Original Article

# Proposal for restructuring of the product individual metering water through the enterprise architecture framework

## *Proposta de reestruturação do produto medição individualizada de água por meio do uso de framework de arquitetura corporativa*

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**Abstract:** The population density in big centers such as the Metropolitan Area of São Paulo leads to the vertical buildings. The water consumption is not individualized, thereby impedes the actions of rational use of water. To meet this demand, a program for individualization of water consumption was structured and the Sanitation Company began offering the product Individual Metering. This product highlighted problems in commercial, operational and Infrastructure Technology. A review of the business strategy was performed and the need to ensure that changes in systems and processes that involve the product are implemented in a structured manner was identified. The objective of this paper was to propose a restructuring of the Individual Metering product in a sanitation company through Enterprise Architecture *framework*. The Enterprise Architecture was chosen because it allows alignment between strategy and execution. The results obtained contributed positively to the implementation of changes in the process and system.

**Keywords:** Enterprise architecture; Individual metering; Process improvement; Sanitation company; TOGAF.

**Resumo:** *O adensamento populacional de grandes centros urbanos como o da Região Metropolitana de São Paulo leva à verticalização e à formação de condomínios onde o consumo de água não é individualizado e dessa forma dificulta ações de uso racional da água, uma vez que cada morador não tem acesso ao seu consumo. Para atender a essa demanda, as empresas de saneamento têm estruturado programas para individualização do consumo de água. A empresa analisada neste trabalho implementou seu produto de individualização de água, porém ocorreram problemas nos processos comerciais, operacionais e de infraestrutura de Tecnologia da Informação que o envolvem. O objetivo deste trabalho foi, então, propor a reestruturação do produto Medição Individualizada em uma empresa de saneamento básico por meio do uso de framework de Arquitetura Corporativa. Optou-se pelo uso da Arquitetura Corporativa por possibilitar o alinhamento da estratégia com a execução, além de também analisar o negócio, os processos, os sistemas de informação e a infraestrutura de informática. Os resultados obtidos com o uso de framework de Arquitetura Corporativa contribuíram de forma positiva para que a proposta de reestruturação do produto fosse realizada de maneira estruturada por meio da visão global de todas as interfaces.*

**Palavras-chave:** *Arquitetura corporativa; Medição individualizada; Melhoria de processos; Empresa de saneamento; TOGAF.*

## 1 Introduction

The universalization of access to basic sanitation is part of the United Nations Millennium Development Goals, since it has a direct impact on the indicators contained in the official document related to infant mortality, population health, disease eradication and environmental sustainability (Madeira, 2010).

Therefore, universalizing access to sanitation and acting on the demand for water consumption, encouraging the rational use of water through technological actions and measures to raise awareness of clients to cope with the scarcity of water resources has become one of the main obligations of

governments (Oliveira et al., 2011; Peixoto, 2011; Franco Netto et al., 2009).

Sanitation companies are constantly seeking solutions that are sustainable and cost-effective, to ensure their operational and financial efficiency, since the participation of state investment has diminished and the public-private partnership has gained prominence in this segment.

In the case of the Metropolitan Region of São Paulo (MRSP), the population density registered in the last thirty years has led the construction market to seek alternatives that meet the increasing demands for housing. Due to spatial arrangements, the construction of collective housing units has grown and condominium housing has become more and more common (Ministério das Cidades, 2010).

The current design of residential facilities in condominiums has led to excessive water consumption. It has been observed that the community does not fulfill its role, since the general tendency is that the individual does not assume its share of responsibility regarding the problem of water waste (CAESB, 2009).

In response to the demands of society for an effective solution to the individualization of water consumption in condominiums, a program of quality and productivity of the systems of individualization of water consumption by the company analyzed in this work was structured. After the consolidation of the program, the Individualized Water Measurement product was created, which consists of issuing individualized water bills for condominiums.

After the four-year maturation period, gaps were identified in the marketing and operationalization process, where the business strategy had to be reviewed and brought impacts on the commercial, operational and IT infrastructure processes that support the product.

In this context, it was necessary to apply a methodology that would ensure that this restructuring process was carried out in a structured manner and that all impacts were properly mapped and treated, since a company should ensure that any change in strategy is implemented in all the levels and areas and in a structured way.

The change in strategy requires a strategic alignment not as an isolated event or result, but a continuous process of adaptation and change in the search for a sustained competitive advantage, with an emphasis on management, through knowledge sharing processes between the Information Technology (IT) and the organization's business area (Kearns & Sabherwal, 2007; Sledgianowski & Luftman, 2005; Avison et al., 2004), in the analysis of IT within the value chain (Tallon & Kraemer, 2003) and improving internal processes (Ndede-Amadi, 2004).

Among the existing management tools, the Enterprise Architecture is one of the methodological proposals that can contribute to deal with the impacts caused by the change of business strategy, since it facilitates the organization in the moments of change, in the incorporation of new forms of management, in the adaptation new technologies and the ease of adoption of new innovation processes. It helps address the impacts of changing business strategy by mapping the entire organization (Belloquim, 2009; Limberger et al., 2008).

Thus, the aim of this paper was to propose the restructuring of the Product Individual Metering Water in a basic sanitation company through the use of the Enterprise Architecture framework.

## 2. Theoretical

### 2.1 Individual metering water product

A few years ago, residents of condominiums have been requesting individualized water metering systems, as is the case with gas and energy systems.

One of the factors that justify this claim is the increase in awareness that the individualized measurement system allows the management of water consumption, contributing to the reduction of wastes of this input and, consequently, of the water actually consumed in the activities carried out in the housing unit (Ilha et al., 2010; Gonçalves, 2009).

The process of individualization of water consumption in condominiums consists of the installation of at least one hydrometer in each of the housing units of the condominiums, be they vertical or horizontal.

As there is no legislation that regulates the subject, the condominiums that are born are not prepared to receive the facilities of the individual meters and it is necessary that hydraulic adjustments are executed so that the individual accounts can be issued.

The sanitation law 11,445, which establishes national guidelines for basic sanitation, and also Decree 7,217, which regulates it, does not mention the obligation to individualize water consumption, only in its Article 8, paragraph 1, that consumption should preferably be individualized in buildings collective agreements (condominiums) (Brasil, 2010).

Therefore, since there is no legislation that deals with the subject and to fill this gap and guarantee the quality of the process of individualization of water consumption, the company object of study in this work created the Individual Metering Water Product, a program that had the objective of preparing companies and professionals to carry out the individualization of water in condominiums.

The Individual Metering Water Product was structured with broad participation of society and the entire production chain in the process of individualization of water consumption in condominiums, participated in this group of discussion the company studied in this work, water individualization companies that

already operate in the market, university professionals (USP and UNICAMP) and representatives of the Housing Union (SECOVI).

The Product was composed of four committees, which were responsible for defining the model to be adopted by the condominiums interested in receiving the water bills directly from the water concessionaire. The structure was divided into: Committee for technical evaluation of innovative products (focus on remote measurement technologies); Committee for training and professional recognition (preparing people); Committee for quality assurance (components of the individualized system) and Committee for Environmental Education (guarantee rational use of water).

In addition to meeting the demand of the population, the product Individualized Water Measurement promoted the rational use of water, since the residents of the condominiums were able to monitor their consumption and had a tool to manage consumption.

However, some gaps in the business, operational, and IT infrastructure processes that support the product have been detected. Therefore, the business strategy of the Individual Metering Water Product had to be restructured and with it the need to use a methodology that would guarantee the implementation of the necessary changes.

## 2.2 Enterprise architecture

The Enterprise Architecture is the organizing logic of business processes and IT, reflecting the requirements of integration and standardization of the operating model of the company. It provides a long-term view of processes, systems, and technologies so that individual projects can determine their capabilities, not just meet immediate needs (Ross et al., 2006).

With Enterprise Architecture it is possible to map the entire organization: it begins with the strategy, it continues with the mapping of the business processes and how these processes execute the strategy; then goes to the Information Systems (IS) that automates these business processes and ends up identifying the available technological infrastructure for the execution of these systems (Belloquim, 2009).

In addition, the Enterprise Architecture process maps not only what exists today, but also what is needed in the future so that the organization's strategy can be implemented. Finally, the process also leads the architects to make the analysis between what exists today and what should exist.

Companies that adopt Enterprise Architecture can anticipate and react quickly to new information, changes or new business requirements. By combining existing systems with the applications of the operational chain, the conFiguretion of these services and their investments with infrastructure can increase their speed, efficiency and flexibility (Tan et al., 2006)

The Enterprise Architecture is used as a management tool (Figure 1) in Asia, Europe and the Americas, in the public and private sector by companies from various sectors such as, Legislative Bodies, Industry, Banks and Service Providers (Cavalcanti, 2009; Tan et al., 2006; Takaaky & Okada, 2008).

Figure 1 illustrates the different levels present in a company and the related architecture components.



**Figure 1.** Enterprise Architecture as a management tool. Source: Lankhorst (2009).

From the company's mission, its vision and its strategic definition, there is a greater understanding about the company's business aspirations, being possible to map the future desires of the organization.

By clearly defining the objectives it is possible to migrate from the current scenario to the future and, at this moment, the actions necessary to implement changes and identify the impacts on operations, products, processes, people and IT must be established. (Belloquim, 2009).

Enterprise Architecture consists of four domains (Figure 2) that ensure effectiveness and deliver solutions that support business strategy (Ross et al., 2006):

- Business Architecture: Definition of the business processes and their functional and operational characteristics, which are the basis for establishing the strategy of the applications that support the processes;

- Information Architecture (or data) - It is the data and its relationships with objective to feed the business strategies and optimize the decisions. It also serves as the basis for the design and delivery of applications;

- Application Architecture (or systems) - Identifies which applications are required to support the business and drive the design, construction (or acquisition) and integration of those applications;

- Infrastructure (or technology) architecture - covers all IT operating elements support that must be operated on a day-to-day basis with tools, monitoring and management process.

Enterprise Architecture makes it possible to change and manage the complexities inherent in large corporations, it brings an operational discipline to the organization and provides for the necessary
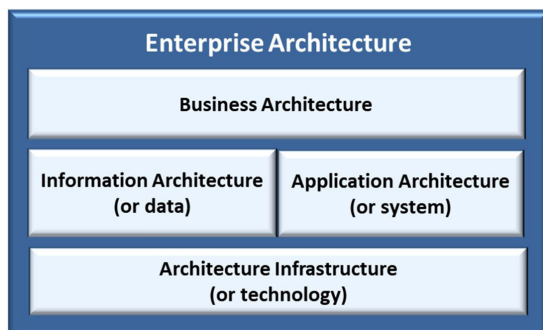
traceability of strategic intentions with its productive capacity to the (Schekkerman, 2006):

- Evaluate impacts on the business of changes caused by mergers, acquisitions or strategy change;

- Identify impacts of improvements in business processes;

- Detect disaster impacts and recovery plans;

- Address issues of security management and definition of architecture standards, in short, it provides the information needed to properly conduct change projects.

### 2.2.1 Enterprise architecture framework

A framework is a structure for content and process that can be used as a tool to structure thinking and ensure consistency and completeness of a methodology (TOGAF, 2011). The framework most used by companies is the TOGAF (*The Open Group Architecture Framework*) (Blevins, 2006).

TOGAF is a framework developed and maintained by The Open Group, a non-profit entity maintained by its members, which are mostly IT service companies such as IBM, SAP and HP (Belloquim, 2009).

TOGAF provides a method for developing a three-part Enterprise Architecture (TOGAF, 2011): TOGAF Architecture Development Method (ADM), which explains how to derive a specific Enterprise Architecture that meets business requirements; the Continum Enterprise, which is a virtual repository of all the architectural standards and descriptions that exist within the company and the TOGAF Resource Base, which is a set of features, guidelines, templates, background to assist the architect in the use of ADM.

The TOGAF ADM describes a method to develop and manage the lifecycle of a Enterprise Architecture and forms the core of the TOGAF framework (Figure 3).

The Preliminary Phase of the TOGAF ADM prepares the organization for implementation. It is necessary to study and understand the business environment, to establish commitments at the highest management levels, to define agreements on the scope of work, to establish the principles and results for the project, establish the governance structure and define agreements on methods to be adopted.

Phase A (Vision Architecture), which is the initial phase of ADM, should describe the development cycle of the architecture, including information regarding scope, stakeholder identification, expectations, and validation of the business context.

Phase B (Business Architecture) describes the development of business architecture to support



**Figure 2.** Enterprise Architecture Domains. Source: Ross et al. (2006).
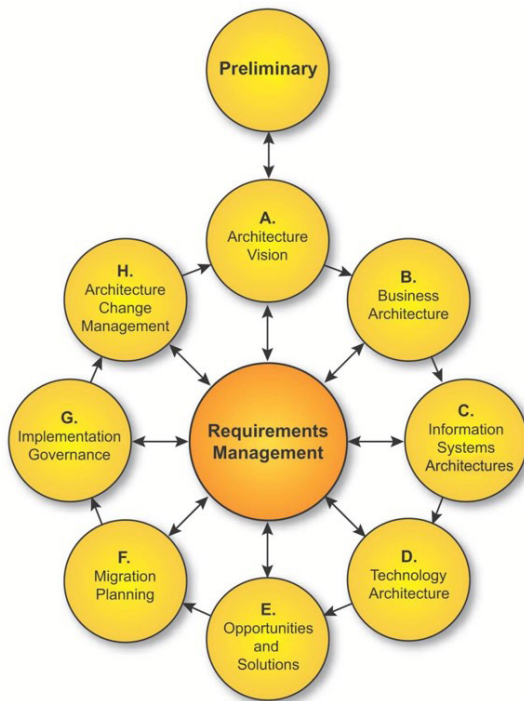
**Figure 3.** The TOGAF ADM. Source: Adapted from TOGAF (2011).

architectural vision agreements. It is the Business Architecture that creates the foundations for a Enterprise Architecture where they must be mapped: the business processes and people involved, the relationship between each one and the environment and the principles that govern their models and their evolution.

In Phase C (Information Systems Architectures) should be described the development of information systems architecture for a design architecture, including development, data and architected application. It is the phase in which it is pointed out how IT relates to the business objectives.

Phase D (Technological Architecture) describes how technology infrastructure is developed, with hardware, software and communication inventory.

Phase E (Opportunities Solutions) describes the initial driving of implementation plans and identification of delivery vehicles for the architectures defined in the previous phases. Recognition of major development projects. At this stage it is decided whether it is necessary to make, buy or reuse; if it will be used outsourcing services. It also assesses costs, the use of open source software, as well as defining the priority of assets and identifying dependencies.

Phase F (Migration Planning) describes the formulation of a set of addressed sequences of the transition architecture to support the implementation of the projects identified in the previous phase, in order

to produce a migration plan, with the appropriate risk analysis, costs involved and benefits.

Phase G (Implementation Governance) describes an internal implementation architecture. Defines the entire software development process of the organization.

Phase H (Change Management Architecture) establishes procedures to ensure that changes in the architecture are managed in a standardized and consistent manner.

Requirements Management defines the process by which requirements for the architecture are identified, stored and fed into and out of the most relevant phases of ADM.

The recommendations of the TOGAF ADM cycle for information gathering can be divided into steps as follows: Selection of reference models, views and tools; Selection of base architecture; Gap analysis; Impacts across the architecture and stakeholder review.

The ADM defines the phases and when a new decision must be made regarding: Corporate scope, ie the scope of coverage of the company; vertical scope and the level of detail to be defined; The time line and the architectural assets to be used in the organization, which consist of the system of technical structuring of the product and process mapping.

## 3 Materials and methods

### 3.1 Research methodology

The research methodology adopted in this work was defined as bibliographic, exploratory and experimental. A bibliographic research was carried out on the themes covered in this study (water, sanitation, individualized measurement, Enterprise Architecture and TOGAF).

The following information was collected regarding Individual Metering Water Product and its business, operational and IT infrastructure processes, as well as the company's business strategy information. Next, a questionnaire was applied to the employees that are related to the Individual Metering Water product in order to obtain information that would support the application of the TOGAF framework.

An exploratory research seeks to provide greater familiarity with the problem with a view to making it explicit or constructing hypotheses. It involves interviewing people who have had practical experiences with the researched problem (Gil, 2002). It can be said that this research aims at the improvement of ideas or the discovery of intuitions. Its planning is, therefore, very flexible so that it allows the consideration of the most varied aspects related to the fact studied.

The experimental research determines an object of study, select the variables that would be able to influence it, define the ways of controlling and observing the effects that the variable produces on the object being studied (Gil, 2002).

The use of the TOGAF framework in its ADM cycle was carried out and its objective was to map the processes that involve the Individual Metering Water Product and thus evaluate the aid that this proposal can bring to the management of the changes arising from the process of restructuring the product. Figure 4 illustrates the steps for conducting the research.

## 3.2 Information search

In order to map the processes and perform the experiments, we used the Enterprise Architect software in its version 2.4.1., Which offers a process modeling tool (BPMN) and systems (UML - UnifiedModelingLanguage), as support for process modeling. Enterprise Architect software utilizes survey techniques and registration of user requirements; complete approach in analysis and design, traceability between all modeling elements (Sparxs Systems, 2012).

The choice of Enterprise Architect software for use in process mapping is due to the TOGAF framework tool as a module and thus facilitates phase-by-phase mapping.

The survey of the information that supports this work followed three phases:

- Phase 1: Business strategy information of the Individual Metering Water Product obtained with the critical analysis of the product performed by the top management of the analyzed company;

- Phase 2: Information about the vision of the employees involved in the processes involving the product (commercial, operational and IT infrastructure) obtained through the application of the questionnaire;

- Phase 3: Product business process information for the use of the TOGAF framework.

In the first phase, data were collected that demonstrate the results of the Individual Metering Water Product and also the critical analysis performed by the top management of the analyzed company. These results were considered as the starting point for the restructuring of the Individual Metering Water Product.

This information was obtained at meetings with senior management and with critical analysis of product results. It was observed that after the four-year maturation period, the results obtained with the sales are well below the initial expectations and also in view of the great market potential for the product.

The following information was used to obtain information on the commercial results of the Individual
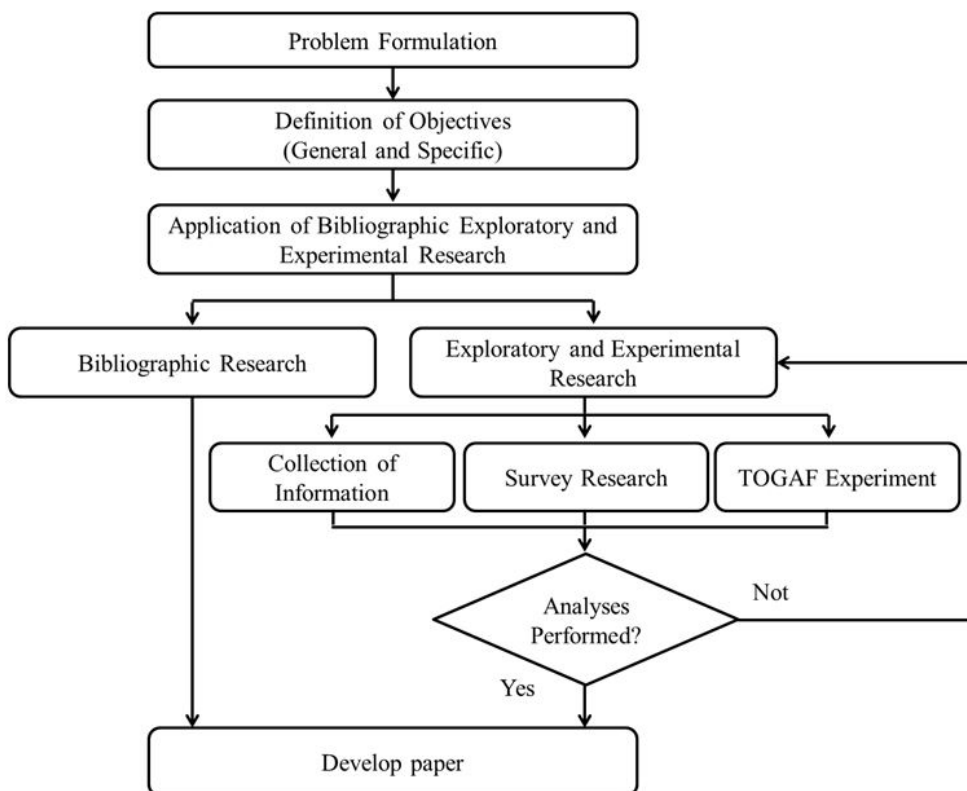


**Figure 4.** Flowchart of steps for conducting research.

Metering Water Product: Water consumption data; Average consumption in m³ per autonomous unit; Average consumption in m³ per condominium; Customer portfolio; Number of existing condominiums; Number of horizontal and vertical condominiums; Number of residential and commercial condominiums; Number of mixed condominiums (residential and commercial); Number of low income condominiums (CDHU, COHAB and other public authorities); Segmentation by consumption range and age of the property and Number of condominiums individualized in the model ProAcqua.

The data obtained in this step research phase are not inserted in this work because they are strategic and confidential, as well as the company name analyzed was omitted.

In the second phase of the information collection, a questionnaire was applied to employees of the company that are related to the Individual Metering Water Product. The objective was to identify gaps in the marketing processes, operationalization and IT infrastructure that support the product and possible contributions in the improvement of the product to base and direct the use of the TOGAF framework.

An email was sent to the 282 employees who interact with the Individual Metering Water Product with the search link available on the company's intranet. The selection of employees was based on the following criteria: Management Level (Managers, supervisors and coordinators) of areas related to the product Individualized Measurement; Analysts and technicians who act directly in the commercialization, operationalization and management of the product and Attendants of the agencies and the service center that has relation with customers of the Individual Metering Water Product.

A questionnaire was elaborated that can be visualized in the Appendix A of this work with 27 questions, being 05 opens and 22 closed. Closed questions are those in which the answers to be chosen are offered. Already the open questions are those in which the respondent is free to speak when answering (Silva & Menezes, 2001).

For the closed questions (with the exception of questions 1, 16, 25, 26 and 27), the Likert Scale was used, which is a type of psychometric response scale commonly used in questionnaires, besides being the most used scale in opinion surveys (Likert, 1932).

When responding to a questionnaire based on this scale, respondents specify their level of agreement with a statement. The scale used in the closed questions of the questionnaire was as follows: 4 = I totally agree, 3 = Partially agree, 2 = Indifferent, 1 = I do not agree partially, 0 = I do not totally agree. For those questions whose content was evaluative, the following scale

was used: 4 = Very Good, 3 = Good, 2 = Regular, 1 = Bad, 0 = Very Bad. The questionnaire was made available online to employees.

After the application of the questionnaire the data were collected and tabulated in an Excel worksheet to compile the answers obtained. Graphs were generated for each response to visualize and understand the results found facilitating the analysis (section 4.1).

The objective of this analysis was to identify the employees' perception about the product and its importance to the company, also identify the points of improvement and attention at the moment of structuring a change, since the questions were made according to the Enterprise Architecture in the TOGAF ADM. The results analysis was carried out focusing on the product, the way it was marketed and the structure behind it, especially the IT infrastructure.

In the third phase, the processes involving the Individual Metering Water product were mapped. In this mapping, we considered all processes, procedures, documentation, systems and IT infrastructure that support the product and this information was inserted in the TOGAF framework, since it is based on an iterative process model supported by best practices and a reusable set of existing architecture assets.

Due to the complexity and because it is a proposal, it was decided to use the TOGAF ADM module (Figure 3) as a reference, since it allows to evaluate the whole process that involves the product Individualized Measurement in a systemic way and clearly defines all the aspects that should be evaluated in the product restructuring process.

It is worth emphasizing the need to relate the questions of the questionnaire applied with the phases of the TOGAF ADM cycle (Chart 1) to an adequate restructuring in the product, since the answers obtained with the application of the questionnaire come from the employees that have relation with the product and assisted in the mapping of processes.

**Chart 1.** List of Phases of TOGAF with questions of applied questionnaire.

| ADM Phases TOGAF | Questions |
|---|---|
| Preliminary Phase | 1 till 27 |
| Phase A - View Architecture | 5 and 6 |
| Phase B - Business Architecture | 7 till 12 |
| Phase C - Information Systems Architecture | 12, 13 and 15 |
| Phase D - Technology Architecture | 12, 13 till 15 |
| Phase E - Opportunities and Solutions | 22 and 23 |
| Phase F - Migration Plan | 1 till 27 |
| Phase G - Implementation of Governance | 1 till 27 |
| Phase H - Change Management Architecture | 1 till 27 |

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# 4 Presentation and discussion of results

The data obtained in the reformulation of the Individual Metering Water product (Phase 1 of the information gathering) are not presented due to their confidentiality, but it should be emphasized that they were taken into account in the mapping of processes suggested by the TOGAF ADM and contributed to analyze the results of the questionnaire.

All the information collected served as input to the TOGAF framework in its ADM cycle and was inserted in the Enterprise Architect software, in order to allow a structural view of the Individual Metering Water product.

## 4.1 Results of the application of the questionnaire

Of the 282 electronic questionnaires that were made available on the company's intranet for 25 days, 127 (45%) were fully answered, 18 were incomplete (6%) and 137 (49%) did not respond. The percentage of questionnaires answered was satisfactory. The analysis of the results was based only on the questionnaires that were fully answered.

With the result of the application of the questionnaire, it was possible to obtain important information about the perception of the employees of the internal areas of the company that have some type of relationship with the Individual Metering Water product and to identify the gaps in the processes of commercialization, operation and IT infrastructure. This made it possible to direct the use of the TOGAF framework.

These results have made it possible for the use of the TOGAF framework to allow changes in strategy to take into account all the levels, areas and processes that involved the Individual Metering Water product.

The main points of attention were identified when implementing the adjustments resulting from the product restructuring process. This identification can be visualized in Chart 2 through the relation of the application of the questionnaire and its impact on the mapping of processes with TOGAF.

In questions 2 to 24, only the answers of the 89 employees who answered yes to question 1 (Are you familiar with the Individual Metering Water product?) Were discarded for employees who were unaware of the product. Questions 25, 26 and 27 are general in nature on the subject of water consumption and were considered in the process mapping of the TOGAF framework.

All the answers given in the questions are related to the dissemination and operationalization of the product and problems were identified at various points in the process. Was selected questions 5, 6 and 22 in which the percentage of responses **I do not agree totally, I do not agree partially and indifferent** was

high and revealed problems in external and internal communication regarding the product and in training.

These are important points that can justify the poor performance in the commercialization of the product and were considered points of attention in the mapping of the processes treated by TOGAF. Questions 4, 10, 11 and 12 were also selected in which the percentage of responses **I do not agree totally, I do not agree partially and indifferent** was high and revealed problems in matters related to the alignment of business strategy with the commercial, operational and IT infrastructure processes that support the product and were considered points of attention addressed by TOGAF.

## 4.2 Mapping of processes through the use of the TOGAF framework

The mapping of the processes that involve the Individual Metering Water product through the TOGAF Enterprise Architecture framework in its ADM cycle was based on the results of the critical analysis of the the Individual Metering Water product; in the information systems of the company, which present the commercial and operational data of the product; in the results of the questionnaire applied, which demonstrate the problems and gaps of the product and in the mapping of the commercial, operational and IT infrastructure processes that involve the Individual Metering Water product.

Figure 5 presents the flowchart of the mapping of processes inserted in TOGAF.

According to figure 5, the mapping of the processes that were inserted in the TOGAF began with the analysis of the business strategy of the Individual Metering Water product, which served as the north to identify the necessary changes for product improvement and consequently the necessary changes to the product meets the expectations of the top management and also of the company's customers.

The process mapping was divided into three: Commercial; Operational Processes and IT Infrastructure supporting the product.

In the business processes, the main processes were identified, which are directly linked to the product and impact both the company and the customers (registration of individualized connections and billing) and support (customer service) that support the product and its interfaces with other areas and business processes.

For the operational processes, we have also identified the main processes, which are directly linked to the product and impact both company and customers (installation of remote measurement technology) and support (water bill reform, of water and cut in supply by default) that support the product and its interfaces with other areas and processes of the company.

**Chart 2.** Summary of the applied questionnaire and impacts on the process mapping of the TOGAF framework.

| Ques-tion | Yes | Not | Not Agree Completely | Partially Disagree | Indi-fferent | Partially Agree | Completely Agree | Very Bad | Bad | Fair | Good | Very Good | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 89 | 38 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 127 |
| 2 | 0 | 0 | 3 | 1 | 4 | 31 | 50 | 0 | 0 | 0 | 0 | 0 | 89 |
| 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 7 | 12 | 55 | 12 | 89 |
| 4 | 0 | 0 | 10 | 23 | 8 | 38 | 10 | 0 | 0 | 0 | 0 | 0 | 89 |
| 5 | 0 | 0 | 11 | 29 | 9 | 35 | 5 | 0 | 0 | 0 | 0 | 0 | 89 |
| 6 | 0 | 0 | 11 | 36 | 6 | 31 | 5 | 0 | 0 | 0 | 0 | 0 | 89 |
| 7 | 0 | 0 | 15 | 16 | 14 | 25 | 19 | 0 | 0 | 0 | 0 | 0 | 89 |
| 8 | 0 | 0 | 2 | 11 | 8 | 33 | 35 | 0 | 0 | 0 | 0 | 0 | 89 |
| 9 | 0 | 0 | 3 | 11 | 8 | 37 | 30 | 0 | 0 | 0 | 0 | 0 | 89 |
| 10 | 0 | 0 | 6 | 15 | 6 | 37 | 25 | 0 | 0 | 0 | 0 | 0 | 89 |
| 11 | 0 | 0 | 8 | 16 | 9 | 33 | 23 | 0 | 0 | 0 | 0 | 0 | 89 |
| 12 | 0 | 0 | 11 | 20 | 15 | 33 | 10 | 0 | 0 | 0 | 0 | 0 | 89 |
| 13 | 0 | 0 | 7 | 8 | 21 | 31 | 22 | 0 | 0 | 0 | 0 | 0 | 89 |
| 14 | 0 | 0 | 6 | 10 | 16 | 38 | 19 | 0 | 0 | 0 | 0 | 0 | 89 |
| 15 | 0 | 0 | 4 | 5 | 13 | 38 | 29 | 0 | 0 | 0 | 0 | 0 | 89 |
| 16 | 39 | 50 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 89 |
| 17 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 4 | 9 | 39 | 35 | 2 | 89 |
| 18 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 5 | 12 | 38 | 33 | 1 | 89 |
| 19 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 4 | 8 | 42 | 34 | 1 | 89 |
| 20 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 4 | 7 | 43 | 33 | 2 | 89 |
| 21 | 0 | 0 | 0 | 2 | 1 | 29 | 57 | 0 | 0 | 0 | 0 | 0 | 89 |
| 22 | 0 | 0 | 14 | 18 | 10 | 37 | 10 | 0 | 0 | 0 | 0 | 0 | 89 |
| 23 | 0 | 0 | 7 | 20 | 22 | 30 | 10 | 0 | 0 | 0 | 0 | 0 | 89 |
| 24 | 0 | 0 | 9 | 22 | 21 | 25 | 12 | 0 | 0 | 0 | 0 | 0 | 89 |
| 25 | 120 | 7 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 127 |
| 26 | 127 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 127 |
| 27 | 24 | 103 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 127 |
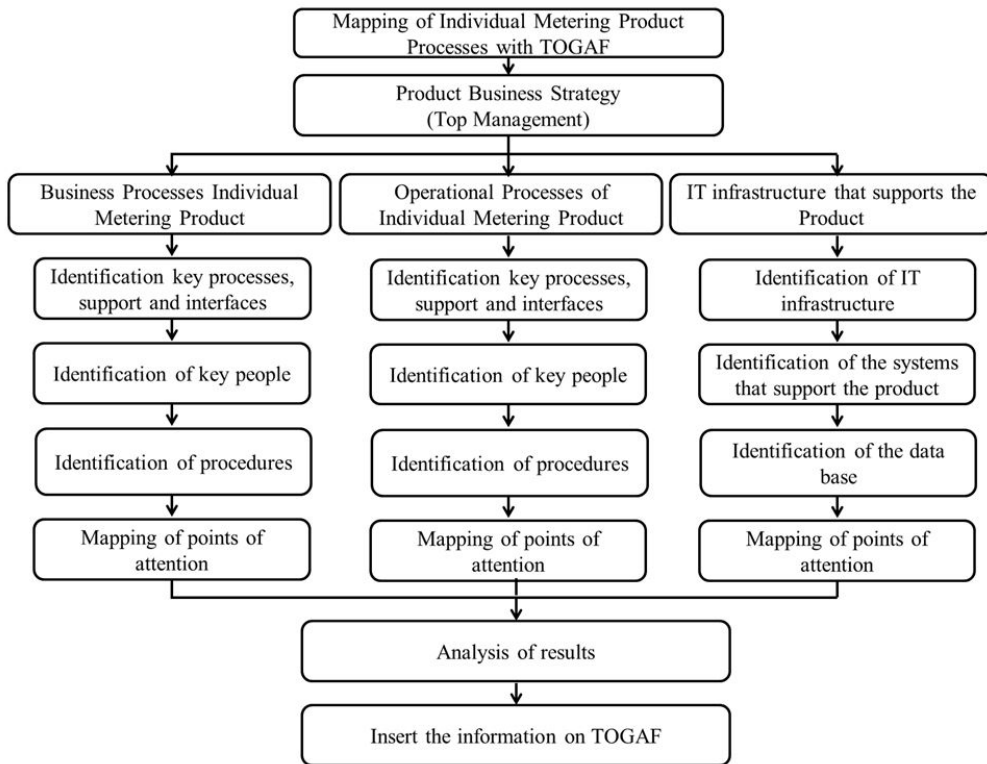
**Figure 5.** Process Mapping Flowchart Individual Metering Water Product.

For both, the procedures that have a direct relationship with the product (registration of individualized connections in the commercial and standards for installation and technology for the operational procedures) or those that are impacted (payment of accounts in commercials and cut and suppression due to delinquency in the operational ones).

At the moment of proceeding with the analysis of the commercial and operational processes and the procedures that are linked to them, it was also identified the points of attention that are fundamental in the moments of changes.

It is worth mentioning that these points of attention mapped following the recommendations of the TOGAF ADM cycle complement those that were mapped with the answers of the questionnaire application, since in the research it was obtained a vision of the employees that act with the product and in the mapping of the processes that are on and are not displayed.

In the mapping of the IT Infrastructure it was possible to identify all the necessary infrastructure for the operation of the product (remote measurement system), as well as its systems (commercial and operational) and database that will be impacted. It was possible to identify the impact that the changes of strategy cause in this infrastructure, which is fundamental to the success of the product.

The ADM Preliminary Phase, which serves to verify how the company treats its architecture, has demonstrated that although the company adopts some management tools such as ISO 9001: 2008, BSC, among others, a standard methodology for way to align the business with processes and systems, especially for new products.

At this stage it is fundamental to map all areas (formal and informal organization chart) and ensure that no unit that interfaces with the Individualized Measurement product is left out of this mapping, according to Figure 6.

Following the mapping of the processes of the Individuali Metering Water Product performed by TOGAF based on Figure 3 is described:

- Phase A: At this stage it was possible to identify all the processes and interfaces the Individual Metering Water product and to validate the scope of the changes that will be generated from the alignment of the company's business strategy.

- Phase B: At this stage it was possible to map the entire environment that involves the Individual Metering Water product, because this phase demonstrates the importance of documenting the organization so that none of the elements is left out.
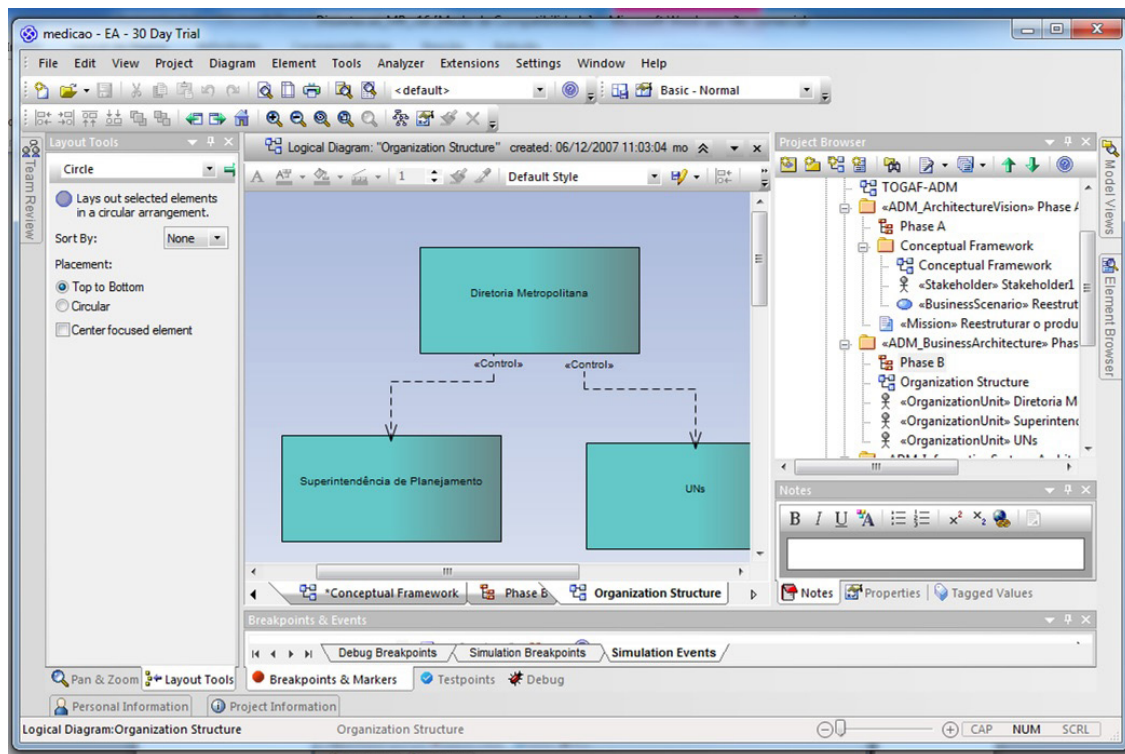
Proposal for restructuring of the product...

*Gest. Prod.*, São Carlos, v. 26, n. 1, e1346, 2019



**Figure 6.** Phase B of the TOGAF framework in Enterprise Architect software.

- Phase C: At this stage, the main systems and information processed were mapped and some gaps were identified in the process of issuing accounts and in the supply cut of the defaulting units.

- Phase D: At this stage, TOGAF's main contribution was to map all the technology that involves the product and thus ensure that the changes being considered take into account the necessary changes in the technological part of the product and if the changes proposals require some significant change in systems that interface with the product.

- Phase E: In this phase the business objectives and the necessary resources were reviewed so that the change of strategy is properly implemented and that all the impacts are duly evaluated.

Phases F, G and H have not yet been structured, since they refer to the migration plan, implementations, governance plan and change management plan and will only be started after the validation of the proposed methodology.

It should be emphasized that the study proposed here has precisely this purpose, that is, to find a methodology that contributes to the changes in the product strategy to be treated and implemented in its totality and that ensures that possible changes are accompanied.

## 4.3 Results discussion of process mapping by the TOGAF framework

It can be evidenced the contribution in the detection of gaps in the processes involving the product, because when one has a general view of the whole it is possible to identify if some point was out of the process at the moment of the implementation of changes. As for example, the gaps in the commercial procedures that have caused problems in the process of creating the RGIs (General Property Register) to enable the issuance of individual accounts. Since employees have expressed doubts about the registration of this information in the company's business system.

The changes in processes based on incomplete information and without analysis of the impact of the problems with the information systems and the technological infrastructure can lead to incomplete solutions and, in this way, to bring damages to the areas that operate the Individual Metering Water product and, consequently, for the company's customers.

Therefore, improvements in this aspect must be implemented urgently, since to ensure that the product meets customer expectations, it is necessary that the existing technological interface in the product, that is, the remote measurement system is aligned with the business processes.

With the mapping of the processes performed according to the recommended in the TOGAF ADM cycle it was possible to have an overview of all these procedures and at the moment of implementing some changes it is possible to look at all and even how they correlate. As for example, the procedure to cut water supply of delinquent customers, which currently does not work, because the module in the commercial system is still in development and the cut has been done manually.

The mapping of the Individual Metering Water product processes, following the recommendations of the TOGAF ADM cycle served, in order to have a view of the whole, that did not yet exist in the company, since the commercial and operational processes were not documented, there were only some procedures commercial.

# 5 Conclusion

The company under study did not have methodology to deal with the issue of change management from the product realignment process of the Individual Metering Water product, that is, each area adopts non-standardized methodologies to solve problems of this type, such as quality, which work well for processes, but do not address the issue of IT infrastructure and alignment with the company's business strategy.

A questionnaire was applied to employees who had some type of relationship with the product. Its application was adequate and important because the results analyzed pointed to the need for restructuring of the product in the part of commercialization, operation and IT infrastructure. This made it possible to target the use of the TOGAF framework considering all levels, areas and processes that involved the Individual Metering Water product.

The application of Enterprise Architecture as a methodology to identify problems and improvement points in the processes that involved the Individual Metering Water product using the TOGAF framework contributed to the mapping of the processes that involved the product.

The choice of the appropriate Enterprise Architecture can be considered because it allowed a unique vision of all the processes, areas, people and resources that involved the product and general vision of what should be changed with the changes in the business strategy and also in the communication strategy of the allowing more assertive decision making.

Mapping with TOGAF also allowed us to verify the impact that these changes have had on processes and the IT infrastructure of the areas that have an interface with the product and its alignment with the company's business strategy.

It was concluded, then, that the proposed restructuring of the Individual Metering Water product through the use of Enterprise Architecture framework in a Basic Sanitation company:

- Identified the main points of attention in the processes involving the Individual Metering Water product;

- Enabled that the necessary changes in the process of restructuring the Individual Metering Water product are implemented in all areas, levels and processes involved;

- Contributed to the future changes in the business strategy of the product are planned, designed and implemented in a structured and organized way and monitored systemically.

Limitations were identified during the development of the work as:

- The complexity of the company, which operates in several regions of the State of São Paulo and has BUs with different characteristics in terms of area of operation (interior and capital);

- The expressive number of clients, about 27 million people attended and come from the most diverse social classes;

- The structure and organizational culture, where each BU has an internal structure with its own characteristic to act with the clients;

- The delay in answering the questionnaire;

It can be considered an important contribution of the work and that opens the way for the continuity of the research the question of social justice. Paying for what has actually been consumed is a determining factor for companies working in the basic sanitation sector to find solutions that meet the demands of their customers by issuing water bills in an individualized way. It is also proposed as continuity of the research the application of the proposal developed in this work in other companies.

# Acknowledgements

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**Appendix A -** Enhancement survey individual metering water product.

1. Do you know the product Individual Metering Water Product?

( ) Yes ( ) No

(negative case go straight to question 23)

2. Does Individual Metering Water Product have any impact on your activity

( ) I agree completely ( ) I agree partially ( ) Not important ( ) I do not agree partially ( ) I do not agree completely

3. Comparing Individual Metering Water Product with that offered by the Market, you evaluate the Individualized Measurement:

( ) Very Good ( ) Good ( ) Fair ( ) Bad ( ) Very Bad

4. In terms of marketing, in its opinion the strategy adopted by the company in the marketing of Individual Metering Water Product is adequate:

( ) I agree completely ( ) I agree partially ( ) Not important ( ) I do not agree partially ( ) I do not agree completely

5. Regarding the disclosure / external communication about Individual Metering Water Product, you consider the strategy adopted by the company effective.

( ) I agree completely ( ) I agree partially ( ) Not important ( ) I do not agree partially ( ) I do not agree completely

6. Regarding internal disclosure / communication within the company about Individual Metering Water Product, you consider that the strategy adopted is effective.

( ) I agree completely ( ) I agree partially ( ) Not important ( ) I do not agree partially ( ) I do not agree completely

7. Individual Metering Water Product t contributes to the incremental sales of my BU.

( ) I agree completely ( ) I agree partially ( ) Not important ( ) I do not agree partially ( ) I do not agree completely

8. The business strategy of Individual Metering Water Product is aligned with the company's strategy.

( ) I agree completely ( ) I agree partially ( ) Not important ( ) I do not agree partially ( ) I do not agree completely

9. The business strategy of Individual Metering Water Product is aligned with my UN strategy.

( ) I agree completely ( ) I agree partially ( ) Not important ( ) I do not agree partially ( ) I do not agree completely

10. The business strategy of Individual Metering Water Product is aligned with the business process of my business unit.

( ) I agree completely ( ) I agree partially ( ) Not important ( ) I do not agree partially ( ) I do not agree completely

11. The business strategy of Individual Metering Water Product is aligned with the operational process of my business unit.

( ) I agree completely ( ) I agree partially ( ) Not important ( ) I do not agree partially ( ) I do not agree completely

12. The business strategy of Individual Metering Water Product is aligned with my UN computer infrastructure.

( ) I agree completely ( ) I agree partially ( ) Not important ( ) I do not agree partially ( ) I do not agree completely

13. Regarding the computer infrastructure (equipment / systems) used in the operation of Individual Metering Water Product (reading and issuing individual accounts) meets the needs of my unit.

( ) I agree completely ( ) I agree partially ( ) Not important ( ) I do not agree partially ( ) I do not agree completely

If you do not agree fully, please justify?

14. Business procedures for Individual Metering Water Product meet the needs of my unit.

( ) I agree completely ( ) I agree partially ( ) Not important ( ) I do not agree partially ( ) I do not agree completely

If you do not agree fully, please justify?

15. You consider that the Remote Measurement technology approved by the company meets the needs of the UN.

( ) I agree completely ( ) I agree partially ( ) Not important ( ) I do not agree partially ( ) I do not agree completely

16. Do you know of any companies certified by the company to provide Individual Metering Water services?

( ) Yes No

If yes, what:

17. Overall, how do you evaluate the relationship with certified partner companies?

( ) Very Good ( ) Good ( ) Fair ( ) Bad ( ) Very Bad

18. How do you evaluate the relationship with the certified partner companies regarding the marketing of the product.

( ) Very Good ( ) Good ( ) Fair ( ) Bad ( ) Very Bad

19. How do you evaluate the relationship with certified companies regarding the operation of the product?

( ) Very Good ( ) Good ( ) Fair ( ) Bad ( ) Very Bad

20. How do you evaluate the relationship with certified partner companies in solving problems arising from the individualization of water consumption?

( ) Very Good ( ) Good ( ) Fair ( ) Bad ( ) Very Bad

21. In your opinion, does Individual Metering Water Product contribute to the rational use of water and the preservation of the environment?

( ) I agree completely ( ) I agree partially ( ) Not important ( ) I do not agree partially ( ) I do not agree completely

22. In terms of training, my unit was properly trained to operationalize Individual Metering Water Product.

( ) I agree completely ( ) I agree partially ( ) Not important ( ) I do not agree partially ( ) I do not agree completely

23. In terms of attendance the return of the demands meets the expectations of my unit.

( ) I agree completely ( ) I agree partially ( ) Not important ( ) I do not agree partially ( ) I do not agree completely

24. Regarding the deadline for meeting the demands of Individual Metering Water Product t, the return time meets the expectations of my unit.

( ) I agree completely ( ) I agree partially ( ) Not important ( ) I do not agree partially ( ) I do not agree completely

25. Do you consider the individualization of water consumption important to the company?

( ) Yes No

26. Do you consider the individualization of water consumption important for society?

( ) Yes No

27. Do you know of any other company, apart from those certified by the company, that carry out the individualization of water consumption?

( ) Yes No

If so, which ones?