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Abstract

This work introduces the CRUDI Framework for management and decision support in Information Systems investments, based in the proposed CRUDI Matrix. The CRUDI Matrix is an abstraction idealized from the CRUD Matrix which was extended by an extra dimension: the Importance dimension. The CRUDI example application presented in this paper generates relevant information regarding issues such as the importance and the priorities in information systems projects, to ensure better alignment with the business needs and better Return On Investments (ROI). We also propose a survey to collect the relative importance of each process based in the APQC list, using as example the banking industry.

Keywords: e-business, management, decision support, business intelligence, information systems, CRUDI, framework.

1 INTRODUCTION

Quite often, there are differences of opinion between the Business Managers of an organization and their Information Systems Manager, regarding the importance of an information system and the priority of necessary investments in Information Systems (IS) in order to better support the business.

It is also difficult to estimate the risk assigned to each information system and to define its need for complete replacement on certain types of larger impact disasters (natural or others). The strategic alignment between business and information systems is very important and is a continuous process, focused in change and the need for adaptation (Henderson & Venkatraman, 1993).

According to previous work (Pereira, Santos, & Gonçalves, 2011), the main difficulties that CIO's have nowadays are the reduced budgets available for investments and the big volume of projects required by business managers to implement the business strategy of each company. Also, in the banking and insurance sectors, there are several international regulatory guidelines addressing the risk and management practices, alongside decision support systems and methodologies (Pereira, Martins, Santos, & Gonçalves, 2011). This paper is part of a more complex and on-going study that proposes the CRUDI framework as a set of new tools and methods (Pereira, Santos, et al., 2011). It had its beginning in 2011 and we are currently in the data collection/analysis stage, trying to understand the relative importance of business processes from different business managers, applying the Zachman View or Roles (Finkelstein, 2011).

2 RESEARCH METHOD AND FUNDAMENTALS, DESIGN SCIENCE

Design Science is an outcome based IS research methodology, which offers specific guidelines for evaluation and iteration within research projects. The research focuses on the development and performance of (designed) artefacts with the explicit intention of improving its functional performance. Design science research is typically applied to categories of artefacts including (but not limited to) algorithms, human/computer interfaces, design methodologies (including process models) and languages. Its application is most noticeable in the Engineering and Computer Science disciplines, though it is not restricted to these and can be found in many disciplines and fields (Vaishnavi V. & Kuechler, 2004).

Hevner has presented a set of guidelines for design science research within the discipline of IS (Hevner, March, Park, & Ram, 2004). Design science research requires the creation of an innovative, purposeful artefact for a special problem domain. The artefact must be evaluated in order to ensure its utility for the specified problem. In order to form a novel research contribution, the artefact must either solve a problem that has not yet been solved, or provide a more effective solution. Both construction and evaluation of the artefact must be done rigorously, and the results of the research presented effectively to both technology-oriented and management-oriented audiences.

According to Hevner in MIS Quarterly (Hevner et al., 2004) (Design Science in IS Research) “The design-science paradigm has its roots in engineering and the sciences of the artificial. It is fundamentally a problem solving paradigm. It seeks to create innovations that define the ideas, practices, technical capabilities, and products through which the analysis, design, implementation, management, and use of IS can be effectively and efficiently accomplished (Denning, 1997; Tsichritzis, 1998). Such artefacts are not exempt from natural laws or behavioural theories. On the contrary, their creation relies on existing kernel theories that are applied, tested, modified, and extended through the experience, creativity, intuition, and problem solving capabilities of the researcher (Markus, Majchrzak, & Gasser, 2002; Walls, Widmeyer, & El Sawy, 1992). The resultant IT artefacts extend the boundaries of human problem solving and organizational capabilities by providing intellectual as well as computational tools. Theories regarding their application and impact will follow their development and use.”

Several authors argue that there is an opportunity for IS research to make significant contributions by engaging the complementary research cycle between design science and behavioural science to address fundamental problems faced in the productive application of information technology (Hevner et al., 2004). Technology and behaviour are not dichotomous in an information system (Observe Figure 1). They are similarly inseparable in IS research (Lee & Turban, 2001). Philosophically, these arguments draw from the pragmatists who argue that truth (justified theory) and utility (artefacts that are effective) are two sides of the same coin and that scientific research should be evaluated in light of its practical implications (Aboulafia, 1991).

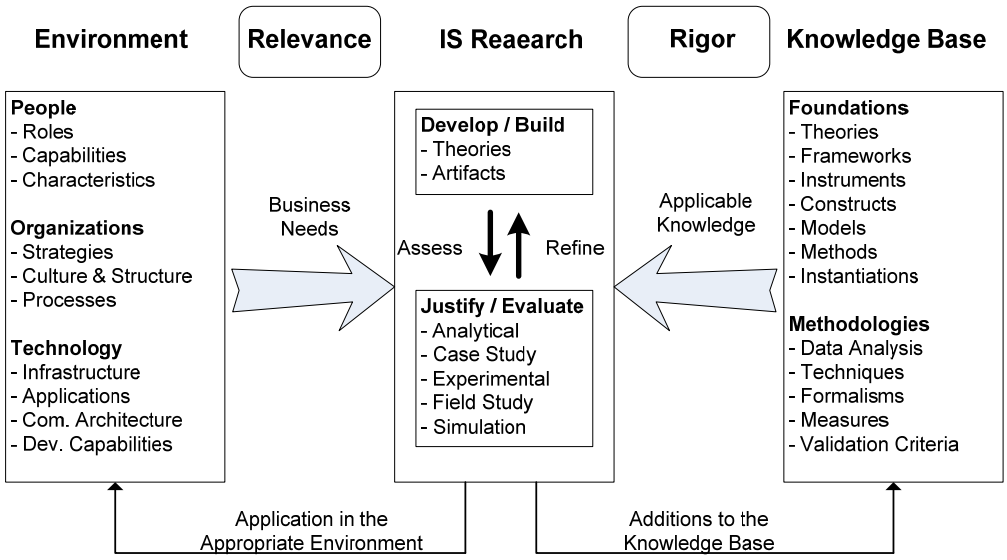

Figure 1: IS Research Framework (Hevner et al., 2004).

Survey - Relative Importance

In order to understand each company's specific options regarding IS investments, and based in the previous considerations, we have conducted a survey to collect data on the "Relative Importance" of each macro-process, using three different opinions (Zachman Views) from board level members in each company. This survey is part of the proposed CRUDI framework, both described in this paper.

According to several authors, the Relative Importance can be defined as an ordinal between 1 (less important; not critical) and 7 (more important; critical) (Chapman, Lawless, & Boor, 2001; Fogliato & Guimarães, 1999; Stone, Sidel, Oliver, Woolsey, & Singleton, 1974). In what concerns the present paper, this was the definition that we have taken in consideration.

The Relative Importance should be defined by business managers or even by the organization CEO, in order to be perfectly aligned with the business strategy. With this, we can also assure that the risk variable is well mapped with an equivalent relative importance ordinal of 5 to 7. Additionally, we can define the relative importance range from 5 to 7 as "Must Have" and the range 1 to 4 as "Should Have", regarding the IS investment needs and priorities.

3 THE CRUDI FRAMEWORK

Measuring the importance of a particular application or IS for the different business units of a given company is normally a very difficult task. Thus, in order to do so, some questions need to be answered:

- What is the system or application with the biggest budged allocation?
- What projects are to "move on" taking into account the budget? (limitations)

The value chain that is perceived by each department is different and is based in different indicators. Nowadays, the coveted alignment between business and Information Systems is not a reality. It is frequent to see a business manager that refuses to talk to an information systems manager. The ITIL and COBIT management are good practices and methods but they don't solve these typical problems.

According to ITIL, COBIT, ISO 27002 alignment for business benefit (ITIL, 2008) and Malta & Sousa (Malta & Sousa, 2009), the development of architectures has been a major issue for IS managers, both from a technological point of view and from an organizational way. It's even more

complex when it comes to Enterprise architecture (EA) that includes business strategies and processes, apart from IS models that support them.

When taking in consideration the referred issues, the CRUD matrix (Lunsford & Collins, 2008) is an excellent technique to model processes and data, as well as how they interact with respect to creation, reading, updating, and deletion of data. In this paper, we present an extent to the CRUD matrix. By proposing to incorporate a third dimension on the matrix, in order to include the relative importance of each node (pair process/data), we reach to a CRUD**I** matrix. To collect the relative importance we propose a survey, based in the APQC list (APQC & IBM, 2010) for each industry typical processes, applying a Likert scale (Jacoby & Matell, 1971; Jamieson, 2004).

CRUDI Approach

The project inherent to the present work aims on creating a new methodology and supporting tools to characterize the relative importance of each IS within the organizations. This characterization will take in consideration the importance of each system and application within the organization, including the interdependencies between systems. The analysis of these interdependencies is central to the evaluation of investment priorities in line with business priorities, working as a constantly updated tool with dynamic information that evolves according to business strategy in the ongoing company. To this set of methodology and support tools we call the CRUDI framework (Figure 2) and it is implemented in six steps, namely:

1. Importance Survey – to collect de relative importance of each process to each business manager within the organization;
2. CRUD Matrix – built based in each industry processes and business entities;
3. CRUDI Matrix (A) – built by combining the results from the two previous steps;
4. Calculate Dependencies – recalculation of each pair process/entity importance, based in dependencies and distances;
5. CRUDI Matrix (B) – based in step 4, translating processes to the corresponding Information Systems that support them;
6. Impact on ROI – simulation of ROI impact based in the CRUDI Matrix (B), for each Information System investment, generating KPI's information to evaluation.

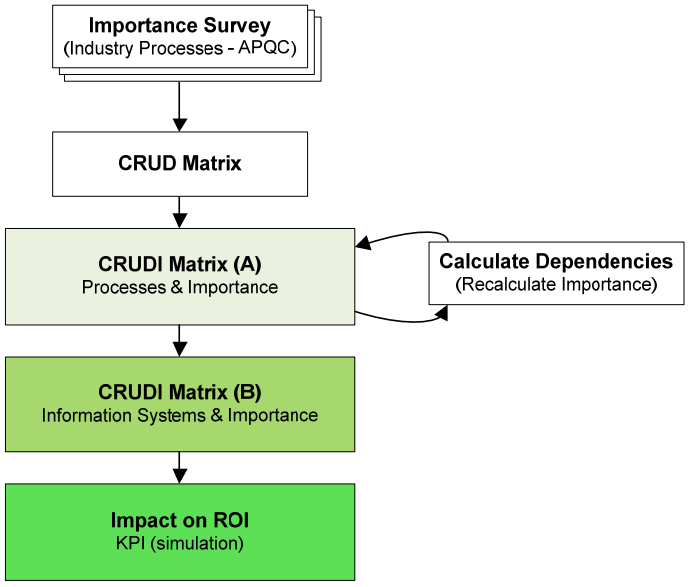

Figure 2: CRUDI Framework.

Business characterization (What we do) - APQC list for each Industry:

In order to characterize the typical business processes of each industry, we will adopt the APQC list available for that industry (APQC & IBM, 2010). This list provides the macro-processes, the detailed 1st level processes and their sub-processes, indicating which are related to core business and which relates to support (internal). It's a common starting point for each industry that allows accelerating the processes mapping and supports the Importance survey, which is specific to each company.

Processes architecture and their relative importance (How is Business made?):

Each company has its own way of doing things (procedures and processes), its own priorities and contingencies (strategy and limitations), and its own strengths and weaknesses. So, each company must decide how to implement its business strategy towards markets, resources and competitors, becoming a distinct entity between many others that work in the same business sector and region. This distinction is based on the differentiation of people, processes, priorities and importance of each internal component of the company to the board management (key decision sponsors). Thus, our proposed framework must understand each company particularities, priorities and importance for each key process.

Risk is another well-known term to all organizations, especially to financial ones, being regulated in several ways by international institutions, mainly because its direct impact in the global economy. These regulations also cover the IS and technology, with several recommendations and impositions to prevent data loss and business disruption in several possible scenarios (Basel-Committee, 2006). Because of this, risk has a direct impact on the importance of some IS and in the investments needed to mitigate them.

Additionally, each Information System has a different relative importance in supporting the business strategy, delivery capacity and global business results. Not only because of the risk variable but because of its impact in business innovation and in client satisfaction, being a very important variable in terms of competitive advantage and to the organization business success (Trkman, P., 2010). Some authors consider the existence of "critical" or more important processes (and their related support systems) and the non-critical or less important (Henderson & Venkatraman, 1993).

The word "importance" has its origin in the Medieval Latin (1495–1505) and means "importantia" or "the quality or state of being important; consequence; significance".

According to the Cambridge dictionary, importance is "the quality of being important" or "the state of being important; significance" with the following visual description in Figure 3. As referred, importance is equivalent to "value" (Heacock, 2011).

Stone has produced several studies in "Sensory evaluation by quantitative descriptive analysis" and used a simple scale from 0 to 15 to qualify attributes regarding several aspects like importance (Stone et al., 1974). This ease to use and to understand scale was also applied by other authors in different areas.

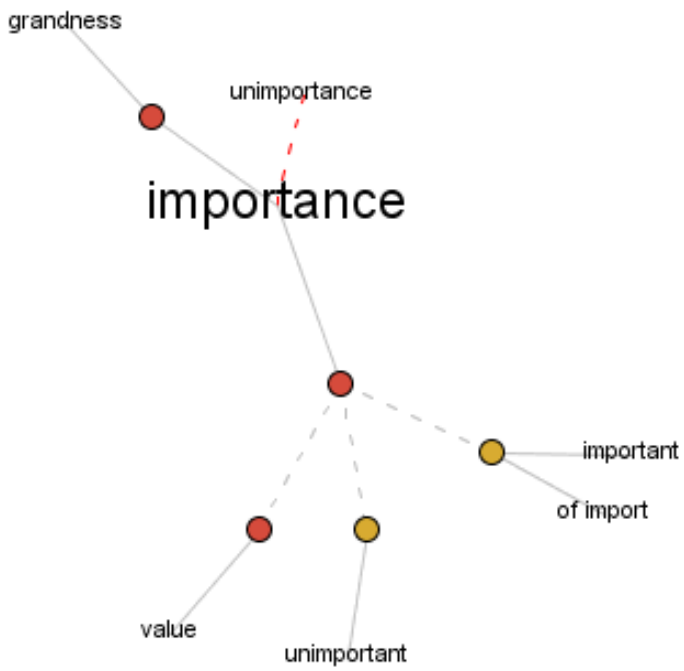

Figure 3: Cambridge Visual Thesaurus – Importance (Heacock, 2011)

Survey presented to three people with three different views, applying the "Zachman Roles":

As a proposed methodology, we will present a survey (attached) to three managers of each organization, each having a different view on the company's business processes, depending on their responsibility in the organization. From the six roles available in the Zachman framework (Finkelstein, 2011), we will adopt only the three top roles relative to the highest management roles in each company, which are responsible for strategy:

- **Executive Perspective** – Business Context Planner's (scope);
- **Director Perspective** – Business Concept Owner's (Enterprise or Business Model);
- **Architect Perspective** – Business Logic Designer's (Information Systems Model);

In each survey we intend to collect the relative values of importance on a scale from 1 to 7 (Likert scale) (Jacoby & Matell, 1971). At the end, we calculate the reference values (relative importance) of each macro process by applying a weighting of 3 responses (survey with three different views).

Since the survey can be assigned to people with different responsibilities and different visions within the same company, we consider the adoption of the "Zachman Views" (Finkelstein, 2011) in the collection and processing of responses in the referred survey, but with different profiles.

With these answers you can determine the difference and competitive strategy of each company within the same sector, allowing a personalized way to characterize which are the most important information systems that should receive priority investments in line with business objectives.

Information Systems Architecture (ISA) - CRUDI Matrix (Tools to Run):

After identifying the processes, sub processes and their respective relative importance to the organization, we can build its custom CRUD Matrix. The construction of this matrix also allows to add a new dimension of the relative importance "i" previously collected by the survey, creating a

CRUDI matrix (Figure 4) for the global organization, where we can still characterize the clusters of macro Processes /Information Entities and their relationships (interfaces), that allow us making a reverse recalculation of the relative importance of each sub process (correction effect based on interdependencies).

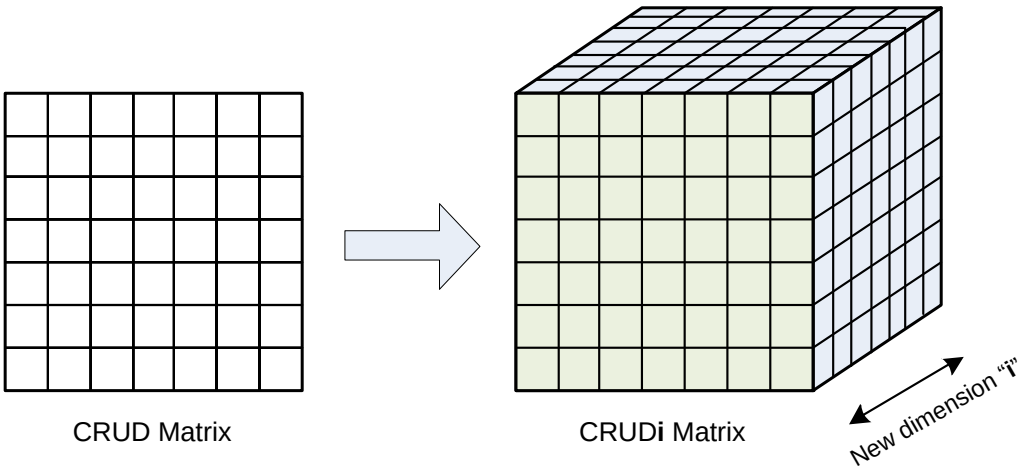

Figure 4: CRUDI Matrix

Impact on ROI (simulation using the CRUDI Framework):

Based on the CRUDI matrix defined earlier, with detail on the sub processes level, we can then build a global 1st level matrix in the value chain according to Porter, for an overview of the ROI (Return on Investment). The relative importance will be calculated based on the survey (Presented in "4 – Survey Example for the Banking Industry") and the relationships defined in the CRUDI matrices produced as described before.

Having the CRUDI matrices that represent the global processes of an organization, with their relative importance and dependency impact, we can simulate the ROI for the investment on a specific Information System, in comparison to other. Through this, we can determine which one will have the biggest (positive) impact and decide in its favour, against the other, if we don't have the budget for both.

Model -> Method -> ROI (Information Systems)

The CRUDI framework intends to define a model, a construct and a method, contributing to a ROI improvement on IS investments. It will also contribute to a better alignment between the business and the IS strategy, because it will assure a proper documentation on relative importance and priorities for each process to support the business strategy and this way, achieving the expected results.

Based on the CRUDI Matrix defined above, detailed at the sub processes level, we can then build a global array of 1st level of the value chain according to Porter, for an overview of the ROI.

The resulting values from the application of the Framework (increasing the ROI of investments and identifying which are the most important IS) allow the companies managers to conclude what IS deserve priority investment. Thus the organization can best affect the budget, maximizing the return on investment with the implementation of the strategy and business priorities set by the top management, achieving greater competitive advantage and a better alignment between Business and the supporting IS.

4 SURVEY EXAMPLE FOR THE BANKING INDUSTRY

As an example, we present a partial application of the CRUDI framework to the banking industry, regarding the survey of its first step. We have chosen this industry as the first example because the professional experience of the investigation team in the activity sector, but also because its high complexity that represents a big enough challenge to prove the advantages of the proposed framework.

For the banking sector, we can find the APQC processes definition with five (5) key business processes and eight (8) support processes, in a total of thirteen (13). This list was used to produce the sample survey (included in this paper).

For the three managers that will answer the survey, we suggest the director of technology (CIO), a business manager responsible for the electronic channels (indirect sales), and a business manager responsible for retail (direct sales).

The following survey will be presented to several banks in the next months and the collected data will be used to evaluate the proposed CRUDI framework approach and efficiency. We will also gather feedback on the survey in order to improve and further detail our framework, with real sample application and data.

Sample Survey (Banking Sector)

Characterization Survey – Processes Relative Importance (2nd level of the APQC list – example for the Banking Industry).

Characterization survey to collect the relative importance associated with each of the five Macro processes ("Operating Processes"), based on the APQC list (Process Classification Framework - PCF) for the banking sector:

- **1.0 - Developing Vision and Strategy;**
- **2.0 - Developing and Managing Products and Services;**
- **3.0 - Marketing and Selling Products and Services;**
- **4.0 - Delivering Products and Services;**
- **5.0 - Manager Customer Service;**

Please qualify each sub process assigning an integer value between 1 and 7, ordering the relative importance of each sub process for the organization (One is less important and 7 is more important):

1	2	3	4	5	6	7

Table 1. The above table represents the answering options available for all the following questions.

1.1 Defining the business concept and long-term vision (10014)

1.2 Developing business strategy (10015)

1.3 Managing strategic initiatives (10016)

2.1 Managing product and service portfolio (10061)

2.2 Developing products and services (10062)

3.1 Understanding markets, customers and capabilities (10101)

3.2 Developing marketing strategy (10102)

3.3 Developing sales strategy (10103)

3.4 Developing and managing marketing plans (10104)

3.5 Developing and managing sales plans (10105)

4.1 Planning for and acquiring necessary resources (Supply Chain Planning) (10215)

4.2 Procuring materials and services (10216)

4.3 Producing/Manufacturing/Delivering product (10217)

4.4 Applying Anti-Money Laundering (AML) policy (13953)

4.5 Performing Know Your Customer (KYC) activities (13954)

4.6 Delivering service to customer (10218)

4.7 Managing logistics and warehousing (10219)

5.1 Interfacing with customers (14017)

5.2 Managing customer information (14021)

5.3 Developing customer care/customer service strategy (10378)

5.4 Planning and managing customer service operations (10379)

5.5 Measuring and evaluating customer service operations (10380)

With the answers to this survey (relative importance characterization) we achieve the step 1 from the CRUDI framework.

Then, we can continue to step 2 and produce the CRUD Matrix, necessary to join to the relative importance collected in step 1 and elaborate de CRUDI Matrix in step 3.

5 CHALLENGES AND CONCLUSIONS

The presented CRUDI matrix is an extent of the CRUD matrix in which a new dimension, the Importance, was included. This new approach will, in our opinion, bring a new set of information that will help CIO's and business managers to make better decisions on new investments. It is also our aim, that the CRUDI matrix will help reducing the gap between business and technology, still present in several business sectors. This method also allows a better alignment between business and information systems.

In this paper we introduce the attached survey as part of the proposed CRUDI framework, to collect the relative importance of each process within the organization (example for the banking industry, based in the APQC processes list). Finally, it is our idea that the use of the CRUDI matrix will help to make investment decisions (impact on ROI), perfectly aligned with the business strategy and priorities, because the organization business managers contributed to the definition of the relative importance of each information system as part of the supporting environment to business.

The present work is part of a more detailed evaluation of possible scenarios, to ensure the complete assessment of a company's need, starting with a bank as an example. We will continue this task, trying to work closely with real entities in the coming year, to define and describe the new method and to create real CRUDI matrix samples, which describe the real problems and business needs. We will present those CRUDI matrix samples to CIO's and to business managers in the way they can evaluate the information and comment if it's useful or not, and if there is any gap we must still solve. Then we intend to provide new articles with a more detailed work and the achieved results (case studies).

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