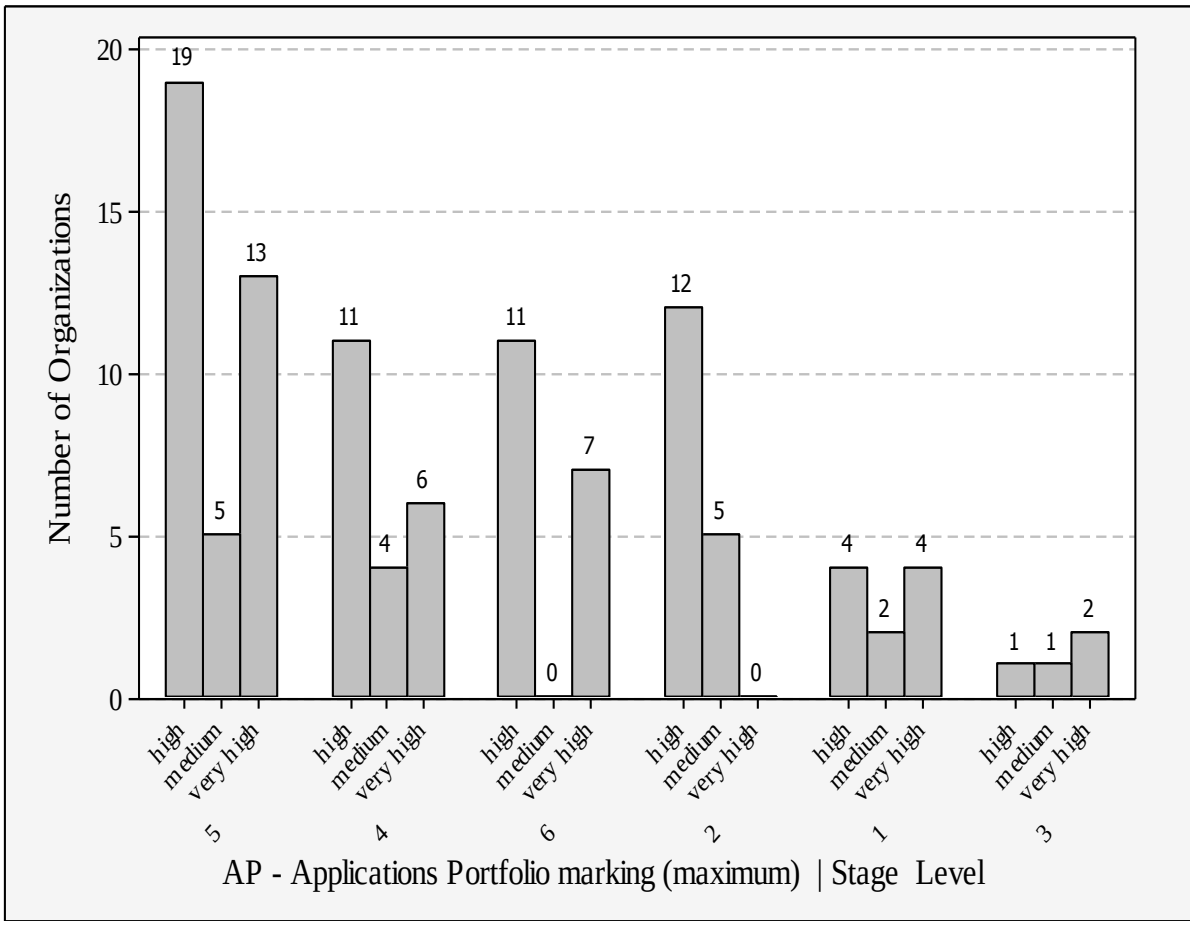
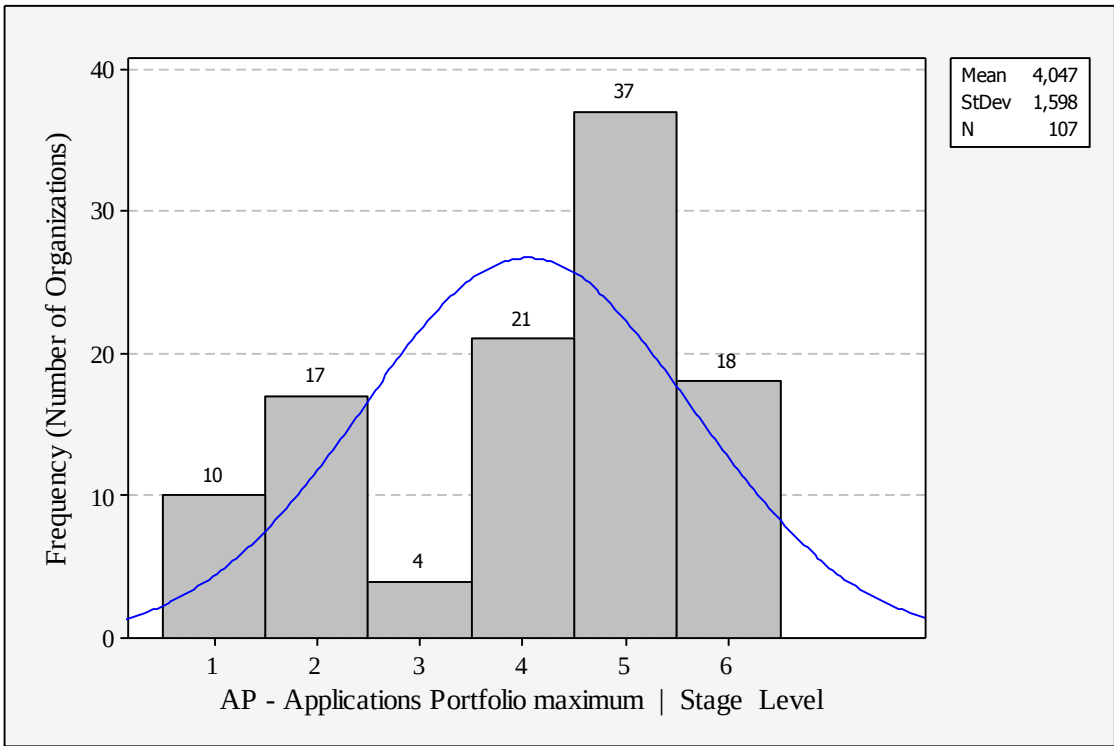
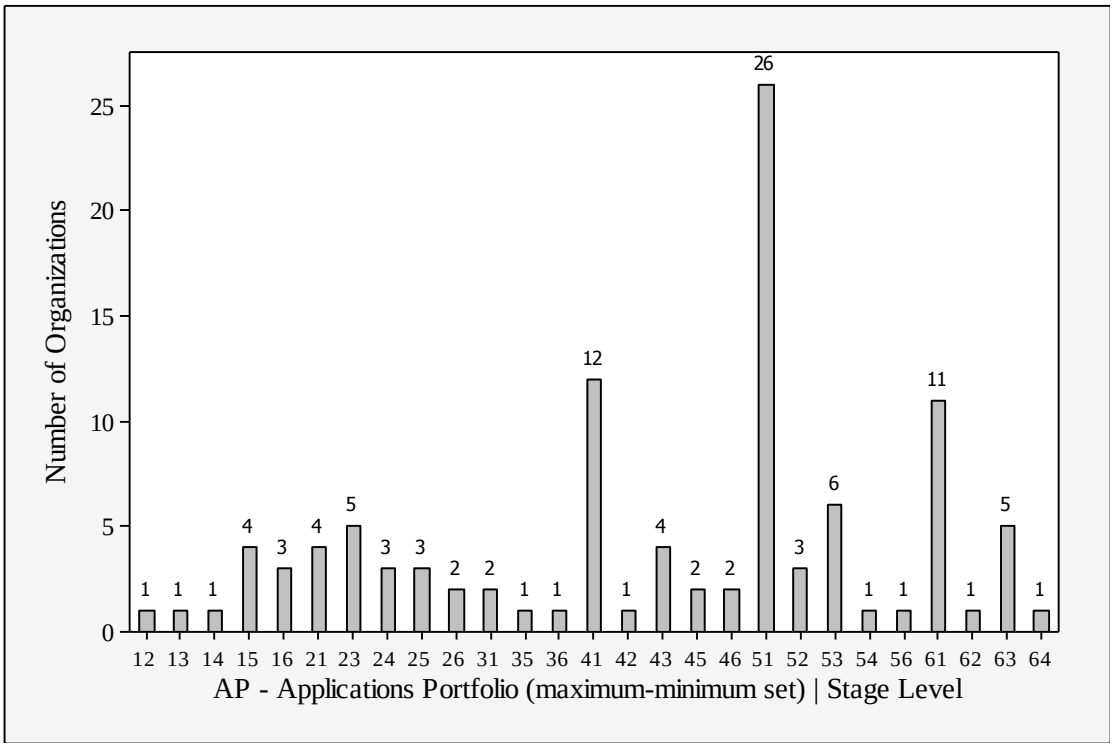


Figure 28 – AP Applications Portfolio (growth process) maximum marking in all of the stages level by the number of organizations

Source: Created by the Author



(a)



(b)

Figure 29 – (a) histogram of AP Applications Portfolio (growth process) maximum marking in all of the stages level; (b) AP maximum and minimum set (stages level) by the number of organizations

Source: Created by the Author

Appendix M – IR-ICT/IS Resources (growth process) in all stages level

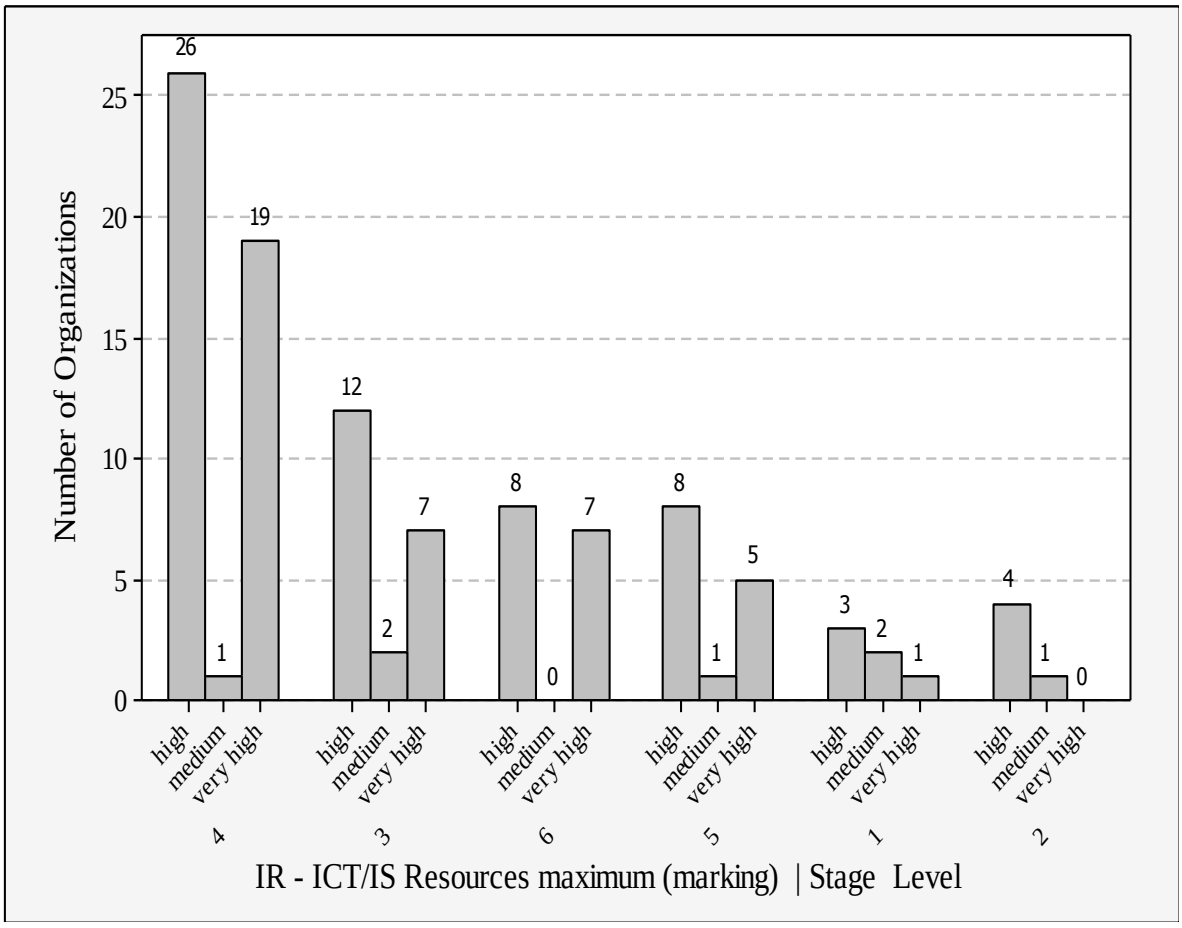
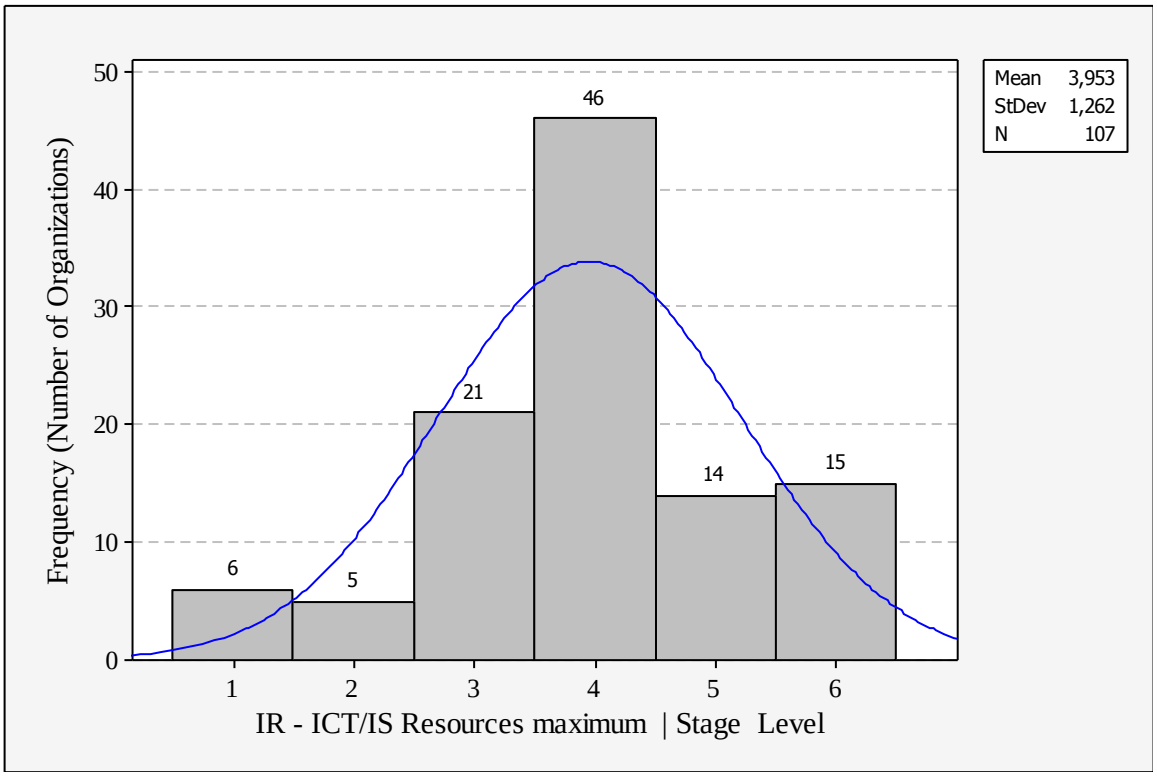
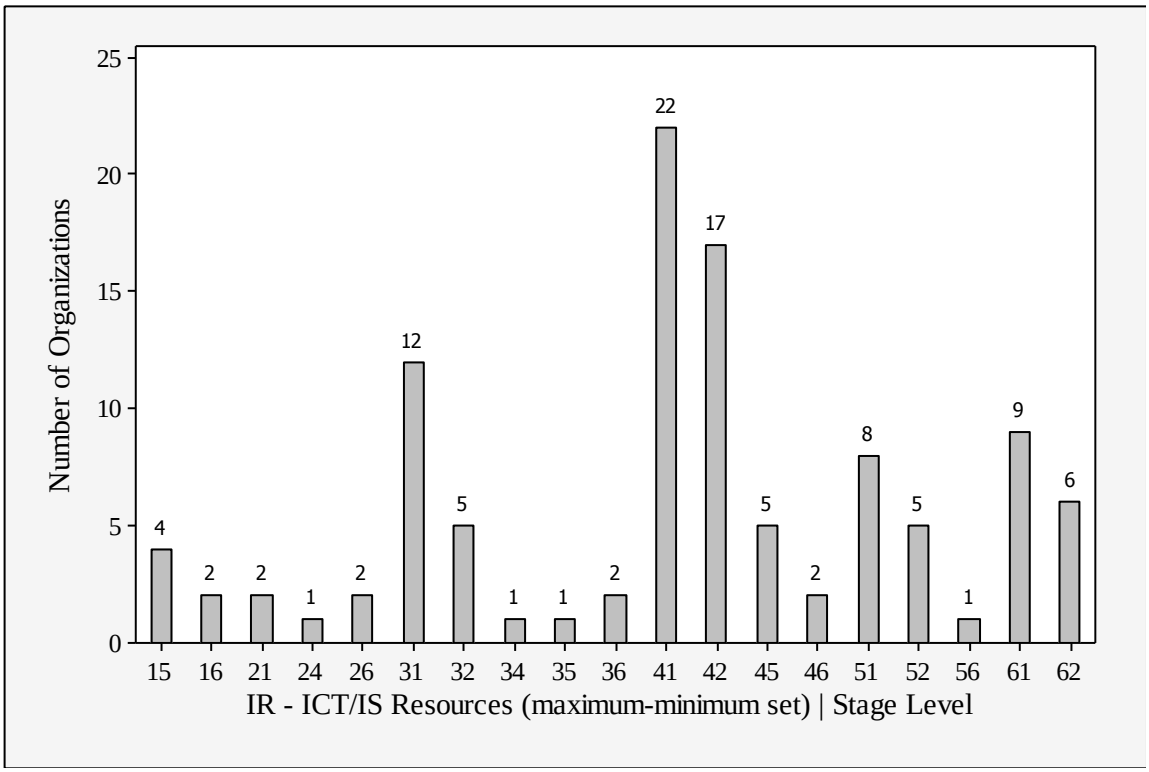


Figure 30 – IR ICT/IS Resources (growth process) maximum marking in all of the stages level by the number of organizations

Source: Created by the Author



(a)



(b)

Figure 31 – (a) histogram of IR ICT/IS Resources (growth process) maximum marking in all of the stages level; (b) IR maximum and minimum set (stages level) by the number of organizations

Source: Created by the Author

Appendix N – IM-ICT/IS Management (growth process) in all stages level

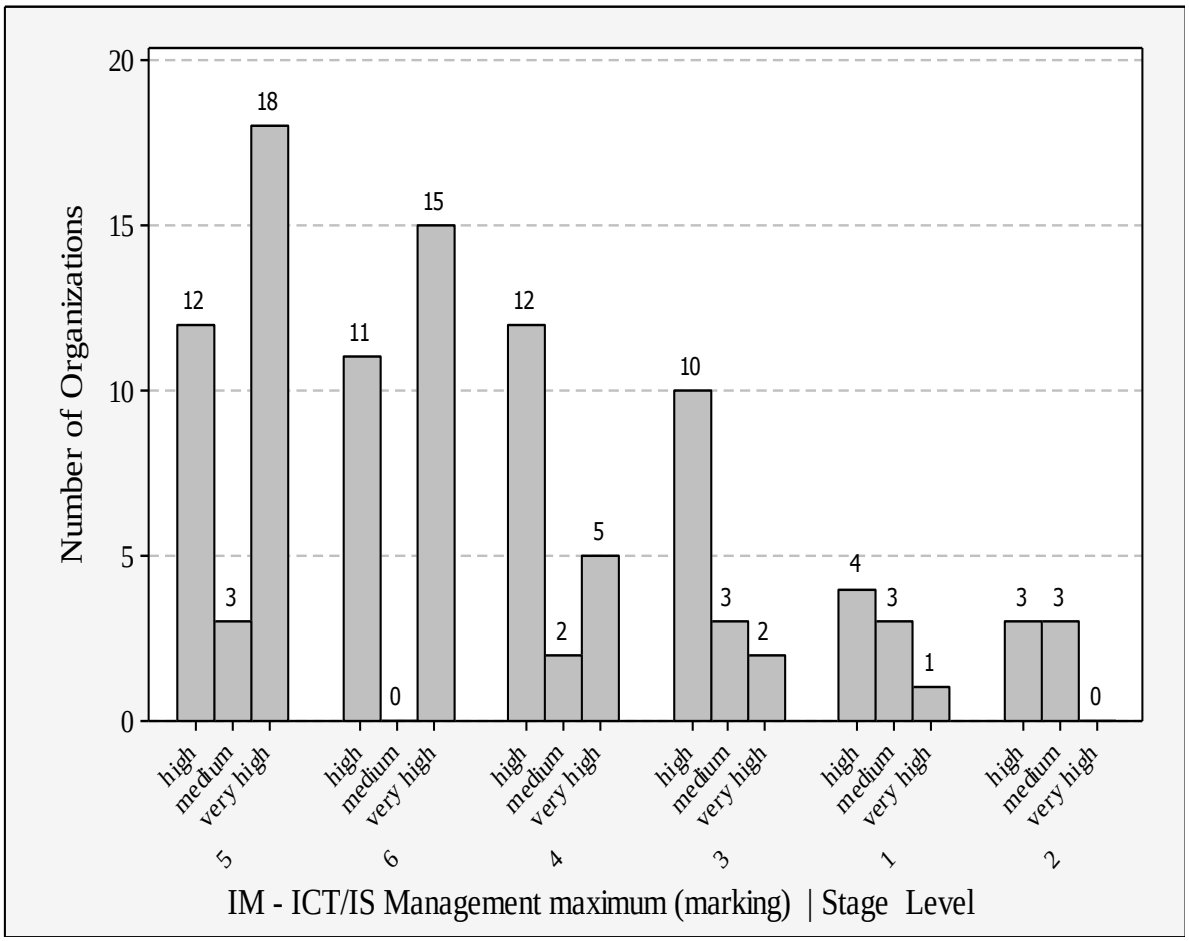
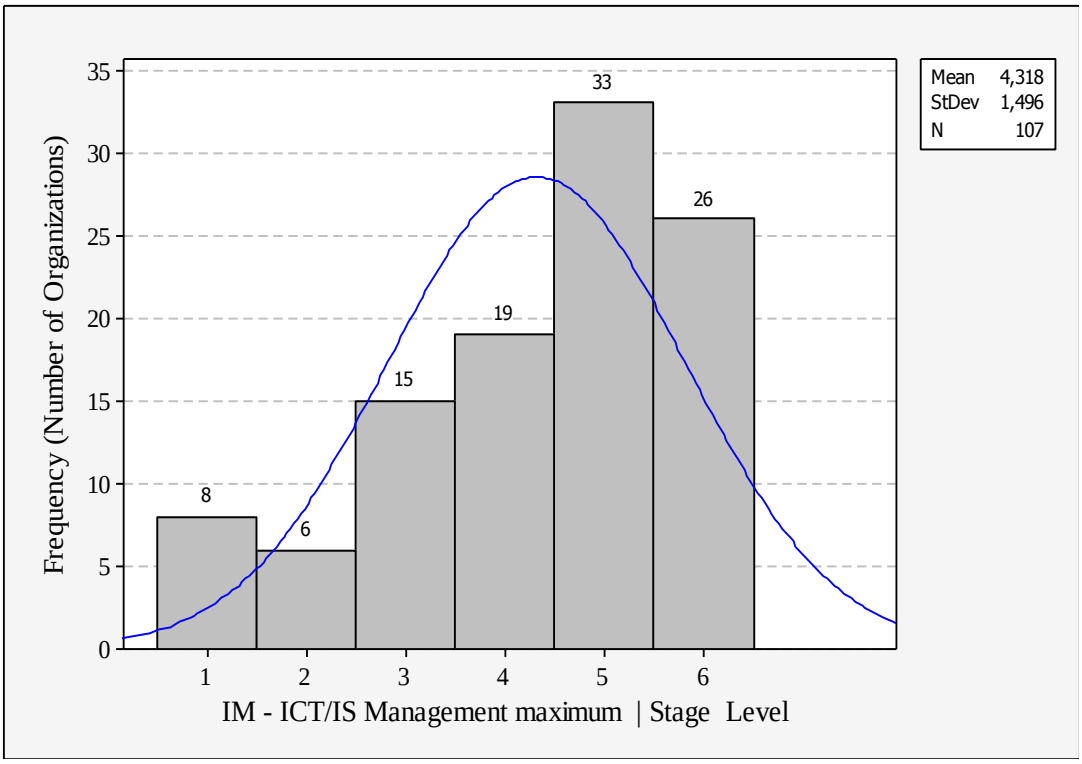
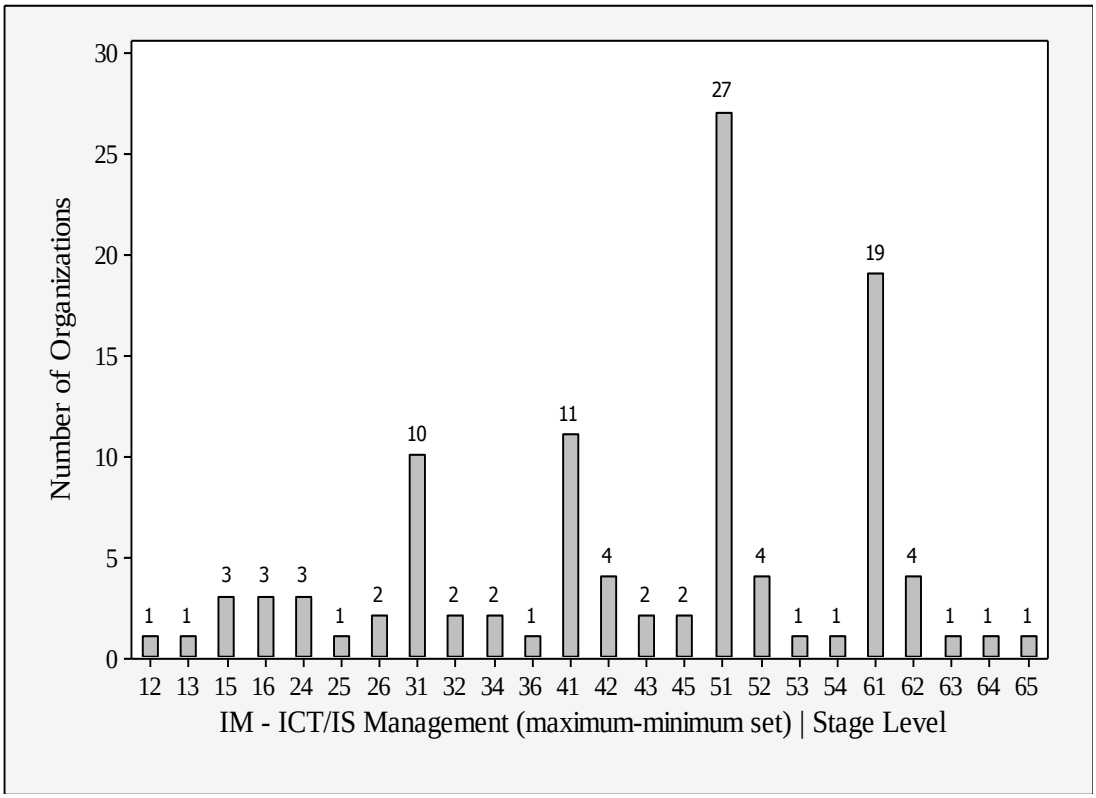


Figure 32 – IM ICT/IS Management (growth process) maximum marking in all of the stages level by the number of organizations

Source: Created by the Author



(a)



(b)

Figure 33 – (a) histogram of IM ICT/IS Management (growth process) maximum marking in all of the stages level; (b) IM maximum and minimum set (stages level) by the number of organizations

Source: Created by the Author

Appendix O – UC-User Community (growth process) in all stages level

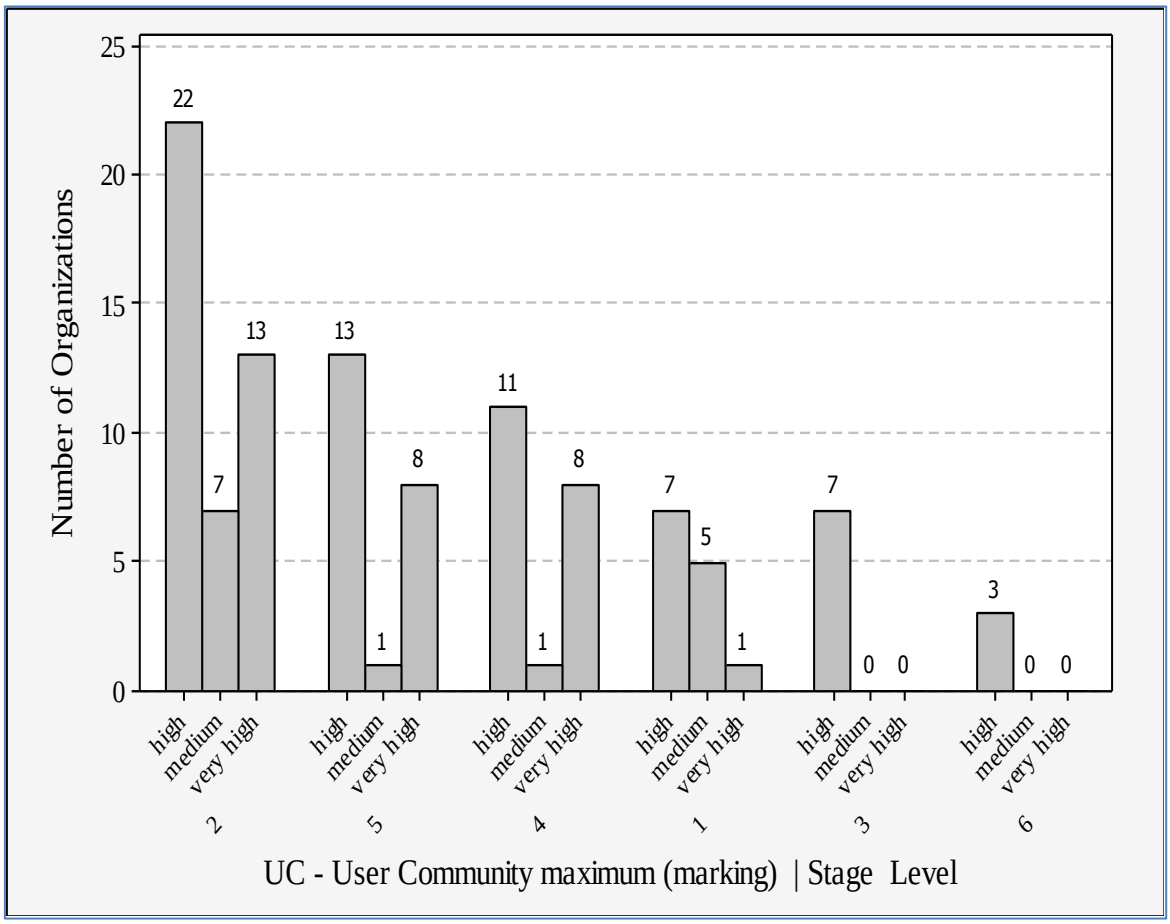
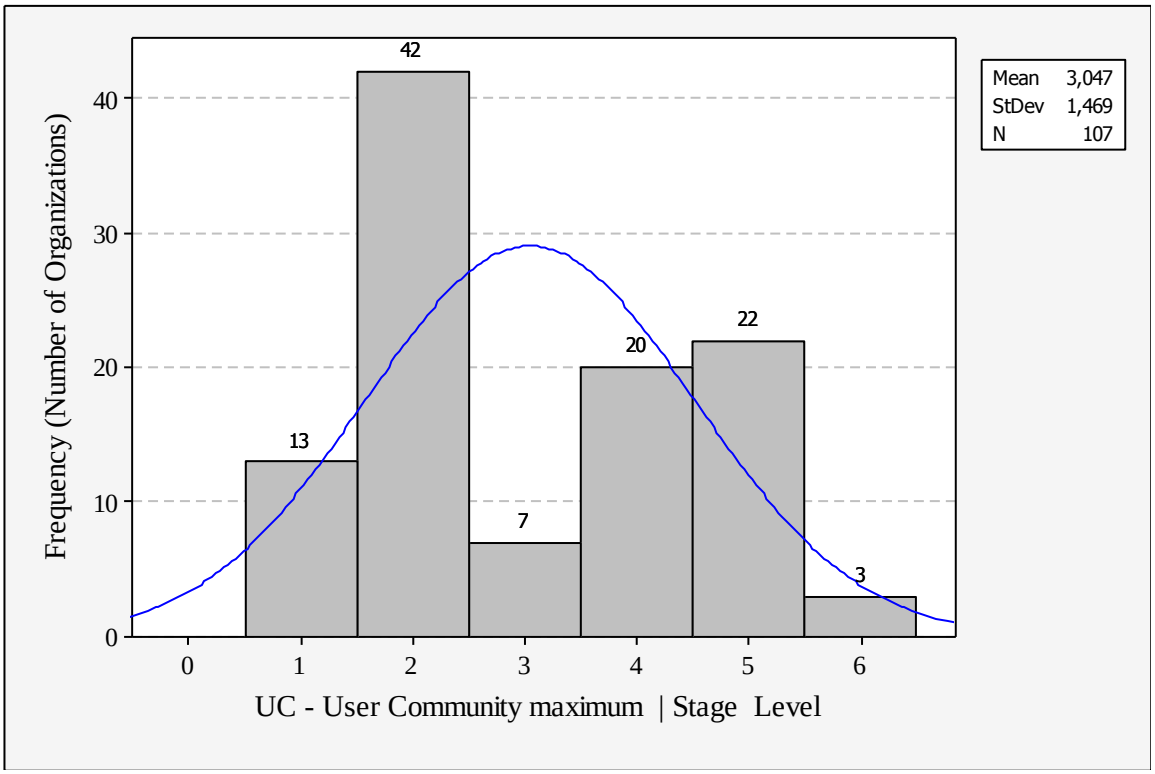
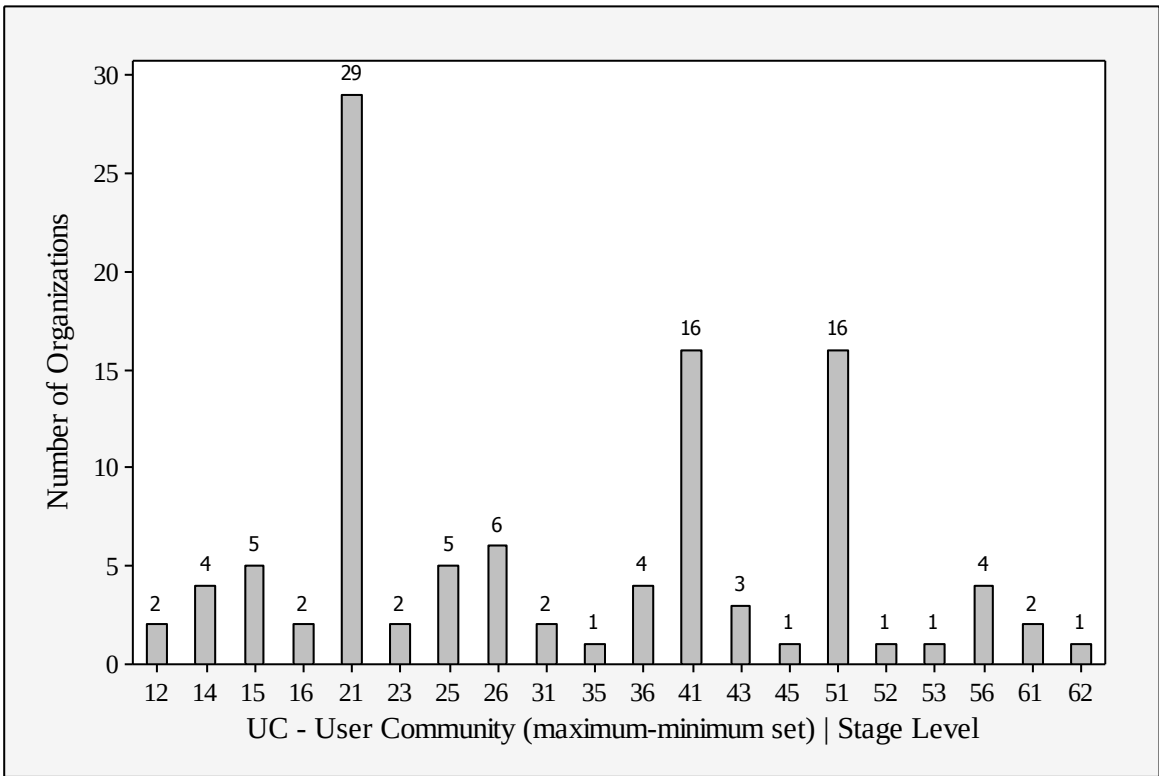


Figure 34 – UC ICT/IS Resources (growth process) maximum marking in all of the stages level by the number of organizations

Source: Created by the Author



(a)



(b)

Figure 35 – (a) histogram of UC User Community (growth process) maximum marking in all of the stages level; (b) UC maximum and minimum set (stages level) by the number of organizations

Source: Created by the Author

Appendix P – EG-Emerging ICT/IS (growth process) in all stages level

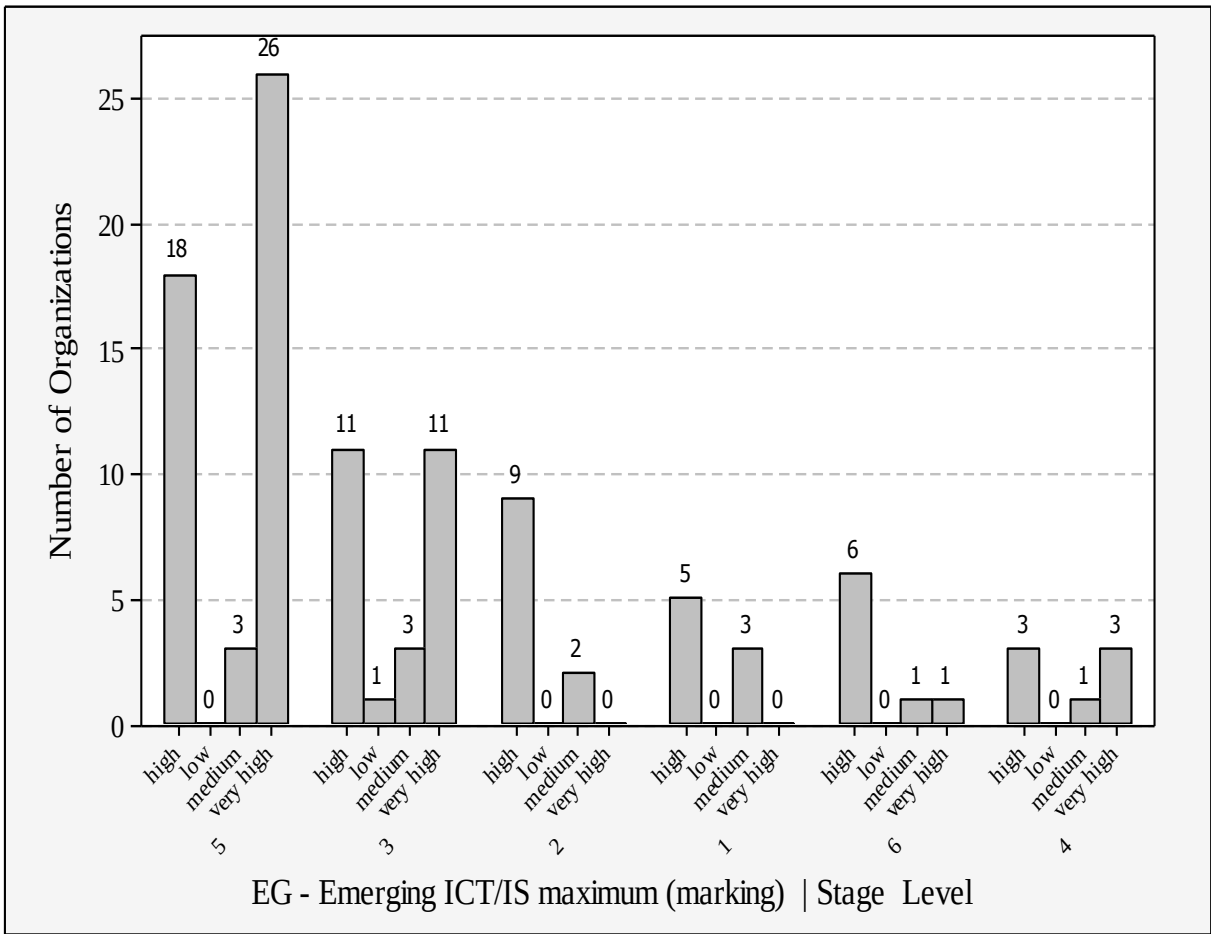
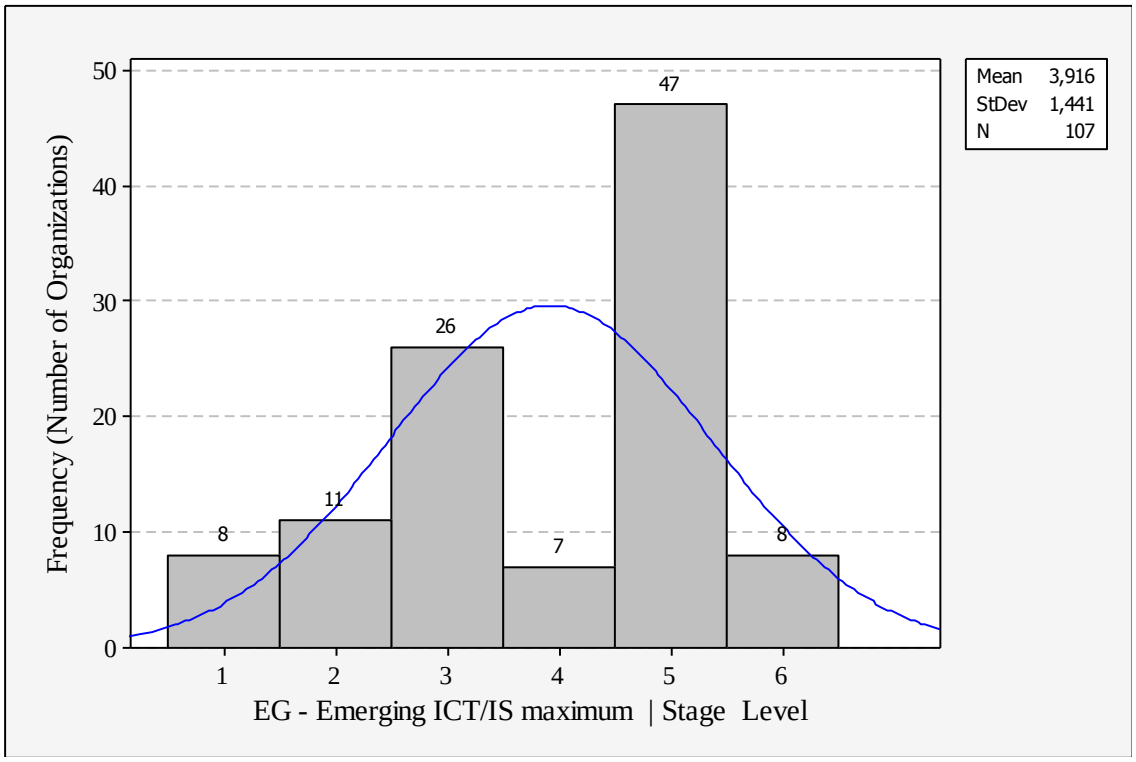
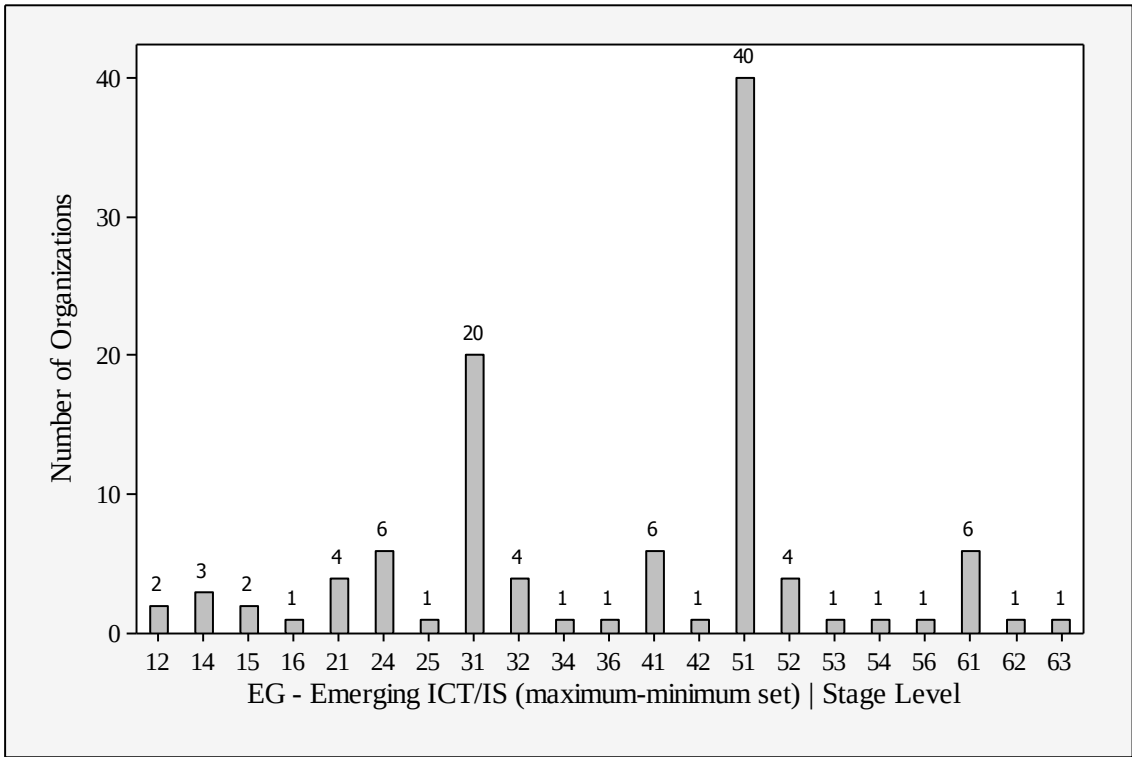


Figure 36 – Emerging ICT/IS (growth process) maximum marking in all of the stages level by the number of organizations

Source: Created by the Author



(a)



(b)

Figure 37 – (a) histogram of EG Emerging ICT/IS (growth process) maximum marking in all of the stages level; (b) EG maximum and minimum set (stages level) by the number of organizations

Source: Created by the Author

Appendix Q – Measurement assessment to Stage IV

Table 22 – Measurement assessment by PLS-SEM to Stage IV (Cross Loading)

Indicator	(**AP4**) Application Portfolio	(**EG4**) Emerging ICT/IS	(**IM4**) ICT/IS Management practices	(**IR4**) ICT/IS Resources	(**UC4**) User Community	Exploitation	Exploration
AP42	**0.679**	0.455	0.310	0.294	0.328	0.283	0.132
AP44	**0.873**	0.613	0.544	0.447	0.603	0.323	0.316
EG41	0.567	**0.753**	0.419	0.515	0.505	0.435	0.249
EG43	0.568	**0.846**	0.588	0.602	0.550	0.329	0.322
EG44	0.518	**0.788**	0.565	0.378	0.571	0.412	0.384
IM41	0.438	0.574	**0.858**	0.411	0.503	0.352	0.441
IM42	0.547	0.581	**0.887**	0.461	0.635	0.433	0.538
IR41	0.249	0.319	0.251	**0.612**	0.286	0.141	0.116
IR42	0.403	0.557	0.489	**0.847**	0.416	0.318	0.373
IR43	0.451	0.552	0.396	**0.851**	0.514	0.380	0.267
UC42	0.580	0.557	0.498	0.445	**0.797**	0.327	0.262
UC43	0.464	0.385	0.448	0.339	**0.696**	0.278	0.123
UC44	0.357	0.579	0.535	0.416	**0.766**	0.478	0.478
inep01	0.275	0.381	0.402	0.228	0.358	**0.824**	0.508
inep04	0.307	0.320	0.213	0.334	0.306	**0.728**	0.252
inep05	0.336	0.441	0.422	0.347	0.464	**0.805**	0.453
inex02	0.348	0.353	0.534	0.331	0.321	0.383	**0.854**
inex03	0.252	0.326	0.453	0.274	0.378	0.456	**0.869**
inex04	0.204	0.364	0.485	0.290	0.320	0.533	**0.884**

Source: Elaborated by the Author based on the sample of respondents
Note: Statistical significance was estimated using bootstrap with 107 registers (sample size) and the use of 5,000 subsamples (Hair, Hult, et al., 2017).

Table 23 – Measurement assessment by PLS-SEM to Stage IV (Outer Loadings)

	Original Sample (O)	**Standard Deviation (STDEV)**	**T Statistics (|O/STDEV|)**	***p-value***
AP42 <- (AP4) Application Portfolio	0.679	0.126	5.390	0.000
AP44 <- (AP4) Application Portfolio	0.873	0.037	23.396	0.000
EG41 <- (EG4) Emerging ICT/IS	0.753	0.055	13.764	0.000
EG43 <- (EG4) Emerging ICT/IS	0.846	0.030	28.108	0.000
EG44 <- (EG4) Emerging ICT/IS	0.788	0.050	15.770	0.000
IM41 <- (IM4) ICT/IS Management practices	0.858	0.038	22.635	0.000
IM42 <- (IM4) ICT/IS Management practices	0.887	0.020	45.260	0.000
IR41 <- (IR4) ICT/IS Resources	0.612	0.110	5.579	0.000
IR42 <- (IR4) ICT/IS Resources	0.847	0.037	23.179	0.000
IR43 <- (IR4) ICT/IS Resources	0.851	0.036	23.497	0.000
UC42 <- (UC4) User Community	0.797	0.050	15.955	0.000
UC43 <- (UC4) User Community	0.696	0.079	8.813	0.000
UC44 <- (UC4) User Community	0.766	0.072	10.565	0.000
inep01 <- Exploitation	0.824	0.033	24.987	0.000
inep04 <- Exploitation	0.728	0.088	8.305	0.000
inep05 <- Exploitation	0.805	0.048	16.597	0.000
inex02 <- Exploration	0.854	0.037	22.850	0.000
inex03 <- Exploration	0.869	0.040	21.566	0.000
inex04 <- Exploration	0.884	0.027	32.655	0.000

Source: Elaborated by the Author based on the sample of respondents
Note: Statistical significance was estimated using bootstrap with 107 registers (sample size) and the use of 5,000 subsamples (Hair, Hult, et al., 2017).

Appendix R – Measurement assessment to Stage V

Table 24 – Measurement assessment by PLS-SEM to Stage V (Cross Loading)

Indicator	(**AP5**) Application Portfolio	(**EG5**) Emerging ICT/IS	(**IM5**) ICT/IS Management practices	(**IR5**) ICT/IS Resources	(**UC5**) User Community	Exploitation	Exploration
AP51	**0.843**	0.460	0.579	0.576	0.435	0.377	0.332
AP52	**0.668**	0.398	0.485	0.570	0.286	0.508	0.454
AP53	**0.767**	0.568	0.440	0.478	0.503	0.422	0.279
EG51	0.390	**0.719**	0.285	0.237	0.227	0.323	0.370
EG52	0.458	**0.841**	0.333	0.321	0.349	0.317	0.564
EG53	0.568	**0.754**	0.546	0.453	0.426	0.410	0.414
IM51	0.507	0.400	**0.790**	0.509	0.343	0.291	0.276
IM52	0.566	0.457	**0.875**	0.569	0.458	0.460	0.372
IM54	0.527	0.414	**0.762**	0.470	0.446	0.508	0.565
IR52	0.643	0.351	0.532	**0.776**	0.313	0.350	0.425
IR53	0.505	0.393	0.480	**0.794**	0.424	0.394	0.288
IR54	0.482	0.301	0.460	**0.739**	0.419	0.322	0.286
UC51	0.447	0.257	0.432	0.350	**0.744**	0.354	0.159
UC52	0.377	0.314	0.485	0.482	**0.794**	0.291	0.346
UC53	0.391	0.451	0.207	0.262	**0.697**	0.294	0.220
inep01	0.402	0.409	0.424	0.350	0.268	**0.824**	0.508
inep04	0.387	0.229	0.295	0.285	0.341	**0.727**	0.252
inep05	0.540	0.419	0.488	0.445	0.389	**0.806**	0.453
inex02	0.415	0.533	0.430	0.422	0.315	0.383	**0.854**
inex03	0.417	0.534	0.391	0.380	0.305	0.456	**0.869**
inex04	0.368	0.461	0.475	0.337	0.242	0.533	**0.883**

Source: Elaborated by the Author based on the sample of respondents
Note: Statistical significance was estimated using bootstrap with 107 registers (sample size) and the use of 5,000 subsamples (Hair, Hult, et al., 2017).

Table 25 – Measurement assessment by PLS-SEM to Stage V (Outer Loadings)

	Original Sample (O)	Standard Deviation (STDEV)	T Statistics (|O/STDEV|)	P Values
AP51 <- (AP5) Application Portfolio	0.843	0.050	16.699	0.000
AP52 <- (AP5) Application Portfolio	0.668	0.093	7.194	0.000
AP53 <- (AP5) Application Portfolio	0.767	0.057	13.367	0.000
EG51 <- (EG5) Emerging ICT/IS	0.719	0.088	8.170	0.000
EG52 <- (EG5) Emerging ICT/IS	0.841	0.043	19.743	0.000
EG53 <- (EG5) Emerging ICT/IS	0.754	0.054	13.898	0.000
IM51 <- (IM5) ICT/IS Management practices	0.790	0.048	16.537	0.000
IM52 <- (IM5) ICT/IS Management practices	0.875	0.027	32.320	0.000
IM54 <- (IM5) ICT/IS Management practices	0.762	0.056	13.503	0.000
IR52 <- (IR5) ICT/IS Resources	0.776	0.045	17.098	0.000
IR53 <- (IR5) ICT/IS Resources	0.794	0.041	19.431	0.000
IR54 <- (IR5) ICT/IS Resources	0.739	0.072	10.200	0.000
UC51 <- (UC5) User Community	0.744	0.089	8.324	0.000
UC52 <- (UC5) User Community	0.794	0.045	17.614	0.000
UC53 <- (UC5) User Community	0.697	0.085	8.185	0.000
inep01 <- Exploitation	0.824	0.034	24.379	0.000
inep04 <- Exploitation	0.727	0.087	8.325	0.000
inep05 <- Exploitation	0.806	0.049	16.397	0.000
inex02 <- Exploration	0.854	0.037	22.838	0.000
inex03 <- Exploration	0.869	0.041	21.412	0.000
inex04 <- Exploration	0.883	0.027	32.147	0.000

Source: Elaborated by the Author based on the sample of respondents
Note: Statistical significance was estimated using bootstrap with 107 registers (sample size) and the use of 5,000 subsamples (Hair, Hult, et al., 2017).

Appendix S – Measurement assessment to Stage VI

Table 26 – Measurement assessment by PLS-SEM to Stage VI (Cross Loading)

Indicator	(**AP6**) Application Portfolio	(**EG6**) Emerging ICT/IS	(**IM6**) ICT/IS Management practices	(**IR6**) ICT/IS Resources	(**UC6**) User Community	Exploitation	Exploration
AP61	**0.810**	0.534	0.387	0.526	0.478	0.474	0.368
AP62	**0.787**	0.513	0.468	0.492	0.240	0.074	0.301
AP63	**0.639**	0.408	0.331	0.275	0.309	0.311	0.273
EG62	0.572	**0.875**	0.605	0.537	0.452	0.586	0.568
EG64	0.549	**0.846**	0.504	0.475	0.388	0.500	0.383
IM61	0.505	0.490	**0.764**	0.532	0.294	0.394	0.345
IM63	0.438	0.601	**0.811**	0.494	0.308	0.371	0.445
IM64	0.265	0.392	**0.741**	0.529	0.217	0.276	0.259
IR62	0.414	0.435	0.378	**0.729**	0.383	0.267	0.216
IR63	0.520	0.533	0.717	**0.814**	0.411	0.358	0.433
IR64	0.448	0.410	0.435	**0.815**	0.252	0.314	0.381
UC63	0.386	0.428	0.365	0.417	**0.857**	0.431	0.086
UC64	0.340	0.338	0.174	0.273	**0.713**	0.237	0.234
inep01	0.376	0.523	0.399	0.338	0.292	**0.825**	0.508
inep04	0.299	0.488	0.245	0.267	0.332	**0.728**	0.252
inep05	0.464	0.487	0.404	0.336	0.417	**0.804**	0.453
inex02	0.306	0.494	0.389	0.391	0.125	0.383	**0.854**
inex03	0.443	0.492	0.396	0.373	0.220	0.456	**0.869**
inex04	0.257	0.469	0.412	0.399	0.142	0.533	**0.884**

Source: Elaborated by the Author based on the sample of respondents
Note: Statistical significance was estimated using bootstrap with 107 registers (sample size) and the use of 5,000 subsamples (Hair, Hult, et al., 2017).

Table 27 – Measurement assessment by PLS-SEM to Stage VI (Outer Loadings)

	Original Sample (O)	Standard Deviation (STDEV)	T Statistics (|O/STDEV|)	P Values
AP61 <- (AP6) Application Portfolio	0.810	0.038	21.292	0.000
AP62 <- (AP6) Application Portfolio	0.787	0.056	13.975	0.000
AP63 <- (AP6) Application Portfolio	0.639	0.098	6.507	0.000
EG62 <- (EG6) Emerging ICT/IS	0.875	0.022	39.679	0.000
EG64 <- (EG6) Emerging ICT/IS	0.846	0.038	22.146	0.000
IM61 <- (IM6) ICT/IS Management practices	0.764	0.063	12.217	0.000
IM63 <- (IM6) ICT/IS Management practices	0.811	0.048	16.965	0.000
IM64 <- (IM6) ICT/IS Management practices	0.741	0.081	9.196	0.000
IR62 <- (IR6) ICT/IS Resources	0.729	0.071	10.344	0.000
IR63 <- (IR6) ICT/IS Resources	0.814	0.036	22.333	0.000
IR64 <- (IR6) ICT/IS Resources	0.815	0.065	12.583	0.000
UC63 <- (UC6) User Community	0.857	0.062	13.737	0.000
UC64 <- (UC6) User Community	0.713	0.123	5.777	0.000
inep01 <- Exploitation	0.825	0.036	23.226	0.000
inep04 <- Exploitation	0.728	0.081	8.971	0.000
inep05 <- Exploitation	0.804	0.050	16.085	0.000
inex02 <- Exploration	0.854	0.039	21.908	0.000
inex03 <- Exploration	0.869	0.041	21.439	0.000
inex04 <- Exploration	0.884	0.029	30.858	0.000

Source: Elaborated by the Author based on the sample of respondents
Note: Statistical significance was estimated using bootstrap with 107 registers (sample size) and the use of 5,000 subsamples (Hair, Hult, et al., 2017).

Table 28 – Measurement assessment to Stage VI (AVE, CR and R square) – LVs of 1st order

Stage VI – LV of 1st order	1	2	3	4	5	6	7
1 - (AP6) Application Portfolio	**0.749**						
2 - (EG6) Emerging ICT/IS	0.652	**0.861**					
3 - (IM6) ICT/IS Management practices	0.531	0.647	**0.772**				
4 - (IR6) ICT/IS Resources	0.591	0.590	0.669	**0.787**			
5 - (UC6) User Community	0.460	0.490	0.357	0.447	**0.788**		
6 - Exploitation	0.488	0.632	0.454	0.402	0.439	**0.787**	
7 - Exploration	0.384	0.557	0.459	0.446	0.187	0.529	**0.869**
Average Variance Extracted (AVE)	0.561	0.741	0.597	0.619	0.621	0.619	0.755
Composite Reliability (CR)	0.792	0.851	0.816	0.830	0.765	0.829	0.902
R Square	0.665	0.719	0.687	0.720	0.393	0.719	0.807

Source: Elaborated by the Author based on research data
Note: The square root of the Average Variance Extracted (AVE) is distributed along the main diagonal, in bold.