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JOSÉ EDUARDO RICCIARDI FAVARETTO

**STAGE LEVEL MEASUREMENT OF INFORMATION AND
COMMUNICATION TECHNOLOGY IN ORGANIZATIONS**

SÃO PAULO
2015

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Dissertação apresentada à Escola de Administração de Empresas de São Paulo da Fundação Getúlio Vargas, como requisito para obtenção do título de Mestre em Administração de Empresas.

Campo de Conhecimento:
Administração, Análise e Tecnologia de Informação

Orientador: Prof. Dr. Fernando de Souza Meirelles

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Banca examinadora:

Prof. Dr. Fernando de Souza Meirelles
(Orientador) FGV – EAESP

Prof. Dr. Diógenes de Souza Bido
Universidade Presbiteriana Mackenzie – SP

Prof. Dr. Eduardo Henrique Diniz
FGV – EAESP

Aos meus pais, não mais entre nós, mas todos os dias em meus pensamentos.

À minha mulher e meus três filhos - a família que pedi a Deus.

Aos meus familiares que participaram de alguma forma desta jornada.

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"The important thing is not to stop questioning. Curiosity has its own reason for existing."
Albert Einstein
US (German-born) physicist (1879 - 1955)

RESUMO

Na moderna Economia do Conhecimento, na Era do Big Data, entender corretamente o uso e a gestão da Tecnologia de Informação e Comunicação (TIC) tendo como base o campo acadêmico de estudos de Sistemas de Informação (SI), torna-se cada vez mais relevante e estratégico para as organizações que pretendem: permanecer em atividade, estar aptas para atender novas demandas (internas e externas) e enfrentar as complexas mudanças na competição de mercado. Esta pesquisa utiliza a teoria dos estágios de crescimento, fundamentada pelos estudos de Richard L. Nolan nos anos 70. A literatura acadêmica relacionada com modelos de estágios de crescimento e o contexto do campo de estudo de SI, fornecem as bases conceituais deste estudo. A pesquisa identifica um modelo com seus construtos relacionados aos estágios de crescimento das iniciativas da TIC/SI organizacional, partindo das variáveis de *benchmark* de segundo nível de Nolan, e propõe sua operacionalização com a criação e desenvolvimento de uma escala. De caráter exploratório e descritivo, a pesquisa traz contribuição teórica ao paradigma da teoria dos estágios de crescimento, adicionando um novo processo de crescimento em sua estrutura conceitual. Como resultado, é disponibilizado além de um instrumento de escala bilíngue (português e inglês), recomendações e regras para aplicação de um instrumento de pesquisa do tipo *survey*, na continuidade deste estudo. Como implicação geral desta pesquisa, é esperado que seu uso e aplicação ao mensurar a avaliação do nível de estágio da TIC/SI em organizações, possam auxiliar dois perfis de indivíduos: acadêmicos que estudam essa temática, assim como, profissionais que buscam respostas de suas ações práticas nas organizações onde trabalham.

Palavras-chave: teoria de estágios, estágios de crescimento, modelo de Nolan, nível de estágio da TIC/SI, modelo de estágio.

ABSTRACT

In the modern Knowledge Economy, in the Big Data Era, properly understand the use and management of Information and Communication Technology (ICT) based on the academic field of the studies of Information Systems (IS), becomes increasingly important and strategic for organizations who seek: to remain active, to be able to meet new demands (internal and external) and to face the complex changes in market competition. This research uses the theory of stages of growth, substantiated by the studies of Richard L. Nolan in the 70s. The academic literature related to stages of growth models and the context of IS study field, provide the conceptual bases for this study. The research identifies a framework with its constructs related to the growth stages of the organizational initiatives of ICT/IS, starting from Nolan's second level of benchmark variables, and proposes its implementation with the creation and development of a scale. With exploratory and descriptive characteristic, the research brings theoretical contribution to the paradigm of the stages of growth theory, adding a new growth process in its conceptual structure. As a result, it is provided a bilingual scale instrument (Portuguese and English), as well as, recommendations and rules for application of a survey type research instrument, to the continuity of this study. As a general implication of this research, it is expected that its use and application in measuring the stage level assessment of ICT/IS in organizations, can assist two types of individuals: academicians who study this thematic, as well as, practitioners seeking answers to their practical actions in organizations where they work.

Keywords: stages theory, stages of growth, Nolan's model, ICT/IS stage level, stage model.

LIST OF ABBREVIATIONS AND ACRONYMS

- ACM – Association for Computing Machinery
- AIS or AISNET – Association for Information Systems
- AP – Information Systems Applications Portfolio Processes [of ICT]
- BYOD – Bring Your Own Device
- CAD / CAM – Computer-Aided Design / Computer-Aided Manufacturing
- CFA – Confirmatory Factorial Analysis
- CIO – Chief Information Officer
- DP – Data Processing
- EDP – Electronic Data Processing
- EUC – End-User Computing
- EG – Information Systems Emerging Processes [of ICT]
- GPS – Global Positioning System
- HBR – Harvard Business Review
- HBS – Harvard Business School
- IaaS – Infrastructure as a Service
- ICT – Information and Communication Technology
- ICT/IS – Information and Communication Technology / Information Systems
- IM – Information Systems Management Processes [of ICT]
- IR – Information Systems Resource Processes [of ICT]
- IS – Information Systems
- IT – Information Technology
- MIS – Management Information Systems
- NSGM – Nolan’s Stages of Growth Model
- NSGT – Nolan’s Stages of Growth Theory
- PaaS – Platform as a Service
- PC – Personal Computer
- RFID – Radio Frequency Identification
- SaaS – Software as a Service
- 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]
- URL – Uniform Resource Locator

SUMMARY

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1 INTRODUCTION

Stages of Growth Theory (SGT) has been used to describe a wide variety of growth phenomena in diverse study fields, during their formative periods of knowledge, in biological growth, growth of galaxies, in the study of economic development of nations in the 19th century (Nolan, 1973 p. 399), or in the organizational life cycle, product life cycle, assuming that predictable patterns - conceptualized in terms of stages - exist (King & Teo, 1997). These stages (1) are sequential in nature, (2) occur as a hierarchical progression that is not easily reversed, and (3) involve a broad range of organizational activities and structures (Lavoie & Culbert, 1978). According to stage models, organizations progress through a number of successive and identifiable stages - the inability of management to understand its organization development problems can result in a company becoming "frozen" in its present stage of evolution or, ultimately, in failure, regardless of market opportunities (Greiner, 1972, 1998).

The concept of Information Systems (IS) maturity dates back to the 1960s based on a report of field research regarding management planning and control of computer-based information systems in organizations, and the influence it was having on the various aspects of the managers' task (Churchill *et al.*, 1969). The generalizations which were derived from the study - despite being supported by persons involved in this field of study - did not make a valuable contribution, and it was considered just an introductory material to the field study.

In the academic field of Management Information Systems (MIS) studies, Nolan's Stages of Growth Theory (NSGT) first appeared in 1973, and is probably the most well-known and most widespread theoretical framework of the development of MIS for the assimilation of Information Technology (IT) in business organizations (Nolan *et al.*, 1993; Mutsaers *et al.*, 1998; Mattia, 2011). Nolan was the first researcher to introduce a structured scheme for explaining the growth of computing in organizations (King & Kraemer, 1984, p. 474), making statements regarding technical and organizational consequences.

Nolan's theory provides many insights of the ways in which technologies have evolved and continue to be evolve in organizations (Mutsaers *et al.*, 1998). As reported by the academic literature, for the developing of a stage theory, there are two key guidelines: 1) the characteristics of each stage should be distinctly described and empirically testable; and 2) the analytical relationship of any stage to its predecessor or successor should be well defined (Kuznets, 1965, pp. 213-216; Nolan, 1973, p. 400; Li et al, 1994, p. 4). In addition, it must be possible to identify what processes cause an element [in the systems] to move from one stage

to the next, over a period of time - with the identification of the elements and the conception of their growth through time (Nolan, 1973, p. 400).

Modern organizations must ever more be focused on maximizing Information and Communication Technology (ICT) performance, in order to be more competitive in their industries. They have been forced to continuously and organically re-organize and re-profile themselves, considering ICT as an important factor to help these changes (Mutsaers *et al.*, 1998). As the necessary organizational learning processes about ICT/IS take time, it is fundamental that each stage has to be passed through (Nolan & Koot, 1992, p. 4) – if the organization learning is explicitly managed in the course of each stage, a better result can be achieved in the group of these (Cash *et al.*, 1994, p. 259).

This way, to find out if the ICT/IS initiatives are properly used and managed by organization, some measurements about it need to be done when analyzing some prescriptive conditions - signaled by stages of growth - which may highlight how the organization's processes have high or low alignment, what they are, and how its measurement could be evaluated accurately. In other words it means, if it is possible to make use all the potential of the ICT processes integrated to the business alignment and deeply analyzed by the perspective of the IS study field, the organization can better understand the use and management of its ICT/IS initiatives. The literature related to stages of growth models and the context of MIS study field, provide the conceptual bases for this research (Nolan, 1973; Gibson & Nolan, 1974; Nolan, 1979, King & Teo, 1997). The rigor in use of theoretical concepts, methodological rules, addressed in additional preparation to empirical research efforts, was the focus of the author to study, understand, clarify and integrate all the pieces of a huge puzzle, which got its start about 40 years ago. The research question to this study is: How can we measure the Nolan's stage level of ICT/IS initiatives in organizations?

The main purpose of this academic research, based on NSGT/MIS, is to identify a model, starting from Nolan's second level of benchmark variables (Nolan, 1979), and operationalize it with a scale creation and development. The complementary purpose is to describe an appropriate formatting of a data collection instrument (survey type), to be used in a future empirical study, based on a Likert classification options (Likert 1932; Brown, 2011) and in a grading systems, in order to allow the stage level measurement of the ICT initiatives in organizations.

It was evidenced in this work that academic research interest in the NSGT paradigm decreased over the past two decades, since the studies with such discussions dating back the 90s (Lyytinen, 1991; Grégoire & Lustman, 1993; Li *et al.*, 1994; Mutsaers *et al.*, 1998) and were not located more recent studies that explore in depth the SGT in Information Systems and the NSGT/MIS, with the purpose to seek new theoretical and/or empirical contributions, to the theoretical body of the paradigm or to the stage model (framework) proposed by Nolan. Despite this, based on the academic literature, a variety of studies and researchers have been found (Damsgaard & Scheepers, 2000; Watson *et al.*, 2001; Prananto *et al.*, 2003; Gottschalk & Khandelwal, 2004; Gottschalk & Solli-Sæther, 2008; Mattia, 2011; Ditlev-Simonsen & Gottschalk, 2011; Grant *et al.*, 2013; Mergel & Bretschneider, 2013), which reiterate the importance that the SGT and Nolan studies represent for the Information Systems field, although limited to only cite them in their work, that use some kind of a stage of growth model, this being a particular thematic or subject studied by these researchers. On the other hand, the academic literature also points out that the Nolan model, with its intuitive appeal and utility (Benbasat *et al.*, 1984; Lyytinen, 1991; Grégoire & Lustman, 1993; Mutsaers *et al.*, 1998), has acceptance and recognition among practitioners (King & Kraemer, 1984; Sääksjärvi, 1985; Mutsaers *et al.*, 1998), which make their use in the management of organizational initiatives of ICT, with the interest in identifying where in the Nolan curve their organizations are located (Nolan & Koot, 1992, p. 8). So, there is the need to be rescued the discussion of this paradigm, widely cited in the field of Information Systems studies, with the dedication of more time for research and exploration of the existing "gaps", theoretical or empirical, exploring new methodological structures, taking advantage of new statistical techniques, using the most current software tools, larger empirical samples with qualified respondents, online data collection instruments via survey on the Internet, and also seek to meet the expectations of practical use in organizations, now seen by the vision of the modern times. This research will bring theoretical contribution to the IS field and it is expected that its use and application in the study of ICT/IS in organizations can assist both sides: academicians who study this thematic, as well as practitioners seeking answers to their practical actions in the organizations where they work.

The use of ICT/IS abbreviation or acronyms will be employed in a variety of parts of this research text, and always will be related to the use and management of technology in organizations, involving not only the technical aspects, but additionally aspects of infrastructure, management team/staff, resources, processes, users, concerning the planning, organizing and controlling activities associated with managing the organizational initiatives.

2 STAGES OF GROWTH THEORY AND 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 (Nolan & Croson, 1995).

Nolan's SGT also received influence from Larry Greiner's 1972 seminal Harvard Business Review (HBR) article "Evolution and Revolution as Organizations Grow". In this article, the author mentioned the terms "evolution" (prolonged periods of growth in which do not occur any major changes in organizational practices) and "revolution" (periods of substantial turbulence in the organization life), explaining as organizations progress through stages of development, with each evolution period creating its own revolution and some key dimensions emerge as essential for building a model of organization development: age and size of the organization, stages of evolution and revolution, besides the growth rate of the industry where the organization is inserted (Greiner, 1972, 1998). Another researcher (Venkatraman, 1994), also developed studies that followed this focus, concerning evolutionary and revolutionary levels of IT-enabled business transformation - a schematic representation of Venkatraman framework (adapted) is illustrated by the Figure 1.

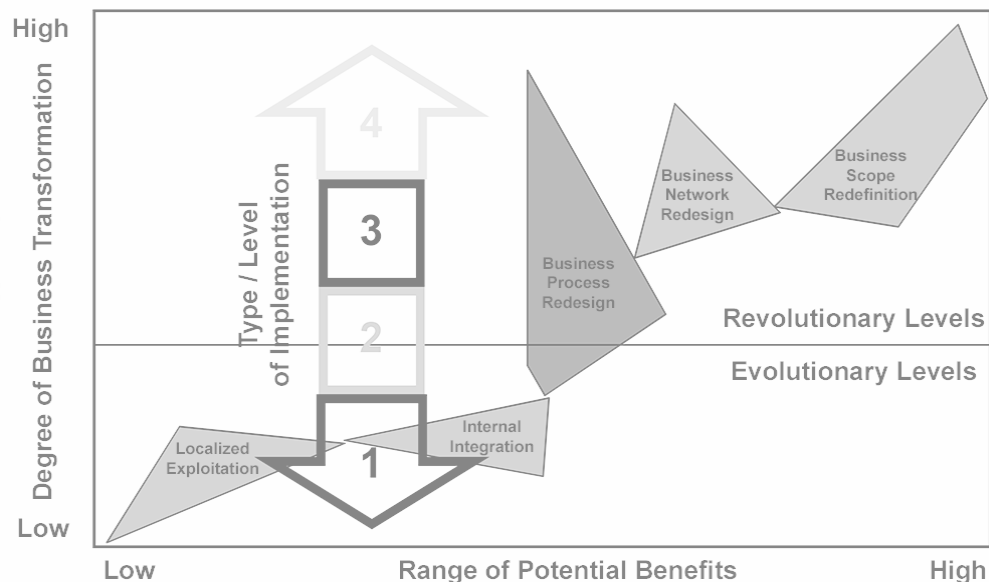


Figure 1 – Levels of IT-Enabled Business Transformation
Source: Adapted by Meirelles (2014) from Venkatraman (1994, p. 74)

The model proposed by Venkatraman (Figure 1) describes levels where each organization can identify a way of conceptualizing the relationship between the role of the IT and the business,

in order to explore this potential. The levels start from evolutionary level of localized exploitation and go up to revolutionary level of business scope redefinition.

The original concept behind the NSGT was proposed by Richard L. Nolan in 1973 in the article “Managing the Computer Resource: A Stage Hypothesis”, published in Communications of ACM journal (Nolan, 1973; Mutsaers *et al.*, 1998; Mattia, 2011), where a descriptive stage hypothesis was presented, based on the study of expenditures for Data Processing (DP). When their articles were published, Greiner and Nolan were both at the Harvard Business School, and this contemporaneity can explain some influence of the Greiner’s model in the Nolan’s model. While Greiner has proposed a model of corporate [structural growth] evolution in which business organizations would move through five phases of growth - doing the transition from small to large (in sales volume and number of employees) and from young to mature - where each phase would be distinguished by an evolution from the prior phase and then by a revolution or crisis, which could precipitate a jump into the next phase (Churchill & Lewis, 1983), Nolan has suggested a descriptive model where the planning, organization and control of organizational activities associated with the assimilation of computer technologies (now ICT/IS initiatives), would change in feature over a period of time, and could evolve in patterns roughly correlated to four stages (phases) of the computer budget growth (now ICT/IS expenditures) (Nolan, 1973).

Just to be comparable, in Greiner’s model each evolutionary phase was characterized by a particular managerial style and each revolutionary period by a dominant management problem faced by the company (Churchill & Lewis, 1983), and in the Nolan’s Stages of Growth Model (NSGM) each stage was described and related to individual tasks for managing the ICT resources, based on the notion that the complicated nature of the technology would generate a body of knowledge on the effective management it in the organization (Nolan & Bennis, 2002).

Throughout the last decades of diversification of technology, the structure of growth stages has been used to understand the effect of adoption of new technologies of information and communication in organizations. According Nolan, the Stages Theory was developed to help managers understand the role and evolution of computers in their organizations, by plotting their annual computer expenditures (budget for computing) in an "S-shaped" curve (Nolan, 1973, p. 401; Nolan, 1975, p. 9; Nolan *et al.*, 1993, p.1). Nolan also found that the “S-shaped” curve reflects the organizational learning that occurs when an organization uses technologies

in their business operations and management - as organizations "learned" how to utilize ICT initiatives in their businesses, they spent more and more money developing this capability (Cash *et al.*, 1994, p. 259). In these organizations, spending begins slowly with the introduction of technology, and after a period of experimentation, expenditures now have a rapid growth, and remain increased until a certain level of maturity, where the pace remains slower, as shown by Figure 2.

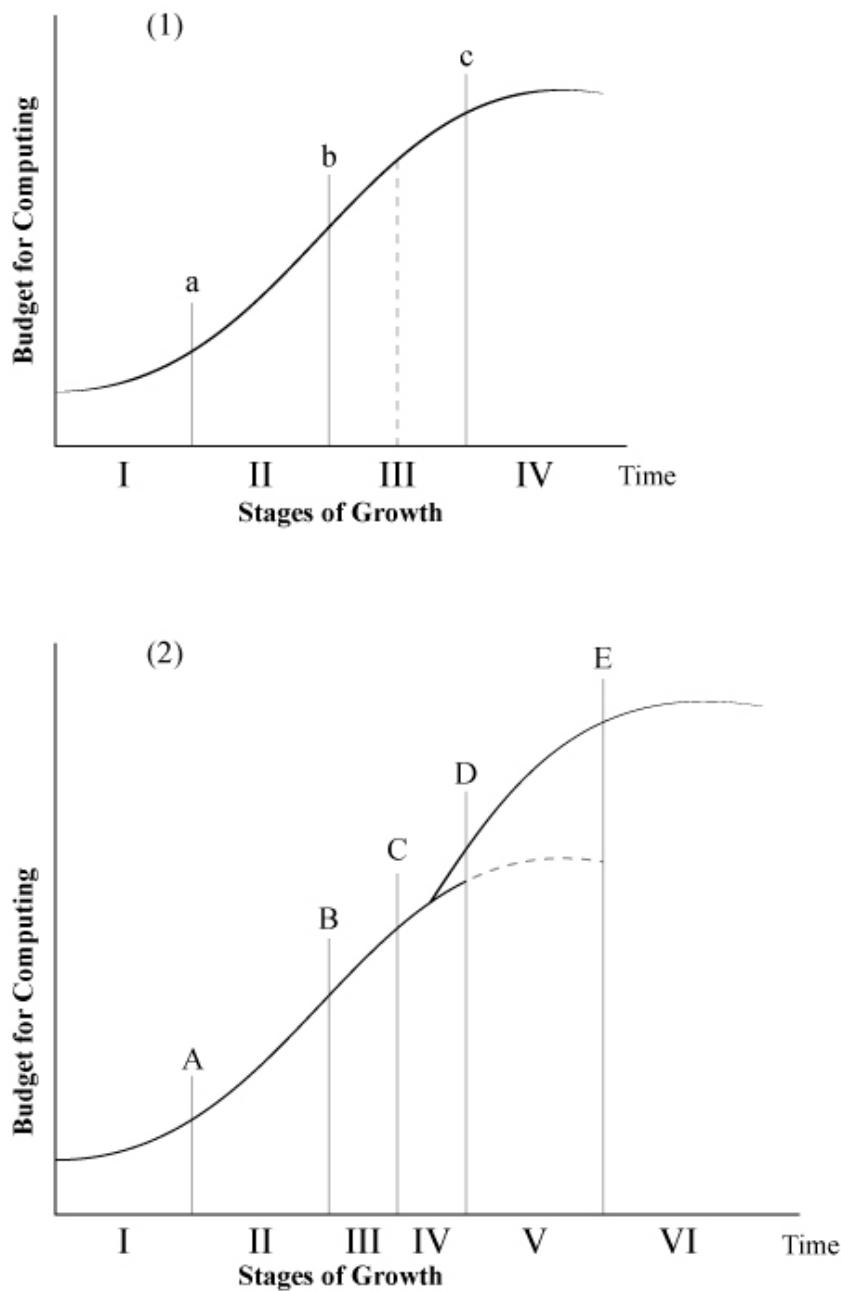


Figure 2 – Nolan's Stages of Growth Models, (1) Early version, (2) Later version
 Source: Adapted by the Author from Nolan (1973, p. 401), Nolan (1975, p. 9), King & Kraemer (1984, p. 467), Lyytinen (1991, p. 94) and Friedman (1994, p. 137)

Figure 2 illustrates the two versions of NSGM. The early version shown in Figure 2 (1), from 1973, presented a SGM for the evolution of computer technology based on four stages (Nolan, 1973, p. 401). The turning points (a, b, and c) in the budget for computing curve are transition points between stages of growth and break the "S-shaped" curve into four stages: I-Initiation, II-Contagion, III-Control, IV-Integration. Thus, each stage: origin–a, a–b, b–c, c–onwards, is characterized by certain application types, a development discipline (application targets), a management strategy, and a user control mechanisms (Lyytinen, 1991, p. 95).

A year later, the names of the stages were redefined as: I-Initiation, II-Expansion, III-Formalization, and IV-Maturity (Gibson & Nolan, 1974).

In the later version of NSGM initially presented in 1975, as shown in Figure 2 (2), 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, and each stage is delimited: origin–A, A–B, B–C, C–D, D–E and E–onwards.

In this new phase of his research, Nolan analyzed all the six stages in the perspective of concepts called "control" and "slack" (Mahmood & Becker, 1985). A "control" environment was characterized by the presence of elaborate management systems - ensuring use efficiency of computing, but restricting innovation - and a "slack" environment was characterized by a lack of such controls and a complacency of top management to spend more than strictly required - allowing inefficiencies, but stimulating innovation (King & Kraemer, 1984).

According to the reviewed academic literature (Nolan, 1979, p. 120; King & Kraemer, 1984 p. 467; Lyytinen, 1991, p. 94; Li *et al.*, 1994; Cash *et al.*, 1994, p. 259; Mutsaers *et al.*, 1998; Nolan, 2001, p. 1), the main characteristics of the six Nolan's stages model are:

- I. Initiation (origin–a; origin–A): Introduction of technologies into the organization to satisfy basic needs; initially limited investment and contained experimentation for proving the value of the ICT initiatives in the organization; management only slightly interested in solving the problems; minimal or almost nonexistent planning; slow growth in use; computerization problems arise caused by technology's role as a "change agent"; decentralized control; few applications are installed; there is a low level of automation in use by the organization.
- II. Contagion (a–b; A–B): Also known as "Expansion" stage. It represents a period of high learning in the organization whereby the ICT initiatives proliferate in a relatively uncontrolled manner; with low control and high slack, ICT adoption and

usage grows rapidly; experimentation is more heavily emphasized than is efficiency; rapid growth in the use and adoption of ICT due to senior management that is committed to explore and promote the potential of its initiatives; high expectations of the users (individuals or units), as organizational members, to experiment new uses of the ICT initiatives; the increase in costs is accelerated, committing more organizational resources than are strictly necessary to get the job done; beginning of centralization; little increase in planning and control to contain cost growth; intensive automation of operational work proliferates with no well-designed systems; management concentrates on introducing the innovation at all available opportunities.

- III. Control (b–c; B–C): Also known as "Formalization" stage. Uncontrolled growth derived from the Stage II eventually led to inefficiency, which created a demand for Stage III controls that slowed the growth to a more manageable rate; problems from bad design and rising costs create difficulties for users and management; top management imposes tighter controls to the ICT initiatives, "squeezing out" slack; ICT function is centralized; priorities in planning; the hierarchy position of ICT activity management in organization is accepted; standards established for documentation, operations and programming; high control and low slack promote efficiency but inhibit learning.
- IV. Integration (c–onwards; C–D): The accumulated learning led to a balance of managed controls and growth; costs continue to rise rapidly; users are more knowledgeable and capable in their participation in the ICT initiatives; management succeeds in striking a balance between slack and control to ICT initiatives; planning is well established; operations are more rational; database systems are brought and several key areas receive the implementation of database technology and data communication, the users perceive the real value of the ICT activity and demand more support from it.
- V. Data Administration (D–E): Organization focuses on introducing of data administration; the organizational ICT initiatives and data resources are tightly controlled; organization-wide integration of applications and databases takes place; the role of the so-called "data administrator", in managing data as a strategic resource and developing a corporate data architecture, becomes critical at this stage; users are effectively held accountable for data quality; the proliferation of new technologies throughout the organization brings new threats and

opportunities; new system development activities are focused on realizing highly-strategic business objectives, such as integration with suppliers and customers; as a consequence, the involvement of top management is increasing rapidly.

VI. Maturity (E-onwards): Controls remain very tight; planning becomes strategic; demand and supply about the ICT initiatives are balanced; the structure of the organizational systems application mirrors the organization and their information flows; from systems integration to flexible modules of functionality and complete network connectivity; the enterprise information system is configured by the user only adjusting some parameters; the users and the organization ICT staff are jointly responsible for the effectiveness of projects that use ICT initiatives; organization is capable to respond to the demands of the information age; the ICT activity from a technological phenomenon, driven by ICT experts, changes to a strategy-driven management resource; top management is highly involved with the ICT initiatives, considered the "heart" of organization business; organization develops strategic alliances with its customers and suppliers.

Although over two decades of its first edition, among numerous authors who have studied and suggested adjustments to the NSGM (King & Kraemer, 1984; Benbasat *et al.*, 1984; Mahmood & Becker, 1985; Sääksjärvi, 1985; ; Friedman, 1994; Li *et al.*, 1994; King & Teo, 1997; Mutsaers *et al.*, 1998), the most functional version often cited in academic literature keeps the use of six stages. But, there are reports of other authors with mention of the attempts to refine the final version of the Nolan's model, suggesting a higher number of stages, for example 8 stages (Friedman, 1994) or 9 stages (Mutsaers *et al.*, 1998).

Stage of Growth Model (SGM), are models which are built around assumptions and predictable patterns describing the evolution of capabilities along an anticipated or desired maturation path (Pöppelbuß & Röglinger, 2011), and have been used in the MIS field to understand growth processes and justify investments (Nolan, 1973, Gibson & Nolan 1973, 1974; Nolan 1979; Galliers & Sutherland, 2003), or to offer useful insights for the management of technological resources based on the premise that you can describe certain patterns of specific stages, where technical and organizational elements move through over time (Nolan *et al.*, 1993; Nolan, 2001; Mattia, 2011), and each stage reflects a particular level of alignment in terms of the use and management of ICT/IS in the organization. The applicability and usefulness of these models generate interest to academicians and practitioners (Röglinger *et al.*, 2012).

Academic literature of the last decades mentions the great struggle of many researchers to develop models of growth stages (Nolan, 1979; Kazanjian & Drazin, 1989; Burn, 1994; King & Teo, 1997, 2000; Prananto *et al.*, 2003; Ditlev-Simonsen & Gottschalk, 2011), which are both theoretically substantiated and empirically validated.

Many researchers have made efforts to access the Nolan model's validity and plausibility (Lucas & Sutton, 1977; Benbasat *et al.*, 1984; Huff *et al.*, 1988), one of the best-known, debated and controversial frameworks for describing the typical developmental patterns of ICT/IS initiatives in organizations (King & Kraemer, 1984; Benbasat *et al.*, 1984; Lyytinen, 1991; Mattia, 2011), with a high level of interest and acceptance among practitioners (Sääksjärvi, 1985), as a valuable empirically-based theory and accepted description of managing technological change over time (Mahmood & Becker, 1985).

Table 1 – Studies published in academic literature regarding Nolan's Stages of Growth Model

Researchers and Publications	Sample Size	Methodology	Number of Stages evaluated	Issue Examined / Finding / Results
Nolan (1973)	3 firms	case study	4	proposed the theory of stages in MIS without empirical test
Lucas & Sutton (1977)	29 firms	questionnaire and interview	4	"S" shaped budget curve not confirmed; did not invalidate the stages of growth
Nolan (1979)	35 firms + a large number of IBM costumers	case study	6	analyzed the technology expenditures applied in various industries in terms of stages; emphasizes the importance of data management; reported 5 guidelines for managing the IT growth successfully; no empirical test
Drury (1983)	144 firms	questionnaire	6	application of benchmarks variables not confirmed; Usage of planning and control partially confirmed
Sääksjärvi (1985)	130 firms	questionnaire (in 3 firms case study)	6	variables had to be adapted; only partially confirmed; suggested that the model is confined in its limits, but it has many attractive and useful measures
Mahmood & Becker (1985)	59 firms + 118 managers	questionnaire	6	suggested to find a new set of maturity variables; modified Nolan's stage model to make it more efficient

Li <i>et al.</i> (1994)	123 firms	questionnaire	6	the questionnaire seems to be reliable and valid; about 20 years ago; brings questions with a single indicator to measure the stage position of the organization; does not address emerging technologies
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Source: Compiled by the Author

Table 1 illustrates several studies published in academic literature regarding Nolan's Stages of Growth Model, and reiterate that it has not been completely confirmed through statistical testing (Leem *et al.*, 2008), and this might be due to the lack of adequacy of the questionnaires used in capturing the essence of the stages model (Benbasat *et al.*, 1984, p. 485; Li *et al.*, 1994, p.5), or because of the failure to perform reliability and validity tests on measuring instruments (Mahmood & Becker, 1986, p. 42). Several attempts to validate the model empirically have brought mixed and sometimes disappointing results (Grégoire & Lustman, 1993, p. 237). The empirical bases of the model are questionable (King & Kraemer, 1984, p. 474), and the model has been testing poorly because it is underspecified (Friedman, 1994, p. 139), or incomplete and no clear conclusion has resulted from the field tests (Grégoire & Lustman, 1993, p. 238), since Nolan had not explicitly defined his own operationalization of the model, remaining proprietary, other researchers were forced to apply their own perception for the stage level measures (Benbasat *et al.*, 1984, p. 485). However, these negative results have not invalidated the NSGM, which is intuitively appealing and very useful (Benbasat *et al.*, 1984; Lyytinen, 1991; Grégoire & Lustman, 1993, p. 239; Mutsaers *et al.*, 1998).

2.1 The number of publications about the NSGT's paradigm in recent years

The NSGT was much debated during the 80s (Benbasat *et al.*, 1984; King & Kraemer, 1984; Mahmood & Becker, 1985; Sääksjärvi, 1985; Huff *et al.*, 1988). In the 90s, other scholars have returned to show approaches to the study of Nolan, suggesting adjustments or new attempts to validate it (Lyytinen, 1991; Grégoire & Lustman, 1993; Li *et al.*, 1994; Mutsaers *et al.*, 1998). Also in these periods, studies that used their theoretical concepts have been published to suggest a variety of SGM, such as: small business growth (Churchill & Lewis, 1983), end-users' satisfaction with IS (Mahmood & Becker, 1986), end-user computing (Huff *et al.*, 1988), technology-based new ventures (Kazanjian, 1988), organizational growth (Kazanjian & Drazin, 1989), and to the evolution of information centers (Magal, 1989). From the 2000s onwards, the critical debate or even other theoretical or empirical contribution

of efforts to the NSGT, practically did not exist. But, scholars efforts to use their research subjects and the theoretical basis of STG were employed in the creation of other models which addressed several thematic's type in the areas of technology and management, such as: intranet implementation (Damsgaard & Scheepers, 2000), data warehousing (Watson *et al.*, 2001), knowledge management (Gottschalk, 2002a, 2002b; Gottschalk & Khandelwal, 2004), e-business (Prananto *et al.*, 2003), web adoption (Teo & Pian, 2003), IT portfolio management (Jeffery & Leliveld, 2004), IT outsourcing (Gottschalk & Solli-Sæther, 2006; Solli-Sæther & Gottschalk, 2008), e-government interoperability (Gottschalk & Solli-Sæther, 2008), data management (Mattia, 2011), corporate social responsibility (Ditlev-Simonsen & Gottschalk, 2011), ERP integration (Grant *et al.*, 2013), and Social Media adoption (Mergel & Bretschneider, 2013).

Based on a comprehensive literature review about SGM in the context of ICT and system management, conducted by two researchers from Norway in 2010 (Solli-Sæther & Gottschalk, 2010), they have concluded that SGM have the potential of creating new knowledge or insights into organizational phenomena, helping researchers create and explore theory-building tools, empirically validated, that conceptualize the evolution over time in a variety of areas, and also help practitioners identify the past, present and future situation of their organizations. They are also responsible for one of the last publications about SGM, based in a thematic for the sourcing of IT (Solli-Sæther & Gottschalk, 2015).

Despite all these parallel works about SGM in different thematic models, any profound recent efforts have not been found in the academic literature to rescue and update the own theoretical body of the NSGT or the framework of NSGM, and to the development of empirical studies that could contribute to the validation and / or extension of the theory, probably due to:

- 1) it being a laborious activity of literature review (Webster & Watson, 2002), to be rescued from their seminal articles dating back from the 70s;
- 2) it requiring refinement to look at the paradigm, with deep upgrade to the theoretical body vision, to the current technologies and organizational management for modern times;
- 3) in addition, it requesting more extensive empirical study, to increase the number of participating organizations (sample size) and to the use of statistics techniques most current and advanced.

The NSGM is difficult to be operationalized and there are some problems with the terminology and interpretation of its variables (Benbasat *et al.*, 1984; Grégoire & Lustman, 1993, p. 239), to properly make the measurement of the growth process of each stage (Drury, 1983, p. 69; Mahmood & Becker, 1986), there must also be a complementary effort to refine its focus, with the use of new variables that would allow better suit its measurement model (Sääksjärvi, 1985; Lyytinen, 1991). This way, it is inferred that there was a natural movement of the authors (demotivation, little dedication in time, other research interests, etc.), in not continuing the efforts to promote new contributions to the paradigm of NSGT, that despite this apparent "inactivity", it was not replaced by a new paradigm (Kuhn, 1970), that would overcome the quality of previous studies and create a new network of researchers on a new similar thematic development.

2.2 New efforts for recovering the research about NSGT

There is a high visibility to the academy encouraging new researches that are inserted into the paradigm of NSGT about the ICT/IS initiatives in organizations, justified by the “gap” still existing to be mitigated or resolved – a previously explained problematic – bringing as motivation to its researchers at least two factors blocks: the structure of the academic research design with an updated and insightful focus [emphasizing rigor and relevance], and the direction of the studies also reflecting on practical contribution to the organizations in the modern society.

With respect to research design, it is possible to justify:

- 1) The availability of new software for statistical analysis, that would allow the use of more sophisticated or refined statistical techniques for evaluation of the measurement model. For example, Confirmatory Factor Analysis (CFA) and Structural Equation Modeling (SEM), using the software Smart PLS, can be more accurate techniques that the techniques used in previous research;
- 2) The possibility of using larger empirical samples with qualified respondents, with the facility of calling potential respondents via Internet, by email or social media networks. For example, groups of CIOs or ICT experts present on LinkedIn, facilitating data collection and expansion of sample size, unlike previous research using samples with limited sizes, as detailed in Table 1;
- 3) Additional new theoretical contributions to NSTG originally grounded by Richard Nolan (Nolan, 1973; 1979) and widely cited in the field of IS studies – for example, to include other new variables and measurements in his model will result in a more

accurate and updated material, for better understanding the assimilation of the ICT/IS initiatives in organizations, by the scientific view of the academy.

In a paper discussed in a conference, and later published as a book in 1984, there is a report of the outcome of its discussion, reflecting the awareness of researchers about the progress of the NSGT:

[...] however useful in earlier practice, now must adjust to a number of issues concerning underlying phenomena, multiple curves, organizational learning, and stage-based management and organization. The new conditions posed by diffusion of IS technology and the emergence of user-dominated systems call for research to aid current and future management of the IS resource. (Nolan, 1984, p. 216)

Nolan himself already foresaw in 1984, the new and emerging phase of the "user computing" by means of the use of PCs in organizations. Similarly, it is easily inferred that the present moment the world connected in real time via Internet, the advances in cloud computing, the existence of mobile devices with the mobility phenomenon, the use of devices from the users (BYOD) and the explosion of generation and access to an increasing volume of data and information in the Big Data Era (Chen *et al.*, 2012, p. 1168; George *et al.*, 2014; Goes, 2014), suggests categorizing the present age, evaluate its needs and identify its impact on organizations, as a new reasonable context in the social sciences, specifically to the management research (George *et al.*, 2014).

As for the practical contribution to organizations of modern society, it can be justified by:

- 1) The techniques or methods used in organizations to manage their ICT initiatives, use in their vast majority, products or commercial services created and managed by IT associations, business companies or professional consultancy working with technology or management in this market, and such methods include not necessarily validations and academic scientific justification from the field of Information Systems studies;
- 2) Increasing interest and confidence in the Academy when it fills in a timely manner, some particular need of the organization, bringing it immediate benefit. For example, the availability of the diagnostic of ICT/IS organizational initiatives, generated in real time immediately after the participation of the respondent in the survey, that is attractive for managers support and to immediately take advantage of the results of certain research;

- 3) Inside new knowledge economy, in the Big Data Era, managers require a more critical look at all that is around the organizations – why does an organization need to trust in commercial products that are not solving its problems and do not generate differential with competitors? According to Mutsaers *et al.* (1998, p. 115), the organization needs to be “transformed” in its essence, abandoning management principles that used to work in the industrial economy and adopting those required in the information economy. Bradley & Nolan (1998) can complete this point of view, mentioning that “new technologies continue to enable new strategies”, and “new technologies create new opportunities to capture economic value”.

It seems that the old concepts of the Industrial Economy practically no longer make sense on the context of the Knowledge Economy. Even so, knowledge acquisition and the process of organizational learning become relevant to influence the pace and the progress of the NSGM. According Cash *et al.* (1992, p. 43), “successful implementation of a technology requires that individuals learn new ways of performing intellectual tasks. As this learning takes place, changes occur in information flows as well as in individual roles. Often this has resulted in organization changes”.

These mentioned steps can clarify and reinforce that NSGM is an important model to explain the organizational learning about the ICT/IS initiatives, and can be very useful for organizations and society. As mentioned by Nolan, the SGT keeps permanent relevance to organizations when they are interested to verify where it is, and where it wants to arrive:

[...] One can use this theory to understand where the company has come from, which problems were a result of weak management, and which problems arose from natural growth. More important, one can gain some insight into what the future may hold and then can try to develop appropriate management strategies that will accomplish corporate purposes. (Nolan, 1979, p. 124)

In other publication, Richard Nolan reinforces his argument that the Stages Theory is not stagnant, and even also highlights the permanent curiosity of senior management to consider the stage level that their own organizations are positioned, when he says:

[...] Only limited further developments were published in the literature after this. This is not to say that the development of the theory stagnated at that time, on the contrary. Senior management presented increasingly more questions regarding where their organizations stood in the Nolan Curve. (Nolan & Koot, 1992, p.8)

Thus, it can be considered that, the arrival of newer technologies quite different from those existing in the 70s - which originally consisted only of large-scale mainframe systems (Nolan *et al.*, 1993) - such as microcomputers, networking, telecommunications, systems based on

the Internet, etc. calls for fresh and important approaches of Nolan's model in terms of their implementation and management (Damsgaard & Scheepers, 1999, 2000, p.10). Also, modern organizations have evolved in an environment which constantly requests evaluation of competitive effects of new technologies, and its organizational learning is influenced by the environment in which it takes place (Nolan, 1979, p. 116) - once that organizational learning is partly formal transfer of recorded knowledge and partly informal accumulation of experimental knowledge (Cash *et al.*, 1994).

As a complement to these justifications, a basic management tenet mentioned by Nolan (1979, p. 124), "If you can't measure it, you can't manage it", can complete the importance of using the descriptive NSGT of the evolution of the ICT/IS initiatives, in order to have a meaningful way to describe and track it.

3 STAGES OF GROWTH AND ICT/IS ORGANIZATIONAL LEARNING

The immense revolution in the modern world caused by the evolution of technology in the organizational environment makes us think that for all of this to occur past several decades of development, each one inserted in periods with their distinctive peculiarities, both technological and organizational. It is important to illustrate here these phases addressed by the authors included in this paradigm (Nolan *et al.*, 1993; Nolan & Croson, 1995; Nolan, 2001; Nolan & Bennis, 2002; Derksen, 2013, p.61), who reported and named these phases as 'Eras' permeated by transitions from the industrial economy to the information economy (Nolan & Croson, 1995, p.7), that directly reflected changes in the operations of organizations, no longer being manual and becoming based on computer technology. The SGT/MIS first proposal has been widely used as a normative theory for the management of IT with its "S-shaped" curve reflected through the data processing budget (Nolan, 1973, 1975). Subsequent publications have emerged the stages based on organizational learning (Gibson & Nolan, 1974; Nolan, 1979, 2001), as shown in Figure 3.

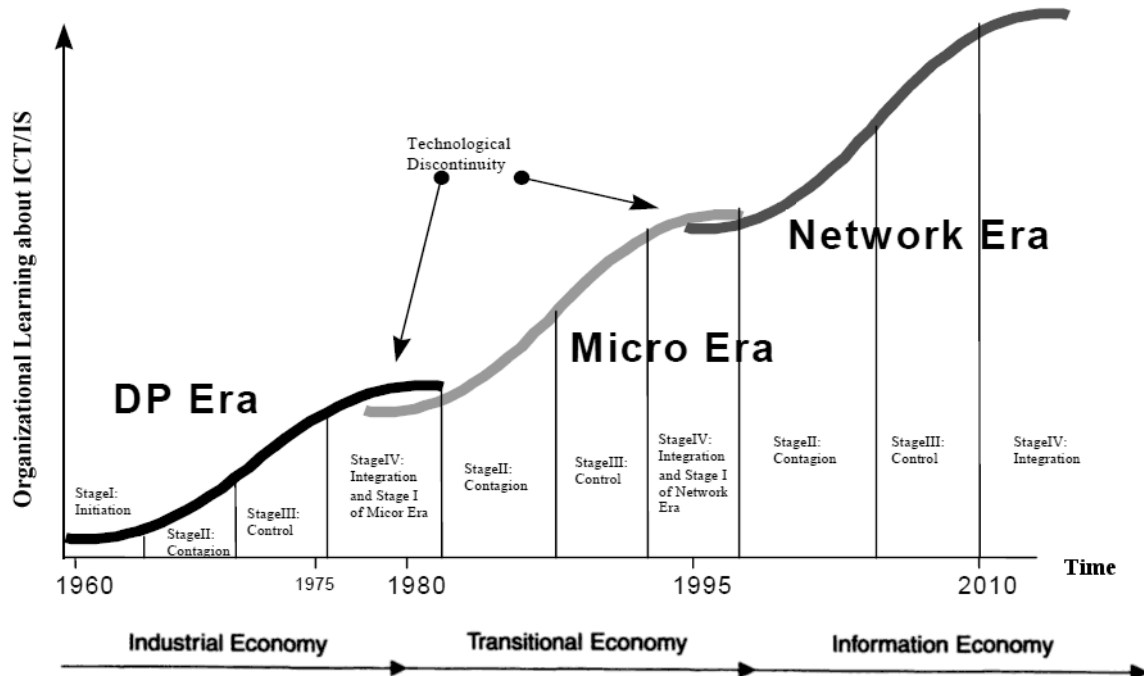


Figure 3 – Three s-shaped-curve Eras of ICT/IS organizational learning

Source: Adapted by the Author from Nolan & Croson (1995, p.7) and Nolan (2001, p.2)

Figure 3 illustrates three Eras, described by Nolan as the S-shaped organizational learning curves (or "experience curves") about ICT/IS initiatives, overlapped during a period of "technological discontinuity" (Christensen, 1997), featuring that technological change is

frequently discontinuous (Nolan *et al.*, 1993). During this period, further development of the old mature technology, which existed as a prevailing conception, conflicted with the vigorous growth of the new emerging technology (Nolan & Bennigson, 2002, p. 6). Organizational learning about ICT/IS initiatives and its movement through the stages are influenced by the external and internal body of knowledge and by the environment in which it takes place (Nolan, 1979, p. 116). Guidelines for action were established to make change a proactive managed process, instead of a reactive environmental process (Nolan, 1979; Nolan & Koot, 1992; Mutsaers *et al.*, 1998):

- **Data Processing Era** (DP Era) – From 1960 to 1980; Industrial Economy; "DP" (data processing); the focus was efficiency by automating manual transaction processing systems (Nolan & Croson, 1995, p.6), made by mainframes and / or minicomputers on centralized computing. In this Era, the notion of managing IT as a portfolio of applications was widely used. Besides giving support to more efficient transaction processing, organizations began to use computers in automating manual and office functions, eliminating the need for many office workers in their human resources. It is common to read in the literature about this old period of years the term "EDP" (electronic data processing), by which meaning the processing of data by a computer and its programs in an environment involving electronic communication. EDP evolved from DP, a term that was created when most computing input was physically put into the computer by individuals and incrementally, using punched tapes or tabulating cards.
- **Microcomputer Era** (Micro Era) – From 1980 to 1995; Transitional Economy; microcomputers; the focus was to take advantage of professional workers (e.g., engineers, financial analysts, and managers), by making use of computers to access, analyze, and present data (Nolan & Croson, 1995, p.6). Terms such as groupware and workflow management began to be used (Derksen, 2013, p.61). In the early 1980's the advent of the Personal Computer (PC) and associated open standards, microcomputers became available to individuals and firms. In DP Era and Micro Era, both application orientations – automating and "informating" - had an internal focus (Nolan & Croson, 1995, p.6). The discontinuity was determined by the rise of the personal computer, client server access, workstations, new types of personal softwares like spreadsheets and graphical user interfaces (Derksen, 2013, p.61; Nolan & Koot, 1992, p.13), CAD/CAM, desktop publishing capabilities, with intense effects of information technology on organizational

structure (Nolan *et al.*, 1993), brought decentralization into the various end-users' departments. In 1988, only 5% of the computers of Brazilian organizations were connected in network, and each one was used on average by three users (Meirelles, 2014).

- **Network Era** (Net Era) – From 1995 to 2015; Information Economy; networked client/servers; is a consequence of the fusion of computer and telecommunications technology. It results from the integration between mainframe (DP Era) and user microcomputer (Micro Era), highlighting the acceleration of innovation in microcomputer hardware and software technology (Nolan *et al.*, 1993). In the 1990's with the rise of the Internet, the relationship with outsourcing partners was facilitated by providing a common platform capable of improving communications, coordination, and supporting electronic transactions (i.e., purchase orders, invoicing, and payments). The interorganizational integration of these technologies allowed for a new firm structure termed the IT-enabled network, more suited for competition in the global marketplace (Nolan & Croson, 1995, p.6), with the information transparency being the emerging policy for the network age (Nolan & Bennis, 2002, p.23-25). Organizations focus on delivering value to customers based on key IT decisions, CIO manages a more formal permeable network organization, constantly changing, characterized as the “extended organization” consisting of many partners and customer groups (Nolan & Bennis, 2002, p.9-10). In this era, processes and organizations were redesigned or even transformed (Derksen, 2013, p. 61). The universal data formatting and file interchange were facilitating mechanisms to promote access to information from all connected computers (Nolan *et al.*, 1993).

As a new academic contribution, in order to give a fresh and updated approach to the present times, a new Era will be included in this research study with the name of “Big Data Era”, as illustrated by Figure 4.

- **Big Data Era** – Since approximately 2010 expecting to last until about 2030; from Information Economy to Knowledge Economy (Nolan & Croson, 1995; Nolan, 2005). ICT/IS-enabled full time connection, Internet mass users/consumers, cloud computing services, mobile technologies (smart phones, games consoles, tablets, private wi-fi networks, etc.), instantaneous real-time transactions everywhere (payments, file storage, group communication, etc.), social media/network sites to organizational and personal use (Facebook, Twitter, LinkedIn, Plaxo, etc.), web general search engines (Google, Yahoo,

Bing, Baidu, etc.), strategic BI analytics, Internet of Things (RFID, dashboard in the car, popular GPS devices, etc.), are some examples of the phenomenal expansion and popular use of different technologies by organizations and people. Today, "information technology" involves a multitude of digital technologies imbedded in computers, telecommunications, and mechanical equipment such as robotics and "smart" machines (Nolan *et al.*, 1993). Also, modern organizations must adapt to the new rules of the Knowledge Economy (Drucker, 1969, p. 264; Drucker, 1998; Davenport & Prusak, 1998; Nolan, 2001; Nolan, 2005), very different from the rules of the old Industrial Economy of the past, considering the management and use of data as one of its most valuable assets, which will influence and will increasingly affect its competitive stay in the market.

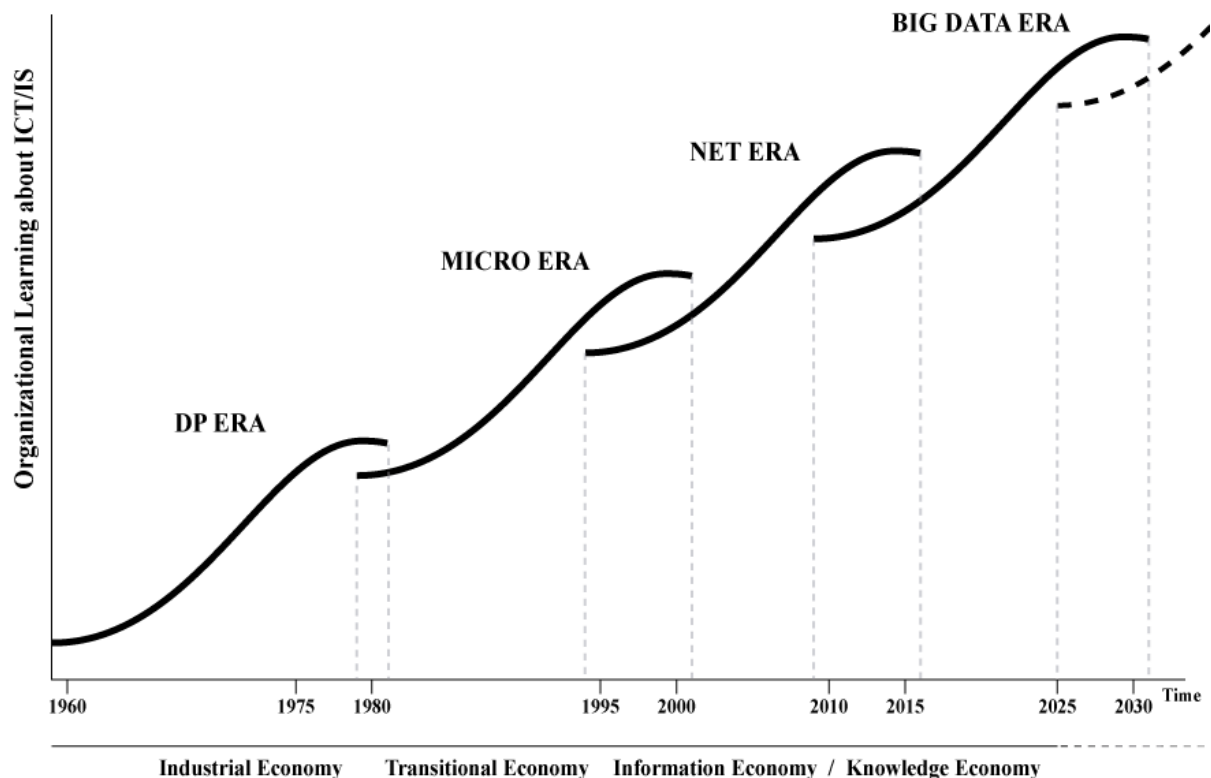


Figure 4 – Four s-shaped-curve Eras of ICT/IS organizational learning

Source: Created by the Author based on Nolan & Croson (1995, p.7) and Nolan (2001, p.2)

Organizations learn how to get value from ICT/IS initiatives and are permanently impacted by technological discontinuities that appear regularly in "Eras" – as shown in Figure 4 – indicating that, when new technologies appear in the organization directly affect their learning. This way, these S-curves describe different "Eras" of ICT/IS development and assimilation over time (Nolan *et al.*, 1993). To modernize their working environment, the organization must conduct the upgrade of the older technology to the newer technology,

favoring further development of organizational learning about ICT / IS initiatives. According to Nolan (2012, p.92), this new phase of ICT ecosystem, includes terms and taxonomies to describe it, such as: Software as a Service (SaaS), for example, Salesforce.com services, Platform as a Service (PaaS), for example, Goggle's Droid smart phones, and Infrastructure as a Service (IaaS), like Amazon's cloud computing service. Organizations may choose not to have their own ICT physical assets (hardware in servers, databases or software applications locally installed). With cloud computing, organizations can rent your digital assets (McAfee, 2011), rather than buy them. For the three categories of cloud services (IaaS, PaaS, and SaaS), there will also be changes in the way to manage it, to plan their capabilities, making your maintenance, and to adjust the solution to their problems. The ICT activity changes its focus, from the management of systems and infrastructure, to become ubiquitous in the ability and ease to help the creation of the organization's strategies and operations (Nolan, 2012, p. 91).

A current question is how to treat the classical concept of the keyboard, which has been very helpful to the basement of indicators to ICT researches (Meirelles, 2014), but is quickly becoming obsolete with the rise of a variety of new devices that, even without keys, can also include computer's functions.

The Big Data Era should influence the organizational learning initiatives (George *et al.*, 2014) relating to use and management of ICT (Chen *et al.*, 2012; Goes, 2014), as has already happened in the other past Eras (Nolan & Croson, 1995, p.7; Nolan, 2001, p.2), requesting new organizational skills to handle a wide diversification of external and internal events, which will generate data continuously increasing in volume and variety, requiring organizations changes in the design of its structures (Galbraith, 2014; Gabel & Tokarski, 2014), with the focus on a new way of thinking about the value to be obtained and rescued from them.

Since the advent of computers, the easy access of the technology by organizations, the content store generated by its use and the way that information systems are managed, has been periodically adjusted according to the epoch. In the Big Data Era, executive, leaders or managers decisions will be based on real evidence rather than own intuition, suggesting that data-driven decisions tend to be better decisions (McAfee & Brynjolfsson, 2012), also bringing out a new prominent role in organizations: the data scientist - an individual who understands how to "refine" answers to relevant questions about business, starting from a huge volume of unstructured information (Davenport & Patil, 2012). The participation of high-level discussion on the strategic direction of the organization has also obtained the

presence of the CIO (Chief Information Officer) or the ICT top management (Nolan & Bennigson, 2002, p. 21-24). Organizations that wish to obtain value through analytics actions are more likely to succeed if preliminary top management of the organization recognizes this importance (Grossman & Siegel, 2014). The ICT staff team, acting as a kind of auditor, will need to ensure that data and information resources will be used effectively and correctly by the organization (Hollyhead & Robson, 2012, p. 48).

Thus, it is noticed that the techniques of data analysis in the Big Data Era, will allow executives in the control of management to act supported by structured and unstructured information. But apparently the traditional ways of relating to corporate strategy, structure of the organization, in addition to the design of information systems, will pass through changes. According to Nolan, it is also important to consider that the management paradigm shifted the focus, from managing technology to managing information resources enabled by ICT:

[...] A major shift in the organizational concept of a computer as a machine to automate work, to an enabler of a new information resource that could be leveraged by workers to create value has occurred. (Nolan, 2001, p. 26)

Through a process of creative destruction in the organization, the principles of the industrial economy management need to be transformed, and concomitantly, need to be built creatively by the management principles of the information economy (Nolan, 2005). The fundamental difference between Industrial Era organizations and Information / Knowledge Era organizations is the formal recognition of information as an important resource of the organization and the incorporation of new management principles to manage it, effectively and explicitly.

The ICT should be seen (perceived) by the management as the “underlying technology” of the information resource. “Underlying technology” can be considered the most important technological resource “included” in a certain type of technology, being it a product (equipment) or a service, example: microprocessor chips to microcomputers, page rank algorithm at Google, TCP/IP to the Internet, etc. – becoming the technology base for the existence of certain equipment or service (technological resources), not always directly perceived by its users.

This way, the organizations need to use ICT to exploit information directly as a resource, and according Nolan (2001, p. 19), “to add value to the product or service, and as a result, management attention shifted from the technology itself to what the technology could produce through the extraction of value from information resources”.

According to literature studies (Nolan & Bennis, 2002, p. 23-25), some components relate to organizational issues, i.e., information transparency freely available, the permeable boundaries of the extended enterprise by strategic alliances or outsourcing, knowledge management – that consists of capturing, storing, combining, analyzing, mining and distributing information resources into forms that create value - and some technological components, i.e., real-time messaging, data warehousing, PC availability, the browser, directory technology, and the web site, are requisites that can help in the discovery and foundation of new variables that will be useful to the adaptation of organizations requirements in the new Big Data Era.

By the perception that modern ICT structures can be used in servers in the cloud, organizations that allow their users to have access directly to their databases (for example: to update their own profile on-line instantly, by using a simple registration form, restricted by a login and password), will be creating extended enterprises to their suppliers and customers.

The majority of organizations consumers will be those referred to as digital natives, which having grown up with the IT (Nolan, 2013, p. 15), forcing the organizations to become collaborative and focused in continuous learning.

4 REVISITED DEFINITION OF THE SIX STAGES OF NOLAN'S MODEL

Based on the last Nolan's six stages model (Nolan, 1975, 1979), on literature review (Nolan & Koot, 1992; Grégoire & Lustman, 1993; Nolan, 1993, 2001; Cash *et al.*, 1994; Mutsaers *et al.*, 1998; Pranantro *et al.*, 2003; Mattia, 2011), and the new demands of ICT/IS due to the current times (modernity) (Nolan & Croson, 1995; Nolan & Bennis, 2002; Derksen, 2013; Meirelles, 2014), the author suggests some updates regarding the descriptions of the stages definitions and its coverage limits in the model, as shown in Table 2.

Table 2 – Revisited definitions of the six stages of growth of Nolan's model

Stage Number	Stage Name	Stage Definition	References
I	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.	Nolan, 1975, 1979, 1993, 2001; Nolan & Koot, 1992; Mutsaers <i>et al.</i> , 1998; Pranantro <i>et al.</i> , 2003
II	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.	Nolan, 1975, 1979, 1993, 2001; Pranantro <i>et al.</i> , 2003
III	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.	Nolan, 1975, 1979, 1993, 2001; Nolan & Koot, 1992; Grégoire & Lustman, 1993; Mutsaers <i>et al.</i> , 1998; Pranantro <i>et al.</i> , 2003

IV	Integration	The accumulated learning led to a balance of 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. There is a move towards integration and greater coordination between the ICT/IS processes and the organization's business processes.	Nolan, 1975, 1979, 1993, 2001; Pranantro <i>et al.</i> , 2003
V	Data Administration	Integration between traditional business processes and activities and ICT/IS initiatives, creates seamless communication and flow of processes within the organization. ICT/IS initiatives aim to provide strategic benefits by building strategic systems.	Nolan, 1975, 1979, 1993, 2001; Pranantro <i>et al.</i> , 2003; Mattia, 2011
VI	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.	Nolan, 1975, 1979, 1993, 2001; Nolan & Koot, 1992; Pranantro <i>et al.</i> , 2003

Source: Adapted by the Author from Nolan (1975, 1979, 1993, 2001) and other academic contributions

Table 2 describes some suggested adaptations to the Nolan's model – descriptions of each stages definition was revisited and updated by the author, based on academic literature and the perception that it is necessary to adjust the contemporaneity of ICT that are found in modern organizational environments.

This way, the stage names suggested by Nolan will be kept in this model. They are: (I) Initiation, (II) Contagion, (III) Control, (IV) Integration, (V) Data Administration, and (VI) Maturity.

5 OPERATIONALIZING THE MEASUREMENT OF THE STAGES OF GROWTH

With the intention to measure the evolution of the stages of growth of IT in the organization, Nolan defined two levels of analysis variables which he called the "benchmark variables" (Nolan, 1973, 1975, 1979; Gibson & Nolan, 1974). In the first level of analysis, he assessed the expenditures and investments of the organization for the implementation of their ICT/IS initiatives (called in those times "budget for computing"), and he was seeking to correlate the amount of sales or other 'links' with the financial results of the company, to investigate the percentage participation in the use of applied technologies and utilized by organizations throughout the stages of growth (for example: X% batch processing; Y% remote job entry processing; Z% time-sharing processing; K% data base processing, etc.). This level of measurement has not demonstrated effectiveness in other empirical studies by various authors (Lucas & Sutton, 1977; Drury, 1983; Sääkjärvi, 1985; Mahmood & Becker, 1985; Li *et al.*, 1994), and was unable to confirm it completely or validate it with a good level of correlation. In the second level of measurement, Nolan proposed the measurement of so-called "growth processes" – because they evolve, or "grow" with use of the IT over time (Cash *et al.*, 1994, p. 260) - to comprehensively describe the IT activity and the dynamics of computer organizational learning in an organization (Nolan, 1993, p.2), assigned into four main dimensions: Applications Portfolio, Resources (technology and personnel), Management (organization, planning and control) and User Awareness (Nolan, 1979, p. 117, p. 121; Nolan, 1984, p. 197) – he considered these four growth processes "more useful" for this measurement, serving as a taxonomy to comprehensively describe the ICT/IS initiatives and the dynamics of the organizational learning about it in organizations (Nolan *et al.*, 1993, p. 2). By consulting the literature studied, there is a perception that, to be suggested a new framework in order to promote the update of the NSGM, the main focus should not be to increase or decrease of the amount of growth stages, but, make adjustments in the measurements of the variables proposed by Nolan (Nolan, 1973, p. 404-405; Gibson & Nolan, 1974, p. 79; Nolan, 1979, p. 117), which took as a basis the technological universe of organizations over forty years ago, and are not suitable to be used today to measure stage level models of ICT/IS initiatives in modern organizations. This way, this research totally discarded the use of the first level of Nolan's measurement, whereas the financial dimension of "ICT/IS expenditures" – reportedly assessed in his model incoherently for today's dynamic investment - should be understood, in any new model, as a dependent variable (which must be properly operationalized), which will be influenced by the "growth processes" (independent

variables), permanently and continuously over the course of each stage of growth about organizational learning ICT/IS initiatives. Keeping the focus on the update of variables used by Nolan, based on SGT, in addition to the literature review and the NSGM characteristics, it is proposed the foundation of a new scale to measure the stage level alignment about the ICT/IS growth and diversification in organizations.

Based on Nolan's model, the overall organizational "learning experience" processes of applying ICT/IS initiatives can be split into four separate growth processes (Mutsaers *et al.*, 1998; Nolan & Koot, 1992). As a new contribution by the author, a fifth growth process is suggested to be added to the variables of the model, in order to include all initiatives related to the new emerging ICT/IS activities explored by the organization, using them as competitive weapon in the new Big Data Era (Chen *et al.*, 2012, p. 1168; Davenport & Patil, 2012; McAfee & Brynjolfsson, 2012; Meirelles, 2014; Goes, 2014).

Table 3 – The five growth processes to the assessment of ICT/IS initiatives stage level alignment

Growth Processes	Definitions	References
Applications Portfolio (AP)	The existing base of information systems that support the business functions and objectives. The set of applications of automated information systems that an organization has at its disposal. For example: financial planning, order processing, on-line customer enquiries. This refers to the functional and technical quality of these systems and the degree to which these systems support the current work processes.	Nolan & Koot, 1992; Nolan <i>et al.</i> , 1993; Cash <i>et al.</i> , 1994; Mutsaers <i>et al.</i> , 1998; Krishna & Barman, 2011
ICT/IS Resources (IR)	The resources (money, 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 research, maintenance, etc.), the skills and relevant knowledge of the ICT personnel.	Nolan & Koot, 1992; Grégoire & Lustman, 1993; Nolan <i>et al.</i> , 1993; Cash <i>et al.</i> , 1994; Mutsaers <i>et al.</i> , 1998; Krishna & Barman, 2011
ICT/IS Management (IM)	All the techniques and procedures that management uses to facilitate effective and efficient use and provision of ICT/IS activities. For example: degree of control, formalization of planning process, management of projects, and extent of strategic plans. The objective of	Nolan & Koot, 1992; Nolan <i>et al.</i> , 1993; Cash <i>et al.</i> , 1994; Mutsaers <i>et al.</i> , 1998; Krishna & Barman, 2011

	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 degree to which user management can indicate the contribution that ICT activity has to provide in the realization of the organizational objectives.	Benbasat <i>et al.</i> , 1980, p. 23; Nolan & Koot, 1992; Nolan <i>et al.</i> , 1993; Cash <i>et al.</i> , 1994, p. 260; Mutsaers <i>et al.</i> , 1998
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, Internet of Things, the power of the social media/network sites, strategic BI Analytics, etc. influencing popular use of different technologies by organizations and its users.	Nolan & Koot, 1992; Cash <i>et al.</i> , 1992; Nolan, 1993, 2001; Christensen, 1997; Mutsaers <i>et al.</i> , 1998, Nolan & Bennis, 2002; Davenport, 2006; Mattia, 2011; McAfee, 2011; Chen <i>et al.</i> , 2012; Davenport & Patil, 2012; McAfee & Brynjolfsson, 2012; Derksen, 2013; Căţinean & Căndea, 2014; Meirelles, 2014; Goes, 2014; and this Author, 2015

Source: Adapted by the Author from Nolan & Koot (1992, p.3), Mutsaers *et al.* (1998, p.120) and other contributions

By Table 3 it is possible to notice the five processes described to allow the assessment of ICT/IS initiatives stage level alignment, four of them based on the stages of growth Nolan's model (Nolan, 1979): Applications Portfolio (AP), ICT/IS Resources (IR), ICT/IS Management practices (IM) and User Community (UC), and a new one, Emerging ICT/IS (EG), based on studies of academic literature and the necessity to update the model to contemplate the present times. Using the five growth processes described in this study, managers can notice where their organizations stand in the evolutionary stage level process. It is also important to mention that, in the development of these growth processes it is recommended that there is a balance by the organization, in order to allow a harmonious progression of its activities of ICT/IS, from one stage to other stage. For example, if an

organization is able to offer sophisticated ICT/IS applications, but the user community does not have the skills to take advantage of all its features and usefulness, there will be an unbalance between the processes of AP (Applications Portfolio) and UC (User Community), in other words, the AP processes can be with a better alignment when compared to the UC processes in a specific stage of growth.

6 RESEARCH FRAMEWORK PROPOSED IN THIS STUDY

In order to integrate the literature review (Webster & Watson, 2002) and several approaches of stage models examined in this study, it is proposed a framework to illustrate this broad understanding and to guide the next steps of this research, as shown in Figure 5.

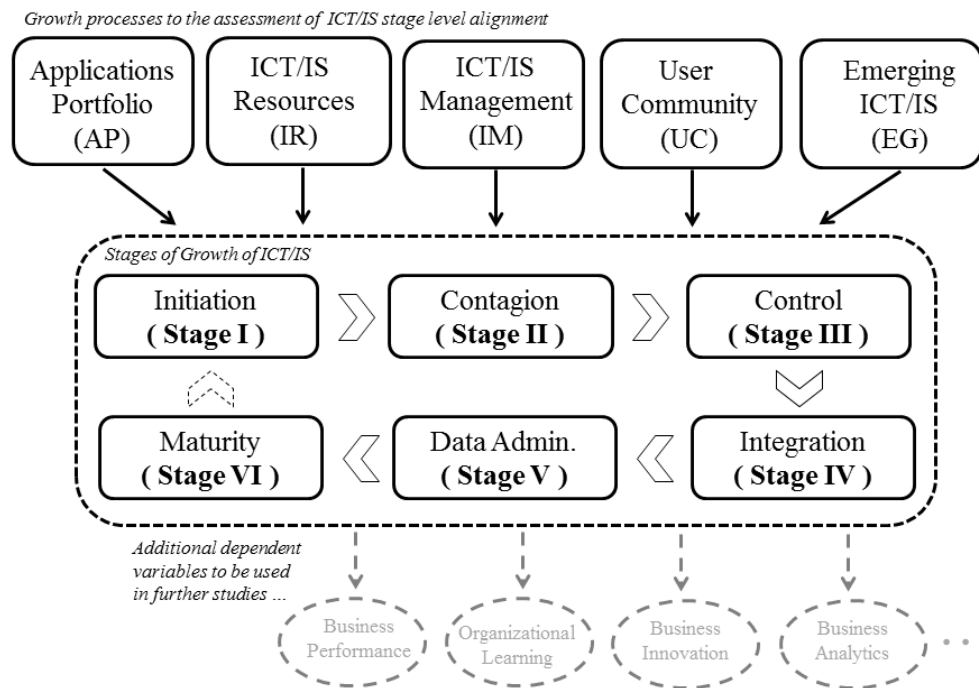


Figure 5 – Proposed research framework to the assessment of ICT/IS initiatives stage level alignment in organizations

Source: Created by the Author based on Nolan's stages model and new contributions

The framework proposed in Figure 5 is an attempt to continue to adapt the theory of stages of growth to the current ICT/IS environment present in the organizational structures, and expect it to be useful to academic and practitioner studies. Further studies are feasible and may use the data collected from the questionnaire developed in this research to explore the relationships between ICT/IS initiatives stage level alignment, in addition with other organizational variables (dependent variables), such as, Business Performance, Organizational Learning, Business Innovation, Business Analytics, etc.

By conducting this research study, it was possible to notice when changes occurs to new Eras, new methods of managing ICT/IS are required or at least their updates, being a complex procedure that needs to be constantly observed, by the reason to cause direct influence in the organization.

The current Big Data Era in the Knowledge Economy – described in chapter 3 - emphasizes the importance that the management and the use of information will have as a valuable asset to the organization, supported by the ICT/IS initiatives, influencing and affecting its competitive permanence in the market. To ensure successful approaches there will be required new tools that allow organizations to analyze different data sources (Buhl *et al.*, 2013), for example, online social networking, search-engine mechanisms, payment transactions, e-commerce transactions, among others, with extraction and analysis of information in real time. As already discussed in the past by IS researchers (Cash *et al.* 1992, p. 266; Nolan & Croson, 1995; Nolan & Bennis, 2002), many organizations must identify (investigate) and explore (assimilate) emerging information technologies as quickly as possible, because in many cases they directly impact on its competitive strategy. But, the efforts of aligning the ICT processes with business strategy have been one of the major problems to modern organizations (McAfee, 2006).

Thus, it is proposed to measure an additional construct named "Emerging ICT/IS", which represents the majority of new emerging technologies that are available to modern organizations (e.g. cloud services, virtual servers, real time information, on-line databases, mobile technologies, etc.) - this construct, besides providing new useful insights for managers of organizations with respect to the organizational ICT/IS initiatives level of alignment, may represent a theoretical contribution (Whetten, 1989, p. 492) to the field of study of the SGT/MIS.

The main approach of the concept involved is related to the permanent 'on-line' connection that organizations need to be every time and every day, in order to usufruct of the "survival capacities", such as: corporate e-mails, instant group communicators, corporate website, intranet and extranet access, etc., that has intense use by the entire organizational structure, internally (i.e., ICT staff, managers, employees, other users) and externally (i.e., suppliers, consumers, partners). In other words, it is not possible "to cut" the wire connection of the Internet in an organization without causing immediate prejudice to its operation. This is a strong reason that justifies adding this new measurement to the stages of growth model.

Furthermore, there is a dotted arrow included in the model, from the Stage VI (Maturity) in the direction to the Stage I (Initiation), which indicates that the stages become cyclical in certain moments, influenced by several factors, such as:

- 1) when "Disruptive Technologies" appears (Christensen, 1977; Nolan *et al.*, 1993) – also known as “technology discontinuity”, which affect the organizations ICT/IS initiatives as a whole, because in practical terms, the organization will no longer use a technology in which the majority of its processes are already grounded, substituting by another technology that does not have complete dominion of its use, requiring the "restart" of the stages assessment of its use and management, focusing for desired maturity;
- 2) when a new "Era" is experienced in society (Nolan & Bennis, 2002; Nolan, 2013; Derkesen, 2013; Căţinean & Căndea, 2014; Goes, 2014; Meirelles, 2014) – the organization, agreeing or not, is pressured by external factors that affect its environment and must adapt to the new initiatives caused by technological impact that arises;
- 3) when “Organizational Discontinuity” occurs (Nolan & Croson, 1995; Mutsaers *et al.*, 1998) – the organization itself, noticing signs of eminent changes, takes the initiative to break the use and management of their current ICT/IS practices linked to its traditional business model, to pass the act on other fronts or markets carrying in this new environment, the newest initiatives of ICT/IS that will impact in that new environment.

Originally (Nolan, 1973), the theory did not specify how "maturity" completion would be recognized, but later (Nolan & Koot, 1992, p. 22), it was considered that Stage VI (maturity) no longer occurs in a “static” way. Nolan interpreted maturity as an equilibrium state, not an end state (Friedman, 1994, p. 145). In other words, it is possible to emphasize that even an organization reaching stage VI, it does not stay in a period of perfect harmony and completeness regarding its ICT/IS initiatives or even its organizational learning. It means that, although the word "maturity" suggests a "conclusion" to the development of the growth processes, it can be inferred that on the stage VI, the last stage, the permanent and continuous development regarding the initiatives ICT/IS is assumed by the organization, being incumbent to the administration to maintain its role to stimulate, control and provide adjustments for the permanent implementation procedure of such initiatives, to the satisfaction of real needs that arise in the organization's day-to-day.

7 THE GRADING SYSTEM TO THE STAGE LEVEL ASSESSMENT OF ICT/IS INITIATIVES IN ORGANIZATIONS

In order to keep the right understanding in this academic research to allow the proper assessment of the stage level of ICT/IS initiatives to organizations, a grading system will be defined and structured as the entire set of measurements, as shown in Figure 6.






		Grading System Intervals				
Processes / Stage Mark and Level						
	Very Low	Low	Medium	High	Very High	
Processes / Stage Alignment (%)	up to 20%	from 21% to 40%	from 41% to 60%	from 61% to 80%	more than 80%	

Figure 6 – The grading system (mark/level and percentage of alignment) to the assessment of ICT/IS initiatives stage level in organizations

Source: Created by the Author

Figure 6 illustrates the grading system that will be useful to analyze and identify grades of each growth processes, in order to help the understanding and interpretation of the scale.

These following definitions will also be kept and used when necessary:

- **Processes / Stage Mark and Level**
Divided in five different levels, with an emphasis mark according to the position of the existing intervals: Very Low, Low, Medium, High and Very High;
- **Processes Score**
A measure obtained from the scale - the minimum value is 1 and the maximum value is 6; the score is individually assigned to each of five "growth processes" - which is generated by averaging all their indicators defined by the scale, in each stage. For example: AP score in 'Stage I' is obtained by adding, AP11, AP12, AP13 and AP14, and dividing this total by 4 (its average);
- **Processes Alignment (%)**
It is generated by each Stage, dividing the respective score of the growth processes by 6 (the maximum value from the scale) and multiplied by 100. There is no sense in

mixing the processes alignment of different stages in just one measure – it is always necessary to analyze them in each of the specific stages of growth. A different representation of mark/level occur every interval of 20%;

- Stage Alignment (%)

It is generated by averaging all their respective five growth processes scores, defined by the scale, divided this by 6 (the maximum value of the scale) and multiplied by 100 (an easy way to obtain a measure that can be comparable). For example: to ‘Stage III’, the average scores of AP3 + IR3 + IM3 + UC3 + EG3, divided by 6, and multiplied by 100. A different representation of mark/level occur every interval of 20%;

- Stage Number

Six in the total, labeled by Roman numerals from I to VI;

- Stage Name

Uses the same names defined by Nolan’s model in 1979, i.e., Initiation, Contagion, Control, Integration, Data Administration and Maturity;

- Processes Names and Labels

Four of them based on the NSGM, AP - Applications Portfolio, IR - ICT/IS Resources, IM - ICT/IS Management and UC - User Community, and a new one, created by the autor, EG - Emerging ICT/IS.

For the item codes to represent each assertion in the scale developed in this study (English or Portuguese), there will be used a nomenclature following the format: processes label – 2 letters, stage number, and assertion number (item or indicator of the scale proposed in that stage). It means, for example, ‘AP31’ represents the first assertion to the processes ‘AP’ in the Stage III – as shown in Figure 7.

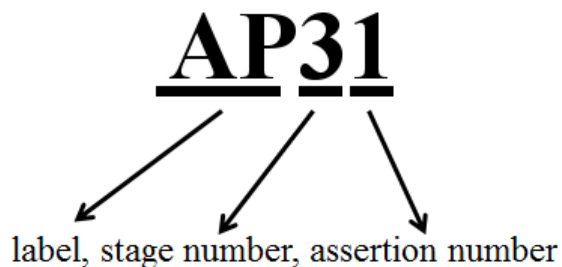


Figure 7 – A nomenclature to the item codes (assertions) that composed the scale for measurement the stage level of ICT/IS in organizations

Source: Created by the Author

Figure 7 illustrates how to easily interpret the abbreviations of the item codes (labels) of the assertions, based on their position on the scale developed in this study, and the representation

of the construct (growth processes) in a specific stage. In other examples: 'EG65' represents the 5th assertion to the processes 'EG' in the Stage VI; 'UC43', it represents the 3rd assertion to the processes 'UC' in the Stage IV, and so on.

It is important to mention that there isn't a total score of the organization average, considering as an unique score or percentage of alignment in the Nolan's stage curve, because it is not possible to integrate all the measure of the six stages in just one measure - if it is done, it will incur in measurement or model analysis errors. It is much better to have a way to explain the stage alignment by each stage, just looking at the measure of the its five growth processes, because each of these measure will signalize to the organization where it is situated, with low or high position, and which actions could help, based on the academic theory and analysis and perceptions of the researcher.

Although Nolan in his many articles often reuses the design of several S-shaped curves as a way to characterize the "discontinuity" of previous technologies (Christensen, 1977; Nolan *et al.*, 1993) towards the "new" technologies that have emerged over the years (or even the representation of periodicity Eras of technological developments), such as "representation in S" is controversial and widely debated in the academic literature by various authors (Lucas & Sutton, 1977; King & Teo, 1977; Benbasat *et al.*, 1984; Mahmood & Becker, 1985), which have not found substantiated empirical evidence to justify their use in several other researches conducted, to illustrate each measurement of the Nolan's six stages, based on his second level of benchmark variables (Nolan, 1979), i.e, the four growth processes (AP, IR, IM and UC).

Therefore, from this point on, this academic research no longer uses this representation in "S-shaped" curves, not rejecting or confirming its validity, preferring to use its own representation of stages of growth in levels rectangle-shaped, similar to a stair – as shown in Figure 8, where it will be possible to identify it measurement to each group of growth processes (5 processes), and for each of stages of growth (6 stages).

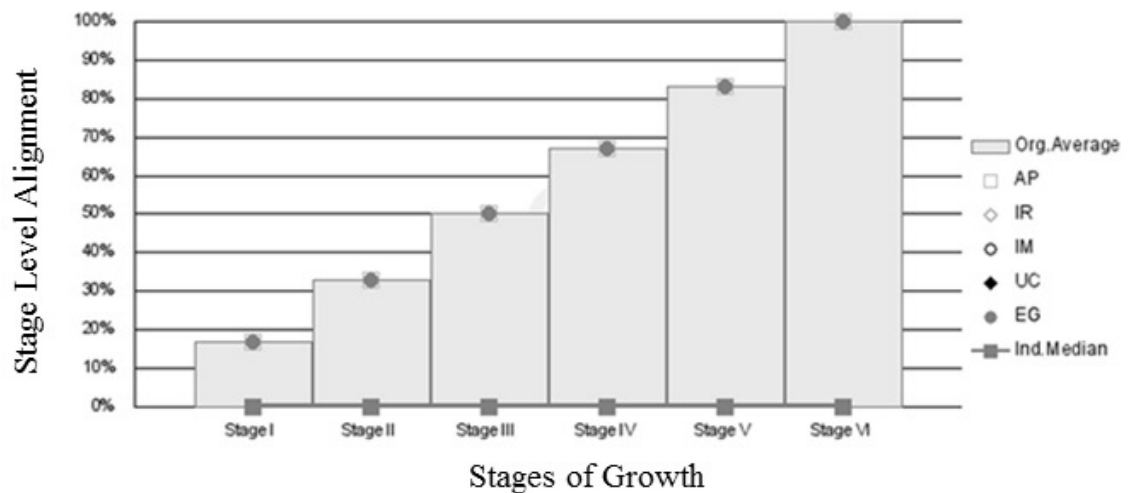


Figure 8 – A new representation of the six stages level of NSGM, based on the measurement of the five growth processes about ICT/IS initiatives in organizations

Source: Created by the Author

Figure 8 illustrates an example of the stages level alignment to each of the six stages of NSGM regarding the ICT/IS initiatives, as a new way of plotting the chart regarding the evolution of the stages in an organization, based on the measurement of its five growth processes for each stage. In this representation, any stage can be received a maximum percentage of alignment up to 100%, based on the respective average of the scores of its five processes (AP, IR, IM, UC and EG).

To complement this explanation, a hypothetical example is shown by Figure 9 and Table 4.

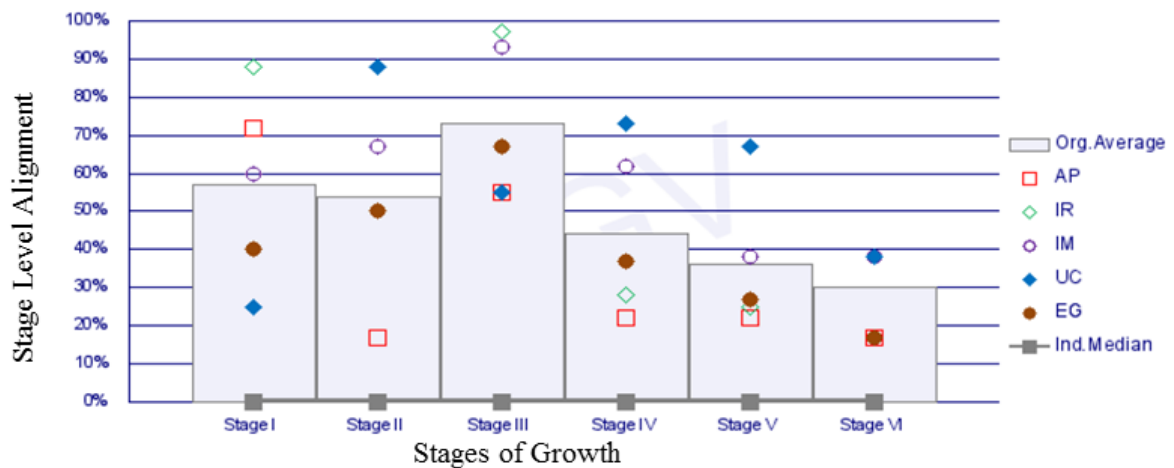


Figure 9 – An example of a measurement and representation of the six stages level of NSGM in a hypothetical case

Source: Created by the Author

By the Figure 9, as an example, it is possible to illustrate in the chart a higher bar indicating that the organization is more aligned in Stage III (Control) in the Nolan curve.

Table 4 – Stages of Growth and the Growth Processes alignment as a hypothetical example

Stages of Growth	Organization Stage Average Alignment (%)	AP Alignment (%)	IR Alignment (%)	IM Alignment (%)	UC Alignment (%)	EG Alignment (%)	Industry Stage Median Alignment (%)
Stage I	57	72	88	60	25	40	NA
Stage II	54	17	50	67	88	50	NA
Stage III	73	55	97	93	55	67	NA
Stage IV	44	22	28	62	73	37	NA
Stage V	36	22	25	38	67	27	NA
Stage VI	30	17	38	38	38	17	NA

Source: Created by the Author

Table 4 is a hypothetical example demonstrating some measure of the five growth processes alignment percentages, in order to illustrate the chart in the Figure 9. In this example, the industry stage median alignment is not available (NA). The organization stage average alignment measure is the dimension that illustrates the height of the bar graph.

8 METHODOLOGY

To ensure a step-by-step process to certify a methodological rigor in the research (Hevner *et al.*, 2004; Gregor, 2006), it was assumed some relevant procedures in this study started with an intense search for scientific papers located in databases for academic use. The following bases were used for location: Ebsco, JStor, ScienceDirect, ACM Digital Library, AISNET, HBS, HBR, Wiley, Emerald, etc. and other academic sources to complement this task, such as: Thomson Reuters Web of Science (<http://wokinfo.com/citationconnection>), Journal Citation Report (<http://thomsonreuters.com/journal-citation-reports>), Google Scholar (<http://scholar.google.com>), Microsoft Academic (<http://academic.research.microsoft.com>), and Research Gate (<http://www.researchgate.net>), i.e., to identify the connections between the researchers and what were those most relevant articles considered by the choices of academicians, being cited in the references of their works.

The search procedure carried out was divided in two phases. During phase one, the main objective was to locate seminal and relevant papers, regarding SGT in MIS, associated exclusively with Richard Nolan studies. The following terms relating to the theme of the research were used to find the articles and books: 'Stages Theory', 'stages of growth', 'Richard Nolan', 'Stage Models', 'IS maturity models', 'Nolan model', 'Nolan's model', 'MIS maturity model', 'information systems maturity model', and other variations of these same terms (words) combined - the period of date covered by this collection of information was from 1969 to 2015. Other relevant sources of information were identified in chapters and books in three libraries of postgraduate schools. In addition, queries and acquisitions in online books repositories have also been made by the author.

In phase two, the following terms relating to the theme of research were searched: "emergent ICT", "emerging ICT", "emergent MIS", "emerging MIS", "emergent/emerging information systems", "emergent/emerging management information systems", "digital economy", "knowledge economy", from 1990 to 2015, and "big data" from 2004 to 2015, in order to cover a period of time from the popularization of microcomputers, the advent of the commercial Internet, and the emergence of new other technologies to the present day.

This procedure helped the author to get sufficient material to organize this research, doing notes and markings on the connections between subjects that might make sense when they were grouped. For example, after reading each paper, the author could associate its references list, identifying how were formed the 'connections' of the discussions of the subjects among other papers. This helped to understand the "networks of conversations" between authors of

this paradigm (Kuhn, 1970), and how the subject could still be exploited in certain gaps that were still unclear [or not well understood].

After finding some titles of books mentioned in papers, they also were used to assist in several connections of the issues addressed in this body of research, clarifying important milestones that have been incorporated into this document - for example: preconditions for having a theory of stages of growth (Kuznets, 1965), precursor study of MIS stage model (Churchill, 1969), important discussions about NSGM (Nolan, 1984), considerations about the evolutions of the Nolan's stages (Cash *et al.*, 1992, 1994), the concept of Eras associated with a technological moment, reflecting in the shape of the current economy (Nolan & Croson, 1995), technological discontinuity (Christensen, 1997), and others.

From this point, a set of academic articles authored (or co-authored) by Richard L. Nolan were chosen when identified any mention of the 'theory of stages of growth' or the 'stage models' proposed by him - even in the early version of four stages in 1973 (Nolan, 1973) to the final version of six stages in 1979 (Nolan, 1979) until the year of 2013 (Nolan, 2013) - with the purpose to capture the essence of them, by the author's thoughts and the conceptual background, for this understanding to be used to describe the essential features of the requirements that ICT/IS initiatives should meet, throughout its evolution line of stages of growth, from the initiation phase to maturity phase.

This approach generated the perception that organizational ICT/IS initiatives suffer dramatic changes over this period of years, reflecting the needs of new adaptations of its use and management, periodically influenced by bounded times in intervals of 15 to 20 years – known as “Eras”, as shown in Figure 3 – which also causes the “technology discontinuity” (Christensen, 1977; Nolan *et al.*, 1993) in organization, and also causes simultaneously and permanently replacement of technologies that were implemented in their established processes, because of its obsolescence (Meirelles, 2014), forcing the organization to rethink again all the features about ICT/IS initiatives, which should be extended to provide due to these changes.

Thus, to complete the perception of this evolution, during this 40 years period (1973 – 2013) regarding Nolan's studies, it was also necessary to plan the creation and to substantiate the adequacy of several factors (indicators) that would affect the current Big Data Era (Chen *et al.*, 2012, p. 1168; George *et al.*, 2014; Goes, 2014), inserted in the Knowledge Economy (Drucker, 1969, p. 264; Drucker, 1998; Davenport & Prusak, 1998; Nolan, 2001; Nolan, 2005) - which is experienced today by modern society - for they are also part of the scale (Devellis, 2003), assisting the measurement of the Emerging ICT/IS growth process construct.

From this point forward, there was a search in academic papers which had contributed more in an attempt to identify relevant theoretical concepts in order to subsidize the creation of a new framework of analysis that could capture the essence of the Nolan's model (six stages of growth), which could list the main constructs (Hair Jr *et al.*, 2006) with the validation of the theoretical body (Straub, 1989; Boudreau *et al.*, 2001; MacKenzie *et al.*, 2011) and also be validated along the "Big Data Era" (current) and "the following Eras" that are to arise over the next years, integrating all these points in a way that would allow the operationalization of constructs (Sekaran, 2000) – what prompted the need to create and support a scale specific to this.

Thus, with the creation of the framework (illustrated in Figure 4), it was possible to return to the theoretical material that was previously filtered (academic papers, books chapters and books), with the aim of extracting relevant points that were influential and could help to operationalize each construct (MacKenzie *et al.*, 2011). The use of more recent academic works was prioritized (from Richard L. Nolan and from other authors), which already had indications of models that would help in identifying assertions that could be added on the scale development, which could serve to each of the five growth processes, in each of the six stages of growth.

The author emphasizes the maximum possible theoretical refinement (content validity) (Straub, 1989; Boudreau *et al.*, 2001; MacKenzie *et al.*, 2011), based on the rigor and relevance of academic theory (Nolan, 1973, 1979) and scientific methodology (Hevner *et al.*, 2004; Gregor, 2006), to prepare and choose each of the assertions of the scale.

More details regarding these methodological steps about the scale creation and use are explored in next two chapters of this document (chapter 9 and chapter 10).

9 SCALE DEVELOPMENT

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 (Devellis, 2003, p. 9). From the original instruments of Nolan's studies (Nolan, 1973, 1975, 1979, 2001), it was possible to identify the starting point for the research study. But, an initial perceived difficulty was that Nolan had poorly documented his research topics – or items or indicators that could measure the research variables, i.e., his second level of benchmark variables (Nolan, 1979) - that characterize each of the processes of growth, making the difficulty of its measuring extremely critical.

The literature review (Webster & Watson, 2002) can indicate to the researcher, a determined theory in which a construct (MacKenzie *et al.*, 2011) is useful, and this can take the role of an independent or dependent variable (Netemeyer *et al.*, 2003, p.90). The use of theory and a detailed literature review will show whether the items or indicators correctly represent the construct (Straub, 1989; Boudreau *et al.*, 2001; MacKenzie *et al.*, 2011) which is to be measured (content validity) and may also help determine whether they are reflective or formative. Thus, it had started the challenge of creating, developing and implementing a scale instrument to measure the Nolan's stage levels, from a wide collection of additional references, through articles published in journals and conferences, books with his authorship or co-authorship, and material from academic study centers, such as the Harvard University in the USA, where Richard Nolan is emeritus professor.

According Bido *et al.* (2012, p. 143), there are some steps to be followed in the course of quantitative studies that intend to use scales, based on the theoretical body and after the operational definition of latent variables, if there is no scale previously validated for its measurement, the researcher must develop items and promote the scale creation.

Thus, in order to develop a most updated scale for the present Era, and correctly identify each of its dimensions and assertions, such assertions should not bring essentially the same words or "jargon" resulting from the three Eras of the past (DP, Micro and Network), with the explanations of the organizational ICT/IS initiatives from that time, but it should be possible to "capture" the essence of each items and writing them in a more comprehensive way, given that the academic literature (Benbasat *et al.*, 1984; King & Kraemer, 1984; Friedman, 1994) had reported that the "questions" poorly documented by Nolan may not be the best to be used,

needing to be replaced or upgraded, meeting other new insights during this elapsed period of time.

As a methodological recommendation (MacKenzie *et al.*, 2011), it is also very important to pay attention on the way to write the text that represent each of the items (indicators): to be clear in words, to avoid redundant words and alternating "positive" and "negative" sense (Siegle, 2011), and the variation of formats in the questions / answers. There are many steps and procedures for the correct definition and generation of constructs, considering the development and validation of scales (Netemeyer *et al.*, 2003; Cha *et al.*, 2007).

Because the author is proficient both in Portuguese and in English, he dedicated to setting up the scale initially in English, trying hard to make use the limited information [summarized] documented by Nolan, that made mention to his four growth processes, partially located in some of its publications (Nolan, 1973, 1979, 1984; Nolan & Koot, 1992), dividing and distributing phrases blocks to start the writing of the statements of the scale. The methodological literature regarding scale translation on academic research (Brislin, 1970; Prieto, 1992; Cha *et al.*, 2007; Gjersing *et al.*, 2010), brings extensive discussion about the subject. Some back translation procedures are suggested (Brislin, 1970), that consists of a series of repeated translation and back-translation. Others alternatives are cited as a combination of techniques without the back-translation method - that can compromise the importance of using appropriate translation procedures (Cha *et al.*, 2007).

This research has developed its own procedure for the adjustment of assertions to the English and Portuguese languages. After completing the sentences with words to build an updated meaning to the assertion, aiming to correct and update its context to modern times, the author generated the initial version of it, only written in English. Then the author used a software tool as support for translating automated way to the Portuguese language, inserting the English text assertion in this software, and getting back the same assertion now written in Portuguese. After careful monitoring adaptations of words in Portuguese, reaching its ultimate meaning desired, the statement was again adjusted to the English language, so that the translation / version of these remain with minimum differences, minimizing inconsistencies in the understanding in any of the two languages – the use of this procedure and the technique adapted by the author, ensured a bilingual adjustment more accurate and reliable to the scale, consistent with the purpose of this research. The academic literature reports that to adapt a scale instrument to use it in another language or cultural environment, there is no universal agreement (Gjersing *et al.*, 2010), especially when costs and time may impact on the viability

of the research. Evidently, instruments that were originally constructed in two or more languages can be used by cross-cultural researchers, but, it is necessary to be meticulous when using translations to maintain the cross-cultural equivalence (Cha *et al.*, 2007).

Covering the amount of expansion of the scale items to the four constructs from Nolan studies (AP, IR, IM and UC), and also the need to fully describe the new EG construct (proposed by the author), the author made use of academic literature to find the coherent theoretical content to the subject, which was related, for each of the six growth stage (Stage I, Stage II, Stage III, Stage IV, Stage V and Stage VI), and for their five growth processes (constructs: AP-Applications Portfolio, IR-ICT/IS Resources, IM-ICT/IS Management, UC-User Community, and EG-Emerging ICT/IS). To distribute the assertions along the measuring scale, the author followed the theoretical concepts studied, and in a complementary way, when necessary, also took advantage of his personal experience as a scholar and a professional working in the technical area of ICT for many years, to discern the best positioning point that a certain assertion could be in the scale. This part of the procedure is reported by the academic literature (MacKenzie *et al.*, 2011) as a valid procedure to guarantee that the assertions are properly adjusted to the scale.

As a way to refining the scale construction procedure, a number of assertions (indicators) for each of the five constructs (AP, IR, IM, UC and EG), in each of the six stages, were associated varying of the minimum amount of three indicators, as recommended by the literature (Hair Jr *et al.*, 2006), up to the maximum quantity of five indicators, always choosing those that best could represent the construct that was intended to operationalize, hereby avoiding overly extending the total number of assertions to the scale. Guidelines recommended by scholars were followed to avoid pitfalls when developing a scale (Siegle, 2011) to be used in a future survey instrument (Brown, 2010), in the adaptation and / or the creation of the text content of the assertions, to ensure a better understanding and the correct interpretation of each assertion (question) by the respondent, and thereby, may contribute to increase the number of participants in the research. For example, the statements were objectively referenced to a single assertion, i.e., it was not asked for more of an issue in the same assertion, also was prevented the use of 'jargons' of management or technology area – Nolan and Gibson, originally used several of them, such as, “LAX” (negligent or careless, i.e., a work environments where undisciplined atmosphere can develop), “hands-off” (uninterested or passive), “FIFO” (first in, first out), “Closed-shop” (a restrictive group of technical experts), etc., to not confuse the respondent unfamiliar with such terms.

This procedure results in a full scale with 123 items, divided in the six stages of growth (from Stage I to Stage VI), covering completely the five growth processes (AP, IR, IM, UC and EG), ready to operationalize the new framework of the Figure 5, to allow the creation of the measurement model to analyze the stage level measurement of the information and communication technology in organizations.

Table 5 – A simplified structure representing the full scale of measurement

Stages of Growth (dimensions)	Growth Processes (constructs)	Number of items (indicators) to the scale according to the stage e growth processes	Total of items by stage
Stage I (Initiation)	AP 1	4 items to AP-Applications Portfolio in the Stage I	21
	IR 1	3 items to IR-ICT/IS Resources in the Stage I	
	IM 1	5 items to IM-ICT/IS Management in the Stage I	
	UC 1	4 items to UC-User Community in the Stage I	
	EG 1	5 items to EG-Emerging ICT/IS in the Stage I	
Stage II (Contagion)	AP 2	3 items to AP-Applications Portfolio in the Stage II	20
	IR 2	4 items to IR-ICT/IS Resources in the Stage II	
	IM 2	5 items to IM-ICT/IS Management in the Stage II	
	UC 2	3 items to UC-User Community in the Stage II	
	EG 2	5 items to EG-Emerging ICT/IS in the Stage II	
Stage III (Control)	AP 3	4 items to AP-Applications Portfolio in the Stage III	22
	IR 3	4 items to IR-ICT/IS Resources in the Stage III	
	IM 3	5 items to IM-ICT/IS Management in the Stage III	
	UC 3	4 items to UC-User Community in the Stage III	
	EG 3	5 items to EG-Emerging ICT/IS in the Stage III	
Stage IV (Integration)	AP 4	4 items to AP-Applications Portfolio in the Stage IV	20
	IR 4	3 items to IR-ICT/IS Resources in the Stage IV	
	IM 4	3 items to IM-ICT/IS Management in the Stage IV	
	UC 4	5 items to UC-User Community in the Stage IV	
	EG 4	5 items to EG-Emerging ICT/IS in the Stage IV	
Stage V (Data Admin.)	AP 5	4 items to AP-Applications Portfolio in the Stage V	20
	IR 5	4 items to IR-ICT/IS Resources in the Stage V	
	IM 5	4 items to IM-ICT/IS Management in the Stage V	
	UC 5	3 items to UC-User Community in the Stage V	
	EG 5	5 items to EG-Emerging ICT/IS in the Stage V	
Stage VI (Maturity)	AP 6	3 items to AP-Applications Portfolio in the Stage VI	20
	IR 6	4 items to IR-ICT/IS Resources in the Stage VI	
	IM 6	4 items to IM-ICT/IS Management in the Stage VI	
	UC 6	4 items to UC-User Community in the Stage VI	
	EG 6	5 items to EG-Emerging ICT/IS in the Stage VI	
6 Stages of Growth	6 Groups of 5 Growth Processes	123 items (to cover the full scale)	

Source: Created by the Author based on Nolan (1975, 1979, 1993, 2001) studies and other contributions

In order to easily understand how the scale of measurement will be organized to allow proper measurement of the constructs based on the assertions (items or indicators), substantiated by academic theory, Table 5 has been structured.

Table 5 shows a simplified structure to substantiate the full scale – as illustrated and available in the Appendix A of this document. The six Stages of Growth are the dimensions (Stage I-Initiation, Stage II-Contagion, Stage III-Control, Stage IV-Integration, Stage V-Data Administration, and Stage VI-Maturity), the five Growth Processes are the constructs (AP-Applications Portfolio, IR-ICT/IS Resources, IM-ICT/IS Management, UC-User Community, and EG-Emerging ICT/IS) to the each stage, and in the column “Total of items by stage “, the specific number of items totalize 20 to Stage II, IV, V, VI; 21 to Stage I; and 22 to Stage III.

10 GUIDELINES TO ASSEMBLY THE SURVEY TYPE INSTRUMENT

In order to instruct some procedures to help future steps of this research, the author prepared a simple guideline to organize and to assembly a survey type instrument, to allow the use and test of the scale created and developed by this research.

By measuring concepts through scales, we can use up to four basic types: nominal, ordinal, interval and ratio. Depending on the type and complexity of the research, it is possible to mix its uses or "calibrate" the scale in sophistication to get better response accuracy and therefore, in the measurement and analysis of data collected. It is recommended when using a Likert classification (interval) the minimum number of five options (Hair Jr *et al.*, 2006), having in mind that if there is a central point (odd number of options), respondent bias may exist, when they choose the middle of the scale, highlighting as "neutral" in these cases. It is also highly recommended by the methodological literature to do a random arrangement of the order of the items to minimize response bias. Another way to refine the validation of the definition of a construct (MacKenzie *et al.*, 2011), can be made by performing an evaluation by a group of experts, which holds deep knowledge of the subject matter involved (or by individuals potential respondents) - they will judge whether these items (indicators) are adequate to explain the construct (face validity).

This way, the author recommends a configuration of a survey type instrument, to use the scale created by this study, following a sequence of "steps", from 1 to 6, as illustrated by the Figure 10.

The screenshot displays the initial interface of a survey instrument. At the top, the logo for FGV EAESP is visible, along with the text "[Academic Research] • edition 1.0 • fev/2015" and "Stage Level Measurement of Information and Communication Technology (ICT) in Organizations". The page is titled "Start" and features a progress bar indicating 17% completion. A navigation menu includes buttons for "Start", "Profile", "Part A", "Part B", "Part C", and "Diagnostic". The main content area is divided into two sections. The first section, titled "Please, informe about You:", contains input fields for "Full Name:", "Main E-mail:", and "Alternate E-mail:". Below these fields, there is a note: "(a web:ome message will be sent to this e-mail with a Web link for continuing this research)". A "Gender:" section includes radio buttons for "Male" and "Female". The second section, titled "What is your main function or role in the Organization you represent in this research?", lists four roles with radio buttons: "President o Chief Executive Officer (CEO)", "Chief Information Officer (CIO)", "Chief Financial Officer (CFO)", and "Chief Data Officer (CDO)".

Figure 10 – Suggestion of the first screen shot about the six steps of the survey instrument - an on-line form with the full scale and complementary demographic questionnaire

Source: Created by the Author

As shown by the Figure 10, the potential respondents may participate in a future empirical study using a survey type instrument available via the Internet, that in addition to including the scale developed for this study, may also include demographic variables (questions) about the organization that they represent, creating the possibility of performing study comparisons, between these variables, for example, sector and industry, size of the organization, number of employees, and so on.

The scale instrument developed will require an easy way to be correctly understood by the respondents, in order to help and stimulate them to participate on the survey with a minimum waste time and personal efforts. The author suggested the creation of an online user friendly survey instrument, disposal on the Internet - with divided screens in blocks, which will be advanced by 6 steps - in order to accommodate the scale and demographic questionnaire, as a progressive manner to be filled out by the respondents, including its six steps, as follows:

Step 1: Start – The beginning of the survey form, requesting respondent identification with demographic questions about his/her personal characteristics, as a preliminary validation;

As the research unit of analysis (Sekaran, 2000) was focused on the organization rather than the individual as a person, the respondent public should be highly qualified preferably having corporate knowledge covering management and / or technology (i.e, CEO, CIO, CFO, Vice-Presidents, Directors, Executive Managers or Administrators, etc.), having under their responsibilities, administrative technical tasks involving the organizational ICT activities, so that their responses may reflect the closest reality of what occurred in the organization, rather than just be a personal opinion of one respondent as an individual.

Step 2: Profile – The organizational identification profile, with complementary demographic questions about the organization;

Step 3: Part A – The first block of mixed assertions regarding the scale developed in a Likert classification with 6 options (from “1 – Disagree Completely”, “2 – Disagree”, “3 – Disagree Slightly”, “4 – Agree Slightly”, “5 – Agree” to “6 – Agree Completely”);

The assertions of the scale should be "shuffled" and arranged in research survey type instrument, and up to 3 different blocks (Part A, B and C). This way, dividing 123 assertions by 3 we will have 41 assertions in each one of these blocks. It means, Part A, from ‘A001’ up

to 'A041'; Part B, from 'A042' to 'A082'; Part C from 'A083' to 'A123', where 'A-number' is the referred number of that assertion, but in a mixed order from the original scale order.

Step 4: Parte B – The second block of assertions, continuing the answers regarding the scale measurement;

Step 5: Part C – The third and last block of assertions, to complete the answers to finalize the scale measurement;

Step 6: Diagnostic – The final step of the survey, where the respondents will get a simple report about the results of the measurement of the stage level of its organizational ICT/IS initiatives.

Due to the easiness of Internet access for potential survey respondents, and considering the limited availability of free time of these managers, who hold such functions in organizations, the focus on maximum automation and ease use of the research survey type instrument should be a main feature in this task.

Brazilian IS researchers are challenged to produce good research that can be useful, both locally and internationally (Pozzebon *et al.*, 2011). Capturing this message from other important Brazilian scholars, the author has planned the research instrument to have the possibility to be answered by any of the two languages (Portuguese and English), allowing that, besides organizations active in Brazil or Portuguese speaking countries, may also participate in the research, international respondents, increasing the probable number of participants, as well as, the variety of profiles organizations due to their different locations in the world.

This full step by step, of the 6 blocks, suggested by the author to be used in the preparation of the English and Portuguese survey type instrument, is available in the Appendix B of this document.

11 RESULTS AND DISCUSSION

The scale developed in this research does the identification of various activities (based on its assertions), which represent, when considered together, each one of the processes in the theoretical framework of NSGT, to contemplate each of the stages of growth of organizational ICT/IS initiatives. Important considerations can be listed reflecting the extracted results of this research:

- 1) Measurements of stage levels are independent of one another, no "mixing" perceptions (below or in addition to) one over the other – that is, a next stage does not need to be better evaluated than the previous one or vice versa;
- 2) It is important to note which groups of processes were better or worse evaluated (based on high or low note received by the scale) - the joint composition of these notes will contribute to the final score of the respective stage alignment;
- 3) How much more the respondent assign a higher grade value in a given range of a specific assertion, it will be 'more agreeing' with that assertion, meaning that if the organization is aligned with that exposed condition or requirement or, on the other hand, how the organization claims to position itself at this stage and / or group of processes. In other words, the organization to meet completely which is informed by the assertion (answer on the scale assertive with maximum grade, i.e., the value 6), it will be "totally agree" with that matter set forth by the assertion (in the respective growth processes, and in the respective growth stage);
- 4) So, the higher the score given by the organization, starting with the thresholds of 1 to a maximum of 6, assigned by the proposed scale, it can be inferred that it is more "positioned" or "aligned" in "meet" or "fulfill" the certain processes measured by that initiatives of ICT/IS, and in turn be positioned at this stage and / or group of processes. In other words, when these perceptions of the respondent totalized for each of the five growth processes in each of the six stages of growth, can be reached at a particular final average rating (between, 1 - min. and 6 - max), of these perceptions;

- 5) It is not proper to evaluate only a supposed stage where the organization probably is located - it has to be analyzed as the activities of ICT / IS organization are situated in each of the stages, because this way the organization will have a 'photo' more precisely where it is positioned in Nolan curve.

As a hypothetical example, if an organization has on the same stage a process note the average "AP" to "1.2" (20%) and an average grade of "4.7" (78%) of the process "IM", this means that their systems applications (AP process) are not aligned according to that particular stage. Then, by definition of this research grading system – Figure 6 - the calculated score is too low in alignment, while the management and administration of its ICT / IS activities are being carried out with the highest alignment (high score).

For this type of evaluation, there is no need that all organizational stages are with the same alignment, or either they are necessarily "passed" by the organization, but rather that there is consistency in aligning the use of their processes, according to the current position on the stage level where the organization is located. For example: if it is "positioned" in stage 3, the ideal is that most of their growth processes, linked at this stage are "harmonized", i.e., that have a good development together with balanced notes in that stage level that it is located. In other words, this means that it should report notes similar of the alignment in all of its five growth processes: AP, IR, IM, UC e EG.

That finding corroborates with the theory, where the effective management of the ICT activity occurs by maintaining balance among all the growth processes, it means, by ensuring that one growth process does not get significantly ahead of the others, nor fall significantly behind (Nolan & Koot, 1992, p.4; Nolan, 1993, p. 3). As also considered by Cash *et al.* (1994, p. p.261), “to achieve a better balance of growth processes, managers can slow down the acquisition of technology or speed up the development of necessary skills”.

In other words, if the management knows how to use and handle all these growth processes, doing right choices, the ICT/IS initiatives will be deployed efficiently and effectively, and the organization will receive back better results.

It can be exemplified with two hypothetical situations considering this time the stage completely (not just a process or otherwise), but they all integrated into a single average:

Example 1: (Stage I) If an organization had a high note in the measurement of Stage I growth processes, it is positioned at this stage. It can be interpreted with this analysis that the

organization has limitations on the use of its initiatives of ICT/IS, because Stage I (Initiation) is considered the most basic stage in Nolan curve, meaning that the organization has yet to evolve a lot in their learning to obtain more benefit from the advantages that the technology offers.

Example 2: (Stage V) If an organization had a low score in the growth processes which measures the Stage V (Data Management), its alignment at this stage will be received little attention, demonstrating that there is a greater need of the organization in fulfilling the respective processes this stage, which in general should identify ICT initiatives / SI strategic support from the activities of the organization in the use of information as a resource (asset) of great institutional value.

In another hypothetical situation, by the analysis of a small organization existing only in the virtual world, founded in 2010, the application and use of the scale developed in this study and the theory of Nolan growth stages can reach a clarification, as follows.

An organization founded in the same period of the beginning of the Big Data Era, often does not feature traditional physical structure (e.g., an available organization only virtually), can not understand very well about the regimented use that was made of 'automation' or 'informatic' (terms that represented the current information and communication technology) during the previous decades (between 1960-1990), both in its management, technical team management, user training, employment resources in equipment and people, as the results of these practices that were reversed in benefits to the organization (e.g., process automation, speed in performing tasks, reduction costs, etc.). It can be inferred that this type of organization, when viewed by modern and current view of organizational ICT initiatives employment brings the assumption that all these conditions and rules should already be intrinsically embedded in the organization's business plan and its intensive use is an important and essential part even for its own existence. Regardless, by the measurement of the preliminary stages (initiation and contagion), it can be inferred that there is a tendency of this organization profile to contain a stage level of alignment with a low value in these two stages, as these stages have been overcome in the very preliminary business design that created the organization. And it seems that the following stages (III, IV, V and VI), will be higher scored.

In another hypothetical situation as an example, a practice occurring within the organization can be cited: the management (management - IM process) has the willingness to invest in a new technology by buying new hardware or software (resource - IR process), the which has

the potential to suit their market position with the competitors (management - IM process), no use to the organization's databases (feature - IR process) are not appropriately refined, with good quality data collection and information, and the user (user - UC process) which will have the task operation to be performed if he is not properly trained to do and know exactly extract the best features found in the "product" to reverse in immediate benefit to the organization.

The academic literature (Cash *et al.*, 1994) also reiterates that situation when one common imbalance situation occurs when the technology is too far ahead of the organization's ability to apply it. We can consider as a similar example:

[...] ICT managers would occasionally acquire advanced data base technology without having the appropriate technical skills in their programmer ranks and functional awareness of users to effectively apply the advanced technology. The result would be rejected in systems that were expensive to develop and maintain (Cash *et al.*, 1994, p.261).

With the changes in market conditions, there will be a continuing need for adaptation of the statements of each growth stage (update of scale), and especially, the process of "EG" should always be aligned with emerging technologies often still outside the domain the organization, which will come with the new "Eras".

As mentioned by Bradley & Nolan (1998), "new technologies continue to enable new strategies; new technologies create new opportunities to capture economic value".

To end the discussion of the results of this research, this author believes that the old concepts of Industrial Economics practically no longer make sense in the new context of the Knowledge Economy, and the acquisition of knowledge and the process of organizational learning become relevant to influence the pace of progress in the growth stage model of the organizational initiatives of ICT/IS.

12 STUDY LIMITATIONS

This study did not include in its scope the face validity step with experts from other countries and showed restricted to a small number of Brazilian experts, by limiting the identification and contact with such individuals – deep knowledge of the theoretical field of IS and NSGT, and with active participation as acting professional in the ICT area. An expansion of this step to further increase the methodological rigor of this research is one of the author's recommendations.

The author suggests to apply the scale developed, as a data collection instrument, intends to involve a series of pretests using some groups of experts: MIS doctoral students, ICT/IS practitioners (CIOs or IT top managers), and postgraduate business school faculty members, which are somehow involved on teaching about the discipline of information systems or are potential decision makers in corporate environments where they act professionally.

The scale should accommodate the needs of different organizations sizes (small, medium and large), but, when comparing the results obtained, it is recommended that consistent groupings must be used with respect to size and sector / industry, to avoid possible comparison bias.

Another relevant situation is the observation of some temporal variable – i.e., what time the scale will be applied (or the questionnaire will be answered) - because the answers may receive the impact of some managerial requisites (the structure of the organization, the economic, political, market time, etc.) or technological issue (early use of a technology, obsolescence of technology, exchange of technical staff, untrained operators, etc.), and these situation can compromise the measure of the stage level of the organizational ICT/IS initiatives.

13 CONCLUSION

The challenge of this dissertation was to provide theoretical contribution to the study field of Information Systems (IS), based on the Stages of Growth Theory and Nolan's studies regarding stages of growth models.

Furthermore, to substantiate a bilingual scale instrument (Portuguese and English), with a purpose to make the measurement of the stage level of ICT/IS initiatives in organizations, with academic scientific rigor, and adapted for the evaluation of emerging technologies in modern society, can be considered a very useful working tool for academics and practitioners.

There is a wide perception that ICT management is becoming inseparable from the essence of every manager's attitude, or even the organization itself, and needs to be dealt now with one of the most important resources of the modern organization.

This study emphasized that it is very important that the organization maintains a balance among all the growth processes and its effective management, to allow a harmonious progression of the organizational ICT/IS activities in the evolution of the stages of growth.

Technology can be the same for two organizations but the "art" of making its use is what makes the difference or efficiency. That is, the influence of technology and the role of management are crucial for the organization to be successful in their activities.

For this academic research does not extend its scope, it has not tried to operationalize additional dependent variables (that could be useful in statistical techniques of SEM - Structural Equation Modeling), leaving this possibility to be used in a subsequent academic work.

Future researches can be derived from this study and subsequently applied with empirical and statistical validation approach, with the use of descriptive statistics, Confirmatory Factorial Analysis (CFA) and also SEM techniques, being an important step to verify the validity and reliability of the framework and scale proposed in this study.

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APPENDIX A
BILINGUAL SCALE FOR MEASUREMENT THE STAGE LEVEL
OF ICT/IS IN ORGANIZATIONS (PORTUGUESE AND ENGLISH)

Stages	Constructs	Item Codes / Assertions (English and Portuguese)	References
Stage I	Applications Portfolio (AP)	AP11 – The set of systems applications portfolio is limited. AP11 – O portfólio de aplicações de sistemas é limitado.	Nolan (1973, 1979); Nolan & Koot (1992); Mutsaers <i>et al.</i> (1998)
		AP12 – The systems applications portfolio is decentralized. AP12 – O portfólio de aplicações de sistemas é descentralizado.	
		AP13 – The systems applications portfolio is primarily focused on operational level. AP13 – O portfólio de aplicações de sistemas é focado principalmente no nível operacional.	Nolan (1973, 1979); Nolan & Koot (1992); Nolan <i>et al.</i> (1993); Li <i>et al.</i> (1994); Mutsaers <i>et al.</i> (1998)
		AP14 – The current Organization systems applications are strictly defined to automate administrative tasks, replacing manual labor and minimizing costs. AP14 – As atuais aplicações de sistemas da Organização são estritamente definidas para automatizar tarefas administrativas, substituindo trabalhos manuais e minimizando custos.	Nolan (1975); Nolan & Koot (1992); Mutsaers <i>et al.</i> (1998)
	ICT/IS Resources (IR)	IR11 – The ICT activity is composed of technologists and operates as a "closed group" focused to technological learning. IR11 – A atividade da TIC é composta de tecnólogos e opera como um "grupo fechado" focado ao aprendizado tecnológico.	Nolan (1979); Nolan & Koot (1992); Li <i>et al.</i> (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 <i>et al.</i> (1998)

		<p>IR13 – The ICT staff of the Organization has focused on narrow objectives, for themselves defined.</p> <p>IR13 – O pessoal da TIC da Organização tem se concentrado em objetivos restritos, por eles mesmos definidos.</p>	Nolan (1975)
	<p>ICT/IS Management (IM)</p>	<p>IM11 – The management of organizational ICT is decided only by those responsible for the ICT area.</p> <p>IM11 – A gestão da TIC organizacional é decidida apenas pelos responsáveis pela área da TIC.</p>	<p>Nolan (1973, 1979); Nolan & Koot (1992); Mutsaers <i>et al.</i> (1998); Li <i>et al.</i> (1994)</p>
<p>IM12 – There is no planning and controlling to execute the ICT management.</p> <p>IM12 – Não existe planejamento e controle para executar a gestão da TIC.</p>			
<p>IM13 – The ICT management has attention focused only the occurrences that arise.</p> <p>IM13 – A gestão da TIC possui a atenção focada somente nas ocorrências que vão surgindo.</p>			
<p>IM14 – The Organization is in a period of primary learning about how to use their ICT initiatives.</p> <p>IM14 – A Organização está em um período de aprendizagem primária sobre como utilizar as suas iniciativas da TIC.</p>		Nolan (1975)	
<p>IM15 – The Organization traditionally follows the main recommendation to use ICT initiatives only to improve its efficiency.</p> <p>IM15 – A Organização segue tradicionalmente a orientação principal de utilizar as iniciativas da TIC somente para melhorar a sua eficiência.</p>		Mutsaers <i>et al.</i> (1998)	

	User Community (UC)	UC11 – The users of the Organization are not involved in organizational ICT initiatives. UC11 – Os usuários da Organização não estão envolvidos nas iniciativas da TIC organizacional.	Nolan (1973, 1979); Nolan & Koot (1992); Mutsaers <i>et al.</i> (1998)
		UC12 – The Organization users do not show interest in the involvement with the initiatives of organizational ICT. UC12 – Os usuários da organização não demonstram interesse no envolvimento com as iniciativas da TIC organizacional.	Nolan & Koot (1992); Li <i>et al.</i> (1994)
		UC13 – The Organization users are not aware of the benefits arising from the organizational ICT initiatives. UC13 – Os usuários da Organização não são conscientes dos benefícios decorrentes das iniciativas da TIC organizacional.	Nolan & Koot (1992); Li <i>et al.</i> (1994)
		UC14 – The users do not even collaborated with the Organization's ICT initiatives. UC14 – Os usuários ainda não colaboraram com as iniciativas da TIC da Organização.	Nolan & Koot (1992)
	Emerging ICT/IS (EG)	EG11 – The Organization knows well the technology that already use today, while the new technology, freshly available on the market, it is by definition associated with problems. EG11 – A Organização conhece bem a tecnologia que já utiliza atualmente, enquanto a nova tecnologia, recém-disponibilizada no mercado, é por definição associada a problemas.	Nolan (1984); This Author (2015)
		EG12 – The ICT activity manager has a tendency to be cautious towards new	Grégoire & Lustman (1993); This

	<p>technologies and typically adopts an attitude of wait-and-see. EG12 – O gerente da atividade da TIC tem uma tendência a ser cauteloso para as novas tecnologias e normalmente adota uma atitude de esperar-para-ver.</p>	Author (2015)
	<p>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.</p>	Nolan & McFarlan (2005); This Author (2015)
	<p>EG14 – The Organization website only provides information as well as contact options, without the intention of being used with a strategic focus. EG14 – O website da Organização só fornece informações além de opções de contato, sem o intuito de ser utilizado com foco estratégico.</p>	Teo & Pian (2003); This Author (2015)
	<p>EG15 – The Organization has no interest in using emerging technologies (e.g. mobility, cloud computing, APPs, etc.) in their ICT initiatives. EG15 – A Organização não tem interesse em utilizar as tecnologias emergentes (ex: mobilidade, computação na nuvem, APPs, etc.) em suas iniciativas da TIC.</p>	This Author (2015)

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Stages	Constructs	Item Codes / Assertions (English and Portuguese)	References
Stage II	Applications Portfolio (AP)	AP21 – There is an intense proliferation of systems applications in all functional areas of the Organization. AP21 – Há uma intensa proliferação de aplicações de sistemas em todas as áreas funcionais da Organização.	Nolan (1973, 1979); Gibson & Nolan (1974); Li <i>et al.</i> (1994)
		AP22 – To avoid the recurrence of problems with the development of its system applications, the Organization adopts a formal method of monitoring by steps. AP22 – Para evitar a recorrência de problemas com o desenvolvimento de suas aplicações de sistema, a Organização adota um método formal de acompanhamento por etapas.	Nolan & Koot (1992)
		AP23 – The system applications during its adequacy and implementation are seen as costs, rather than being treated as investments or assets. AP23 – As aplicações de sistemas no decorrer de sua adequação e implantação são vistos como custos, ao invés de serem vistos como investimentos ou ativos.	Nolan & Koot (1992)
	ICT/IS Resources (IR)	IR21 – The organizational ICT activity is maintained by technologists attending the support of users of each functional area. IR21 – A atividade da TIC organizacional é mantida por tecnólogos que atendem ao suporte dos usuários de cada área funcional.	Nolan (1973, 1979); Nolan & Koot (1992); Li <i>et al.</i> (1994)
		IR22 – The Organization concentrates on introducing new ICT initiatives at the operational level, in all available opportunities. IR22 – A Organização concentra-se na introdução de novas iniciativas da TIC no nível operacional, em todas as oportunidades disponíveis.	Nolan <i>et al.</i> (1993)

		<p>IR23 – The Organization devotes less and less attention about the efficient use of its existing ICT resources.</p> <p>IR23 – A Organização dedica cada vez menos atenção sobre o uso eficiente de seus existentes recursos da TIC.</p>	Nolan <i>et al.</i> (1993)
		<p>IR24 – Even increasing the ICT initiatives budget, it has not helped to avoid backlogs in meeting the needs of the Organization users.</p> <p>IR24 – Mesmo aumentando o orçamento das iniciativas de TIC, isto não ajudou a evitar atrasos no atendimento das necessidades dos usuários da Organização.</p>	Nolan & Koot (1992)
	ICT/IS Management (IM)	<p>IM21 – The administration of organizational ICT is decided together by those responsible for ICT area and by the management.</p> <p>IM21 – A gestão da TIC organizacional é decidida em conjunto pelos responsáveis pela área da TIC e pela administração.</p>	Nolan (1973, 1979); Nolan & Koot (1992); Nolan <i>et al.</i> (1993); Li <i>et al.</i> (1994); Mutsaers <i>et al.</i> (1998)
		<p>IM22 – With a high slack and low control, the use of ICT initiatives is growing rapidly, but in an inefficient and uncontrolled way.</p> <p>IM22 – Com uma alta negligência e um baixo controle, o uso das iniciativas da TIC está crescendo rapidamente, mas de uma maneira ineficiente e descontrolada.</p>	Nolan (1973, 1979); Nolan & Koot (1992); Nolan <i>et al.</i> (1993)
		<p>IM23 – Management continues to commit more resources to the development of ICT initiatives, exceeding what is necessary to do the job.</p> <p>IM23 – A gestão continua a empenhar mais recursos ao desenvolvimento das iniciativas da TIC, superando o estritamente necessário para fazer o trabalho.</p>	Nolan & Koot (1992); Nolan <i>et al.</i> (1993)
		<p>IM24 – The Organization encourages innovation by maintaining low control of the ICT environment.</p>	Nolan (1979)

		IM24 – A Organização incentiva à inovação, mantendo baixo o controle do ambiente da TIC.	
		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)
	User Community (UC)	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 aquisição de experiência pelo usuário.	Nolan & Koot (1992); Mutsaers <i>et al.</i> (1998)
		UC22 – The Organization users are enthusiastic to initiate their involvement in the ICT initiatives. UC22 – Os usuários da Organização estão entusiasmados para iniciar seu envolvimento 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 <i>et al.</i> (1998)
	Emerging ICT/IS (EG)	EG21 – The users, at different levels in the Organization, are bypassing the ICT policies and on their own go directly to cloud service providers getting applications with high convenience of use and immediate accessibility. EG21 – Os usuários, em diferentes níveis na Organização, estão ignorando as políticas da TIC e por conta própria vão diretamente para provedores de	Cătinean & Căndea (2014); Meirelles (2014); This Author (2015)

		serviços na nuvem obtendo aplicações com alta conveniência de uso e acessibilidade imediata.	
		EG22 – Understand emerging technologies and new organizational design are current challenges to be managed by the ICT activity. EG22 – Compreender as tecnologias emergentes e o novo design organizacional são desafios atuais a serem geridos pela atividade da TIC.	Cătinean & Câdea (2014); This Author (2015)
		EG23 – The Organization also wants to take advantage of emerging technologies (i.e: mobility, cloud computing, APPs, etc.) in their initiatives of ICT, but it is uncertain how to do this. EG23 – A Organização quer também aproveitar das tecnologias emergentes (ex: mobilidade, computação na nuvem, APPs, etc.) em suas iniciativas da TIC, mas está incerta de como fazer isso.	Meirelles (2014); This Author (2015)
		EG24 – A period of high learning in the Organization whereby emerging technologies proliferate in a relatively uncontrolled manner. EG24 – Um período de alta aprendizagem na Organização em que tecnologias emergentes proliferam de uma maneira relativamente não controlada.	Nolan & Bennis (2002); This Author (2015)
		EG25 – Social media applications (e.g., blogs, Facebook, Twitter) are used informally by users who have some prior experience, to help the Organization. EG25 – Aplicações de mídia social (ex.: blogs, Facebook, Twitter) são usadas informalmente por usuários que têm alguma experiência prévia, para ajudar a Organização.	Kaplan & Haenlein (2010); Mergel & Bretschneider (2013); This Author (2015)

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Stages	Constructs	Item Codes / Assertions (English and Portuguese)	References
Stage III	Applications Portfolio (AP)	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 <i>et al.</i> (1994)
		AP32 – After a period of Organization negligence, several systems are replaced by a new generation of applications. AP32 – Após um período de negligência da Organização, vários sistemas são substituídos por uma nova geração de aplicações.	Nolan (1973, 1979); Nolan & Koot (1992); Mutsaers <i>et al.</i> (1998)
		AP33 – There is a moratorium on the development of new applications and emphasis on control of those existing ones. AP33 – Há uma moratória no desenvolvimento de novas aplicações e ênfase no controle daquelas existentes.	Gibson & Nolan (1974)
		AP34 – The Organization begins to use time-sharing database applications. AP34 – A Organização começa a utilizar aplicações de banco de dados com acesso compartilhado.	Nolan (1979); Li <i>et al.</i> (1994)
	ICT/IS Resources (IR)	IR31 – The middle management demands more influence in the ICT activities, getting more responsibility to remedy delays. IR31 – A média gerência demanda mais influência nas atividades da TIC, recebendo uma maior responsabilidade para sanar os atrasos.	Nolan (1979); Nolan & Koot (1992); Li <i>et al.</i> (1994)
		IR32 – The senior management and ICT manager directly influence the pace in organizational learning. IR32 – A alta gerência e o gerente da TIC influenciam diretamente o ritmo da	Nolan (1973, 1979, 2001); Nolan & Koot (1992)

		aprendizagem organizacional.	
		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 ICT manager plays an intermediary role between the technical ICT personnel and the Organization’s users. IR34 – O gerente da TIC desempenha um papel de intermediário entre o pessoal técnico da TIC e os usuários da Organização.	Nolan & Koot (1992)
	ICT/IS Management (IM)	IM31 – The senior management imposes a higher level of control, by restricting the budget and disciplining the management of ICT projects. IM31 – A alta gerência 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 <i>et al.</i> (1993); Li <i>et al.</i> (1994); Mutsaers <i>et al.</i> (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 <i>et al.</i> (1994)
		IM33 – The orientation of management shifts from management of the technology to management of data resources. IM33 – A orientação da gestão muda de gestão da tecnologia para a gestão dos recursos de dados.	Nolan (1979); Grégoire & Lustman (1993)
		IM34 – There is an increased use of methods to benefit the ICT initiatives	Gibson & Nolan (1974); Nolan &

		(example: setting priorities, standards and quality systems, project management, etc.). IM34 – Há um aumento da utilização de métodos para beneficiar as iniciativas da TIC (exemplo: definição de prioridades, padrões e qualidade dos sistemas, gerenciamento de projetos, etc.).	Koot (1992); Li <i>et al.</i> (1994); Mutsaers <i>et al.</i> (1998)
		IM35 – Involvement of management and diffusion of technology among users introduce fundamentals changes in organizational behavior. IM35 – O envolvimento da gestão e a difusão de tecnologia entre os usuários introduzem mudanças fundamentais no comportamento organizacional.	Nolan (1984)
	User Community (UC)	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 <i>et al.</i> (1998)
		UC32 – The users are arbitrarily held accountable for the cost of ICT support. UC32 – Os usuários são arbitrariamente responsabilizados pelo custo do suporte da TIC.	Nolan (1979); Li <i>et al.</i> (1994)
		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 see little progress in the development of new control systems, while the ICT activity performs such adaptations.	Nolan (1979)

		UC34 – Os usuários veem poucos progressos no desenvolvimento de novas aplicações de controle, enquanto a atividade de TIC executa tais adaptações.	
Emerging ICT/IS (EG)		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.	This Author (2015)
		EG32 – Mobility is present in the daily tasks of the Organization's people, supported strongly by the resources provided by ICT, where and how it is needed. EG32 – A mobilidade está presente nas tarefas diárias das pessoas da Organização, apoiada intensamente pelos recursos providos pela TIC, onde e como isso for necessário.	Meirelles (2014); This Author (2015)
		EG33 – Data and information resources are being used effectively and correctly by Organization complying external regulatory frameworks. EG33 – Os recursos de dados e de informação estão sendo utilizados de forma eficaz e correta pela Organização cumprindo marcos regulatórios externos.	Hollyhead & Robson (2012); This Author (2015)
		EG34 – The activity of ICT strives to maintain some sense of standardized and centralized control over the emerging technologies. EG34 – A atividade da TIC se esforça para manter algum senso de controle padronizado e centralizado sobre as tecnologias emergentes.	Cătinean & Căndea (2014); This Author (2015)
		EG35 – Appropriate procedures have been established by the Organization management and ICT activity to mitigate issues involving risk and exposure (e.g., security standards, viruses, spy agents, dissatisfied customers or suppliers,	Friedman (1994); Huff <i>et al.</i> (2006); This Author (2015)

		etc.). EG35 – Procedimentos adequados foram estabelecidos pela administração da Organização e pela atividade da TIC para atenuar problemas que envolvem risco e exposição (ex: normas de segurança, vírus, agentes de espionagem, clientes ou fornecedores insatisfeitos, etc.).	
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Stages	Constructs	Item Codes / Assertions (English and Portuguese)	References
Stage IV	Applications Portfolio (AP)	AP41– To promote integration between all departments or divisions of the Organization, most systems had to be rebuilt. AP41– Para promover a integração entre todos os departamentos ou divisões da Organização, os sistemas em sua maioria tiveram que ser reconstruídos.	Nolan (1973, 1979); Nolan & Koot (1992); Mutsaers <i>et al.</i> (1998)
		AP42– By focusing on a more data-oriented approach, the organization had to restructure their systems and the relationships between the various databases. AP42– Ao concentra-se em uma abordagem mais orientada para os dados, a organização precisou reestruturar seus sistemas e os relacionamentos entre os diversos bancos de dados.	Nolan & Koot (1992); Li <i>et al.</i> (1994)
		AP43 – Older applications of the Organization systems had to be replaced to facilitate integration. AP43 – Antigas aplicações de sistemas da Organização precisaram ser substituídas para facilitar a integração.	Mutsaers <i>et al.</i> (1998)

		<p>AP44 – By promoting the integration of its systems and databases, the Organization obtained a better synchronism with your data and information.</p> <p>AP44 – Ao promover a integração de seus sistemas e bancos de dados, a Organização obteve um melhor sincronismo com seus dados e informações.</p>	Li <i>et al.</i> (1994)
ICT/IS Resources (IR)		<p>IR41– The ICT activity focuses on the management of technological capacity of the Organization and its usefulness among its users.</p> <p>IR41– A atividade da TIC tem como foco a gestão da capacidade tecnológica da Organização e sua utilidade junto aos seus usuários.</p>	Nolan (1979); Li <i>et al.</i> (1994)
		<p>IR42 – The ICT activity uses technology to make the integration of different platforms and applications.</p> <p>IR42 – A atividade da TIC utiliza a tecnologia para efetuar a integração de diferentes plataformas e aplicações.</p>	Mutsaers <i>et al.</i> (1998)
		<p>IR43 – The ICT activity delivers a service of high quality and reliability to the users of the organization.</p> <p>IR43 – A atividade da TIC entrega um serviço da alta qualidade e confiabilidade aos usuários da organização.</p>	Li <i>et al.</i> (1994)
ICT/IS Management (IM)		<p>IM41 – The Steering Committee or senior management of the Organization engages in corporate orientation of the activities of ICT and ratified the guidelines and proposed standards.</p> <p>IM41 – O Comitê Gestor ou a alta gerência da Organização envolve-se na orientação corporativa das atividades da TIC e ratifica as diretrizes e normas propostas.</p>	Nolan (1984)

		<p>IM42 – The Organization uses ICT initiatives for exploring new forms of revenue or business.</p> <p>IM42 – A Organização utiliza as iniciativas de TIC para prospectar novas formas de receitas ou negócios.</p>	Mutsaers <i>et al.</i> (1998)
		<p>IM43 – Management strives to adjust the balance between slack and control, while ICT initiatives are integrated into the Organization processes.</p> <p>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.</p>	Nolan <i>et al.</i> (1993); Mutsaers <i>et al.</i> (1998)
	User Community (UC)	<p>UC41 – User has budget responsibility regarding the organizational ICT activities.</p> <p>UC41 – O usuário tem responsabilidade no orçamento relacionado às atividades da TIC organizacional.</p>	Nolan (1973, 1979); Nolan & Koot (1992); Mutsaers <i>et al.</i> (1998)
		<p>UC42 – Users are taking an active role in the design and development of ICT initiatives to suit their needs.</p> <p>UC42 – Os usuários estão tendo um papel ativo na concepção e desenvolvimento de iniciativas da TIC para atender às suas necessidades.</p>	Nolan <i>et al.</i> (1993); Mutsaers <i>et al.</i> (1998)
		<p>UC43 –The user is also responsible for data quality and for value-added end-use.</p> <p>UC43 – O usuário também é responsável pela qualidade dos dados e pelo valor agregado em seu uso final.</p>	Nolan (1973, 1979); Nolan & Koot (1992); Mutsaers <i>et al.</i> (1998)
		<p>UC44 – Users perceive the real value of ICT activity and demand more support from it.</p>	Li <i>et al.</i> (1994); Mutsaers <i>et al.</i>

		UC44 – Os usuários percebem o real valor da atividade da TIC e demandam mais apoio desta.	(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)
Emerging ICT/IS (EG)		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 <i>et al.</i> (1998); Meirelles (2014)
		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 <i>et al.</i> (1998); McAfee (2011); Meirelles (2014)
		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 <i>et al.</i> (2006); McAfee (2011); This Author (2015)
		EG45 – The Organization has adopted a formal policy on availability, and has implemented effective controls to deal with potential interruptions (continuity	Huff <i>et al.</i> (2006); This Author (2015)

		plan). EG45 – A Organização adotou uma política formal de disponibilidade, e foram implementados controles eficazes para lidar com interrupções potenciais (plano de continuidade).	
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Stages	Constructs	Item Codes / Assertions (English and Portuguese)	References
Stage V	Applications Portfolio (AP)	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 <i>et al.</i> (1998)
		AP52 – A wide Organization integration of applications and databases require sophisticated tools. AP52 – A ampla integração de aplicações e bancos de dados da Organização exigem ferramentas sofisticadas.	Li <i>et al.</i> (1994); Mutsaers <i>et al.</i> (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 <i>et al.</i> (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 <i>et al.</i> (1994)

ICT/IS Resources (IR)	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 <i>et al.</i> (1994)
	IR52 – Heavy organizational investments are made in database technology. IR52 – Altos investimentos organizacionais são feitos em tecnologia de banco de dados.		Grégoire & Lustman (1993)
	IR53 – The data administrator role becomes relevant in making data management a strategic resource of the Organization. IR53 – O papel do administrador de dados torna-se relevante ao fazer a gestão dos dados um recurso estratégico da Organização.		Mutsaers <i>et al.</i> (1998)
	IR54 – The Organizational ICT activity shifts from an internally-oriented activity to an externally-oriented activity, to support suppliers and customers. IR54 – A atividade da TIC Organizacional muda 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)
ICT/IS Management (IM)	IM51 – The senior management of the Organization takes on responsibilities about the ICT activities, now considering its strategic management. IM51 – A alta administração da Organização assume responsabilidades sobre as atividades de TIC, agora considerando sua gestão estratégica.		Nolan (1973, 1979); Nolan & Koot (1992); Mutsaers <i>et al.</i> (1998); McAfee (2006); Huff <i>et al.</i> (2006)
	IM52 – The senior management increasingly sees the possibilities for using ICT initiatives to achieve strategic objectives.		Nolan & Koot (1992)

		IM52 – A alta administração enxerga cada vez mais as possibilidades de utilizar as iniciativas da TIC para alcançar objetivos estratégicos.	
		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 <i>et al.</i> (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)
	User Community (UC)	UC51 – Users have acquired much experience in system specification, and now in addition to being participants, also improve them with the support of the ICT staff. UC51 – Os usuários adquiriram muita experiência na especificação de sistemas, e agora além de serem participantes, também os aprimoram com o apoio do pessoal da TIC.	Nolan (1973, 1979); Nolan & Koot (1992); Mutsaers <i>et al.</i> (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 <i>et al.</i> (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	Davenport (2006); This Author (2015)

		corporativo, evitando a proliferação de planilhas e bancos de dados desenvolvidos por eles.	
Emerging ICT/IS (EG)		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 <i>et al.</i> (1998); McAfee (2011); This Author (2015)
		EG52 – The enterprise system is accessible to employees even when they are not in the Organization's facilities (e.g. home, traffic, travel, etc.), with the simple use of a web browser. EG52 – O sistema corporativo é acessível aos funcionários mesmo quando não estão nas instalações da Organização (ex: de casa, no trânsito, em viagem, etc.), com a simples utilização de um navegador web.	McAfee (2011); This Author (2015)
		EG53 – ICT is now ubiquitous, i.e., is everywhere, playing multiple roles in the Organization operations and strategies. EG53 – A TIC agora é ubíqua, isto é, está em todos os lugares, desempenhando papéis múltiplos nas operações e estratégias da Organização.	Nolan (2012, p. 91); Meirelles (2014)
		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 (2014); This Author (2015)
		EG55 – The Organization is using the emerging technologies to gain flexibility and responsiveness in meeting customer demands.	Bradley & Nolan (1998); Meirelles

		EG55 – A Organização está usando as tecnologias emergentes para ganhar flexibilidade e capacidade de resposta no atendimento às demandas dos clientes.	(2014)
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Stages	Constructs	Item Codes / Assertions (English and Portuguese)	References
Stage VI	Applications Portfolio (AP)	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 <i>et al.</i> (1998); Meirelles (2014);
		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 <i>et al.</i> (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 <i>et al.</i> (1998); Meirelles (2014)
	ICT/IS Resources (IR)	IR61 – The ICT activity is moved up to top management level. IR61 – A atividade da TIC está deslocada ao nível da alta gerência.	Nolan (1979); Li <i>et al.</i> (1994)
		IR62 – The ICT activity focuses on data resource management with the	Nolan (1979); Li <i>et al.</i> (1994);

		<p>information available in real time.</p> <p>IR62 – A atividade da TIC se concentra na gestão de recursos de dados com a informação disponibilizada em tempo real.</p>	Mutsaers <i>et al.</i> (1998)
		<p>IR63 – The ICT activity, as a weapon for competition, is considered extremely important for the Organization.</p> <p>IR63 – A atividade da TIC, como um armamento para competição, é considerada de importância extrema para a Organização.</p>	Li <i>et al.</i> (1994); Mutsaers <i>et al.</i> (1998)
		<p>IR64 – The ICT activity receives daily demands to enhance and maintain functional technical structure of the Organization.</p> <p>IR64 – A atividade da TIC recebe demandas diárias para aprimorar e manter a estrutura técnica funcional da Organização.</p>	Mutsaers <i>et al.</i> (1998)
	ICT/IS Management (IM)	<p>IM61 – New technologies are used by management to directly exploit information as a resource to add value to the product or service.</p> <p>IM61 – Novas tecnologias são utilizadas pela administração para explorar diretamente a informação como um recurso para adicionar valor ao produto ou serviço.</p>	Nolan (1993, 2001); Gottschalk (2002a); Nolan & Koot (1992); Mutsaers <i>et al.</i> (1998)
		<p>IM62 – The Organization taking advantage of their ICT initiatives, constantly and quickly responds to competitive market pressures.</p> <p>IM62 – A Organização aproveitando de suas iniciativas de TIC, constantemente e de forma rápida responde as pressões competitivas de mercado.</p>	Mutsaers <i>et al.</i> (1998)
		<p>IM63 – The Organization ICT activity changes from a technology-driven phenomenon to a strategy-driven management resource.</p> <p>IM63 – A atividade da TIC Organizacional muda de um fenômeno orientado pela tecnologia para um recurso de gerenciamento orientado pela estratégia.</p>	Nolan & Koot (1992); Mutsaers <i>et al.</i> (1998)

		<p>IM64 – In the participation of high-level discussion on the strategic direction of the organization, the presence of the ICT top management becomes essential.</p> <p>IM64 – Na participação de discussão de alto nível sobre a orientação estratégica da organização, a presença da alta administração da TIC torna-se imprescindível.</p>	Nolan & Bennis (2002)
	User Community (UC)	<p>UC61 – The Organization users are responsible for the acquiring and use of technology, with the support of the ICT staff.</p> <p>UC61 – Os usuários da organização são responsáveis pela aquisição e uso da tecnologia, com o apoio da equipe da TIC.</p>	Nolan (1973, 1979); Nolan & Koot (1992); Mutsaers <i>et al.</i> (1998)
		<p>UC62 – The Organization user takes care about its own workstation (local or mobile) with some support of the ICT staff.</p> <p>UC62 – O usuário da organização cuida de sua própria estação de trabalho (local ou móvel) com algum apoio da equipe da TIC.</p>	Mutsaers <i>et al.</i> (1998); Meirelles (2014)
		<p>UC63 – The users and the Organization ICT staff are jointly responsible for the effectiveness of projects that use ICT initiatives.</p> <p>UC63 – Os usuários e a equipe da TIC da Organização são solidariamente responsáveis pela eficácia de projetos que utilizam iniciativas da TIC.</p>	Nolan (1979); Li <i>et al.</i> (1994)
		<p>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.</p> <p>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.</p>	Mutsaers <i>et al.</i> (1998); This Author (2015)

	Emerging ICT/IS (EG)	<p>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.</p> <p>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.</p>	McAfee (2011); This Author (2015)
<p>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.</p> <p>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.</p>		Bradley & Nolan (1998); This Author (2015)	
<p>EG63 – Any behavior of the Organization can be monitored online and in real time.</p> <p>EG63 – Qualquer comportamento da Organização pode ser monitorado de maneira on-line e em tempo real.</p>		Mutsaers <i>et al.</i> (1998); This Author (2015)	
<p>EG64 – The Organization efficiently, effectively and creatively uses the best competencies and knowledge of its network to create continuous innovation based on real time information.</p> <p>EG64 – A Organização de forma eficiente, eficaz e criativa utiliza as melhores competências e conhecimentos de sua rede para criar inovação contínua com base em informações em tempo real.</p>		Mutsaers <i>et al.</i> (1998); This Author (2015)	

		<p>EG65 – If Organizational systems fail for some minutes, there’s an immediate loss of business.</p> <p>EG65 – Se os sistemas Organizacionais falham por alguns minutos, há uma perda imediata do negócio.</p>	<p>Nolan & McFarlan (2005); This Author (2015)</p>

=== end of the scale

APPENDIX B

SOFTWARE SCREENS FOR THE ASSEMBLY OF THE ON-LINE

SURVEY TYPE INSTRUMENT (ENGLISH VERSION)

FGV EAESP
[Academic Research] • edition 1.0 • fev/2015
Stage Level Measurement of Information and Communication Technology (ICT) in Organizations

Start 17%

Thank you for your interest to participate in this research!

At the end of the answers of the first 5 steps (about 20 minutes of estimated time), you will get a summary diagnostic regarding the ICT initiatives of your Organization based on the academic study field of Information Systems (IS).

So, be very precise in your answers, to obtain the proper diagnostic.

1 Start **2 Profile** **3 Part A** **4 Part B** **5 Part C** **6 Diagnostic**

Please, inform about You:

Full Name:

Main E-mail:
(a welcome message will be sent to this e-mail with a Web link for continuing this research)

Alternate E-mail*:
* Important: e-mail will always be our primary way of contact, please, also inform another one as an alternative.

Gender: Male Female

What is your main function or role in the Organization you represent in this research?

President o Chief Executive Officer (CEO)

Chief Information Officer (CIO)

Chief Financial Officer (CFO)

Chief Data Officer (CDO)

Figure 11 – The first page “Start” to be used in the survey type instrument
Source: Created by the Author

FGV EAESP
[Academic Research] • edition 1.0 • fev/2015
Stage Level Measurement of Information and Communication Technology (ICT) in Organizations

Profile 33%

The research wants to know a little about the profile of the respondents, aiming at studying changes in the grouping of the results obtained by collecting total data.

Your information is confidential and will not be disclosed or shared with third parties. They will be used only for statistical analysis, always compiled and integrated with information from other survey respondents.

1 Start **2 Profile** **3 Part A** **4 Part B** **5 Part C** **6 Diagnostic**

Please, inform about your Organization:

Organization's name:

Country where it is located: -- choose an option --

City name:

ZIP code:

CNPJ* number: * Only for organizations based in Brazil

What is the main economic sector in which the Organization operates?

Commercial sector (retail)

Manufacturing sector

Service sector

Figure 12 – The second page “Profile” to be used in the survey type instrument
Source: Created by the Author



[Academic Research] • edition 1.0 • fev/2015
 Stage Level Measurement of Information and Communication Technology (ICT) in Organizations

Part A

You have already arrived in the middle of the survey!

From now you answer a sequence of assertions based on a six-point scale, from 1='Disagree Completely' to 6='Agree Completely', regarding your Organization ICT initiatives, based on the academic field of study of Information Systems (IS).

50%

1 Start
2 Profile
3 Part A
4 Part B
5 Part C
6 Diagnostic

▶ How would you rate the ICT/IS initiatives in your organization regarding the following items?

	Disagree Completely 1	Disagree 2	Disagree Slightly 3	Agree Slightly 4	Agree 5	Agree Completely 6
A001. Management continues to commit more resources to the development of ICT initiatives, exceeding what is necessary to do the job.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
A002. The Organization also wants to take advantage of emerging technologies (i.e. mobility, cloud computing, APPS, etc.) in their initiatives of ICT, but it is uncertain how to do this.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
A003. After a period of Organization negligence, several systems are replaced by a new generation of applications.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
A004. The data administrator role becomes relevant in making data management a strategic resource of the Organization.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
A005. The enterprise system is platform independent of the type of hardware, i.e., it can be accessed by micro desktops, laptops, tablets and smartphones.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
A006. There is an increased use of methods to benefit the ICT initiatives (example: setting priorities, standards and quality systems, project management, etc.).	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
A007. The Organization knows well the technology that already use today, while the new technology, freshly available on the market, it is by definition associated with problems.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
A008. The Organization website only provides information as well as contact options, without the intention of being used with a strategic focus.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Figure 13 – The third page “Part A” to be used in the survey type instrument
 Source: Created by the Author



[Academic Research] • edition 1.0 • fev/2015
 Stage Level Measurement of Information and Communication Technology (ICT) in Organizations

Part B

You have passed the half of the survey! Continue with the correct answers of the assertions to get just ahead the diagnostic about the initiatives of ICT/IS of your Organization

67%

1 Start
2 Profile
3 Part A
4 Part B
5 Part C
6 Diagnostic

▶ How would you rate the ICT/IS initiatives in your organization regarding the following items?

	Disagree Completely 1	Disagree 2	Disagree Slightly 3	Agree Slightly 4	Agree 5	Agree Completely 6
A042. The users do not even collaborated with the Organization's ICT initiatives.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
A043. The Organizational ICT activity focuses on initiatives to improve data administration.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
A044. The system applications during its adequacy and implementation are seen as costs, rather than being treated as investments or assets.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
A045. The ICT activity focuses on the management of technological capacity of the Organization and its usefulness among its users.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
A046. The systems applications portfolio is decentralized.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
A047. Mobility is present in the daily tasks of the Organization's people, supported strongly by the resources provided by ICT, where and how it is needed.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
A048. The senior management of the Organization takes on responsibilities about the ICT activities, now considering its strategic management.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
A049. The ICT activity, as a weapon for competition, is considered extremely important for the Organization.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Figure 14 – The fourth page “Part B” to be used in the survey type instrument
 Source: Created by the Author

Part C 83%

You are already in the last step that request answers!

In the last part of this block, the assertions takes as the basis a five-point scale, from 1=Below Competitors' to 5=Above Competitors', about the innovations implemented in your organization in the last three years.

Soon you will have in your hands a report compiled with a brief diagnostic that can help you with managerial perceptions about how the currently are the initiatives of ICT/IS in your Organization.

1 Start 2 Profile 3 Part A 4 Part B 5 Part C 6 Diagnostic

► How would you rate the ICT/IS initiatives in your organization regarding the following items?

	Disagree Completely 1	Disagree 2	Disagree Slightly 3	Agree Slightly 4	Agree 5	Agree Completely 6
AD83. Are publicly available in the Organization's website the privacy policy and the terms of use of data and information that are collected.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
AD84. Users have acquired much experience in system specification, and now in addition to being participants, also improve them with the support of the ICT staff.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
AD85. The Organization has no interest in using emerging technologies (e.g. mobility, cloud computing, APPS, etc.) in their ICT initiatives.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
AD86. The ICT activity delivers a service of high quality and reliability to the users of the organization.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
AD87. The Organization users are enthusiastic to initiate their involvement in the ICT initiatives.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
AD88. The Organization traditionally follows the main recommendation to use ICT initiatives only to improve its efficiency.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
AD89. There are in the Organization high-quality information systems, flexible, integrated and constantly updated.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
AD90. The latest technological possibilities are used at the moment to build a highly advanced integrated system.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Figure 15 – The fifth page “Part C” to be used in the survey type instrument

Source: Created by the Author

Diagnostic 100%

Congratulations and thank you!

If you reached this step, you answered the survey completely. We hope that this experience has been valuable to you.

The result obtained in the report and diagnostic generated (link beside), should represent a 'picture' of the stage level of your Organization regarding the current ICT/IS initiatives. Remember that this research is in initial development phase.

Do you have questions about the research or diagnostic? Get in touch by emails below or by the link of the [on-line contact form](#).

1 Start 2 Profile 3 Part A 4 Part B 5 Part C 6 Diagnostic

Figure 16 – The last page “Diagnostic” to be used in the survey type instrument

Source: Created by the Author

APPENDIX C

SOFTWARE SCREENS FOR THE ASSEMBLY OF THE ON-LINE

SURVEY TYPE INSTRUMENT (PORTUGUESE VERSION)

FGV EAESP
[Pesquisa Acadêmica] • edição 1.0 • fev/2015
Medição do Nível de Estágio da Tecnologia de Informação e Comunicação (TIC) em Organizações

Abertura 17%

Muito obrigado pelo seu interesse em participar desta pesquisa!

Ao finalizar as respostas das primeiras 5 etapas (tempo previsto de cerca de **20 minutos**), você obterá um diagnóstico resumido a respeito das iniciativas da TIC de sua Organização tendo como base o campo de estudo acadêmico de Sistemas de Informação (SI).

Portanto, seja muito preciso em suas respostas, para a obtenção do diagnóstico adequado.

1 Abertura Perfil Parte A Parte B Parte C Diagnóstico

▶ Por favor, informe sobre Você:

Nome Completo:

E-mail principal:
(uma mensagem de boas-vindas será enviada para este e-mail com um link Web para a continuidade desta pesquisa)

E-mail alternativo*:
* Importante: o e-mail será sempre o nosso meio de contato principal, por favor, informe também outro alternativo.

Gênero: Masculino Feminino

▶ Qual a sua principal função ou atribuição na Organização que você representa nesta pesquisa?

Presidente ou Chief Executive Officer (CEO)

Chief Information Officer (CIO)

Chief Financial Officer (CFO)

Chief Data Officer (CDO)

Figure 17 – The first page in Portuguese (Abertura) to be used in the survey type instrument

Source: Created by the Author

FGV EAESP
[Pesquisa Acadêmica] • edição 1.0 • fev/2015
Medição do Nível de Estágio da Tecnologia de Informação e Comunicação (TIC) em Organizações

Perfil 33%

A pesquisa quer conhecer um pouco sobre o perfil de seus respondentes, com intuito de observar variações no agrupamento dos resultados obtidos pela coleta de dados total.

Suas informações são confidenciais e não serão divulgadas ou compartilhadas com terceiros. Elas serão utilizadas apenas para análises estatísticas, sempre de forma compilada e integrada com as informações dos demais respondentes da pesquisa.

1 Abertura Perfil Parte A Parte B Parte C Diagnóstico

▶ Por favor, informe sobre a sua Organização:

Nome da Organização:

País onde está localizada:

Nome da Cidade:

Número do CEP:

Número do CNPJ*: * Somente para Organizações com sede no Brasil

▶ Qual é o principal setor econômico de atuação da Organização?

Comércio

Indústria

Serviço

Figure 18 – The second page in Portuguese (Perfil) to be used in the survey type instrument

Source: Created by the Author



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Medição do Nível de Estágio da Tecnologia de Informação e Comunicação (TIC) em Organizações

Parte A

Você já chegou na metade da pesquisa!

A partir de agora você responderá uma sequência de assertivas baseada em uma escala de seis pontos, indo de 1='Discordo Completamente' a 6='Concordo Completamente', a respeito das iniciativas da TIC de sua Organização, tendo como base o campo de estudo acadêmico de Sistemas de Informação (SI).

50%

1 Abertura
2 Perfil
3 Parte A
4 Parte B
5 Parte C
6 Diagnóstico

Como você avaliaria as iniciativas de TIC/SI de sua organização em relação aos seguintes itens?

	Discordo Completamente	Discordo	Discordo Levemente	Concordo Levemente	Concordo	Concordo Completamente
	1	2	3	4	5	6
AD01. A gestão continua a empenhar mais recursos ao desenvolvimento das iniciativas da TIC, superando o estritamente necessário para fazer o trabalho.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
AD02. A Organização quer também aproveitar das tecnologias emergentes (ex: mobilidade, computação na nuvem, APPs, etc.) em suas iniciativas da TIC, mas está incerta de como fazer isso.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
AD03. Após um período de negligência da Organização, vários sistemas são substituídos por uma nova geração de aplicações.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
AD04. O papel do administrador de dados torna-se relevante ao fazer a gestão dos dados um recurso estratégico da Organização.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
AD05. O sistema corporativo possui plataforma independente do tipo do hardware, ou seja, ele pode ser acessado por micro desktops, laptops, tablets e smartphones.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
AD06. Há um aumento da utilização de métodos para beneficiar as iniciativas da TIC (exemplo: definição de prioridades, padrões e qualidade dos sistemas, gerenciamento de projetos, etc.).	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
AD07. A Organização conhece bem a tecnologia que já utiliza	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Figure 19 – The third page in Portuguese (Parte A) to be used in the survey type instrument

Source: Created by the Author



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Medição do Nível de Estágio da Tecnologia de Informação e Comunicação (TIC) em Organizações

Parte B

Você já avançou mais da metade da pesquisa!

Continue com as respostas corretas das assertivas para logo adiante obter um diagnóstico gerencial com a medição do estágio atual das iniciativas da TIC/SI de sua Organização.

67%

1 Abertura
2 Perfil
3 Parte A
4 Parte B
5 Parte C
6 Diagnóstico

Como você avaliaria as iniciativas de TIC/SI de sua organização em relação aos seguintes itens?

	Discordo Completamente	Discordo	Discordo Levemente	Concordo Levemente	Concordo	Concordo Completamente
	1	2	3	4	5	6
AD42. Os usuários ainda não colaboraram com as iniciativas da TIC da Organização.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
AD43. A atividade da TIC Organizacional centra-se em iniciativas para aperfeiçoar a administração de dados.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
AD44. As aplicações de sistemas no decorrer de sua adequação e implantação são vistos como custos, ao invés de serem vistos como investimentos ou ativos.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
AD45. A atividade da TIC tem como foco a gestão da capacidade tecnológica da Organização e sua utilidade junto aos seus usuários.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
AD46. O portfólio de aplicações de sistemas é descentralizado.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
AD47. A mobilidade está presente nas tarefas diárias das pessoas da Organização, apoiada intensamente pelos recursos providos pela TIC, onde e como isso for necessário.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
AD48. A alta administração da Organização assume responsabilidades sobre as atividades de TIC, agora considerando sua gestão estratégica.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
AD49. A atividade da TIC, como um armamento para	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Figure 20 – The fourth page in Portuguese (Parte B) to be used in the survey type instrument

Source: Created by the Author

FGV EAESP
[Pesquisa Acadêmica] • edição 1.0 • fev/2015
Medição do Nível de Estágio da Tecnologia de Informação e Comunicação (TIC) em Organizações

Parte C 83%

Você já está na última etapa que solicita respostas!

O último bloco de assertivas desta parte toma como base uma escala de cinco pontos, indo de 1="Abaixo dos Concorrentes", a 5="Acima dos Concorrentes", a respeito das inovações implementadas na sua organização nos últimos três anos.

Em breve você terá em suas mãos um relatório compilado com um diagnóstico resumido que poderá ajudá-lo com percepções gerenciais sobre como estão atualmente as iniciativas de TIC/SI de sua Organização.

1 Abertura **2** Perfil **3** Parte A **4** Parte B **5** Parte C **6** Diagnóstico

Como você avaliaria as iniciativas de TIC/SI de sua organização em relação aos seguintes itens?

	Discordo Completamente 1	Discordo Levemente 2	Discordo Levemente 3	Concordo Levemente 4	Concordo 5	Concordo Completamente 6
A083. Estão disponíveis publicamente no website da Organização a política de privacidade e os termos de uso de dados e informações que são coletadas.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
A084. Os usuários adquiriram muita experiência na especificação de sistemas, e agora além de serem participantes, também os aprimoram com o apoio do pessoal da TIC.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
A085. A Organização não tem interesse em utilizar as tecnologias emergentes (ex: mobilidade, computação na nuvem, APPs, etc.) em suas iniciativas da TIC.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
A086. A atividade da TIC entrega um serviço de alta qualidade e confiabilidade aos usuários da organização.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
A087. Os usuários da Organização estão entusiasmados para iniciar seu envolvimento nas iniciativas da TIC.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
A088. A Organização segue tradicionalmente a orientação principal de utilizar as iniciativas da TIC somente para melhorar a sua eficiência.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
A089. Existem na Organização sistemas de informação de alta qualidade, flexíveis, integrados e permanentemente atualizados.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Figure 21 – The fifth page in Portuguese (Parte C) to be used in the survey type instrument

Source: Created by the Author

FGV EAESP
[Pesquisa Acadêmica] • edição 1.0 • fev/2015
Medição do Nível de Estágio da Tecnologia de Informação e Comunicação (TIC) em Organizações

Diagnóstico 100%

Parabéns e muito obrigado!

Se você chegou nesta etapa, você respondeu por completo a pesquisa. Esperamos que esta experiência tenha sido de valor para você.

O resultado obtido no relatório e diagnóstico gerado (link ao lado), deve retratar uma "fotografia" do nível de estágio de sua Organização quanto as atuais iniciativas de TIC/SI. Lembramos que esta pesquisa está em fase inicial de desenvolvimento.

Você tem dúvidas sobre a pesquisa ou seu diagnóstico? Entre em contato pelos e-mails abaixo ou pelo link do [formulário de contato on-line](#).

1 Abertura **2** Perfil **3** Parte A **4** Parte B **5** Parte C **6** Diagnóstico

Figure 22 – The sixth page in Portuguese (Diagnóstico) to be used in the survey type instrument

Source: Created by the Author