Warsaw School of Economics
Collegium of Economic Analysis

mgr inż. Marcin Ludzia

Summary of doctoral thesis:

Designing IT architecture of a city

Doctoral thesis written under the guidance of Mr.
Andrzej Sobczak, Ph. D., prof. SGH.

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BACKGROUND AND JUSTIFICATION OF THE RESEARCH

Nowadays, radical change of the way an organization works or the way it interacts with environment, that was enabled by innovative IT[1] technologies, is called digital transformation. It is defined by G. Westerman, D. Bonnet, A. McAfee as the use of technology to radically improve performance or reach of enterprises[2].

Although, the term *digital transformation* is mostly used to describe changes in enterprises, similar processes can beobserved in public administration. There is already a new class of information systems created by government and local administration in Poland, which are aimed at changing the way public services are delivered[3]. This is particularly evident in the case of cities, where city halls provide not only possibility for residents to submit official documents via Internet, but also are creating completely new, innovative IT solutions[4].

All such solutions are part of the global trend of cities transformation, where innovative IT solutions play important role. This trend is leading to smart cities concept. After analyzing a number of definitions to this idea, the author of this dissertation proposed his own definition of the term 'smart city'. Smart city is a city whose broadly understood urban infrastructure, through innovative use of information technology, is able to adapt to changes in the external environment and by use of possessed data to deliver specific benefits to residents, businesses and tourists while interacting with them.

The results of semi structured interviews with city officials, conducted by the author in 2016 in six cities (Lębork, Nowy Targ, Olsztyn, Płock, Stalowa Wola, Zakopane), show that there is an interest in the smart cities concept. However, there is a precaution and an attitude of 'hard' analysis and indication of the benefits that will be provided to the city residents' thanks to the use of IT solutions realizing smart cities idea.

It should be emphasized that in order to make investments in IT solutions in cities cost-effective and flexible, they need to be planned and predictable. Unfortunately it turns out that the innovative IT solutions developed by cities don't create components of a coherent enterprise architecture for IT of a smart city[5], and are rather island solutions.

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[1] Information Technology and acronym IT are used alternately.

[2] Westerman G., Bonnet D., McAfee A., *The Nine Elements of Digital Transformation,* MIT Sloan Management Review, 4 January 2014, http://sloanreview.mit.edu/article/the-nine-elements-of-digital-transformation/ (December 13, 2016).

[3] Vide e.g. the *Mobile Connect* concept, which allows to authorise and authenticate citizens by government with use of a phone (https://mc.gov.pl/aktualnosci/sprawy-urzedowe-rowniez-przez-komorke) (December 20, 2016).

[4] Examples of such system include: Warszawski System Powiadomień, Alert Szczecin, eZdrowie portal, Bezpieczny Olsztyn application. In selected cases, mobile applications are intended to promote city or region (i.e. 'Graj Hejnał' developed in Cracow).

[5] Enterprise architecture for IT of a smart city is understood as IT solutions landscape in the city depicting the dependencies and exchange of data between IT systems, as well as the hardware architecture and placement of individual TI software components on specific hardware components. (see *Architektura IT: Klucz do efektywnego wykorzystania zasobów informatycznych firmy*, „Harvard Business Review Polska", https://www.hbrp.pl/a/architektura-itklucz-do-efektywnego-wykorzystania-zasobow-informatycznych-firmy/B3Eykepz, March20, 2017). IT architecture consists of three layers of enterprise architecture: data

This observation is confirmed by author's research[6]. The main findings are as follows:

1. The development of the city's IT infrastructure through the implementation of a well-thought and cohesive IT strategy is rare. In most of the analysed cities, there is no organized and coordinated approach to implementation of IT strategy.
2. The activities taken to implement ICT solutions are mostly ad hoc and not coordinated with other activities.
3. With the increase in the number of users and the number of IT professionals working in IT departments of city halls, the frequency of having an actual IT strategy is increasing.
4. The most important organizational problems during the implementation of strategic IT goals – indicated by the respondents – include: insufficient financial resources, difficulties in identifying architectural constraints (especially regulatory ones) and requirements, unrealistic expectations regarding the due dates, difficulties in coordinating activities and the need to maintain consistency of strategic initiatives.

The IT strategy defines goals and a high-level approach to the development and maintenance of city's IT systems and infrastructure needed to provide access to expected information and services, streamline communications, and facilitate user collaboration[7]. Over the years, a number of methods have been developed to support the implementation of TI strategies that can be adapted for use by city authorities, i.e.: Henderson-Vankatraman model (SAM model)[8], F.W model. McFarlana[9], IAF model[10], IPMF IT model[11], Reich and Benbasata[12].

An important element of IT strategy is IT architecture, which is a bridge between strategic IT goals and projects in which information systems are implemented[13]. The use of an architectural

architecture, application architecture and technical architecture (see Piąsta K., *Od architekta IT do architekta korporacyjnego – podobieństwa i różnice*, http://architekturakorporacyjna.pl/od-architekta-it-do-architekta-korporacyjnego-podobienstwa-i-roznice/1921/). In the case of city halls, it seems reasonable to skip business architecture, as the activities of the offices and, in particular, the services provided by the city councils are in many cases governed by the legislature.

[6] The survey was conducted in the form of a questionnaire survey from mid-May to mid-June 2015. Respondents were given the opportunity to respond via a questionnaire sent on paper or via an online questionnaire (CAWI) under a dedicated web address. As a population, all large and medium (with a population of over 20,000) Polish cities were selected. The population included in total 223 cities, 39 of them were large cities (over 100,000 inhabitants), and the remaining 184 cities were medium cities.

[7] Barszczewski L., Gogolewski A., *Strategia biznesowa a strategia informatyzacji*, red. Szyjewski Z., Nowak J. S., Grabara J. N., Strategie informatyzacji i zarządzanie wiedzą, Wydawnictwo Naukowo-Techniczne, Warsaw 2004, p. 81.

[8] Ibidem, pp. 83-85.

[9] McFarlan F.W., *Information Technology Changes the Way You Compete*, Harvard Business Review, vol. 62 issue 3. May/June 1984, pp. 98-103.

[10] Wiggers P. Kok H., de Boer-de Wit M., *IT Performance Management*, Elsevier, Oxford, 2004.

[11] Bainey K., *Integrated IT Performance Management*, CRC Press, Boca Raton, Florida, 2016.

[12] Reich B. H., Benbasat I. *Factors That Influence the Social Dimension of Alignment Between Business and Information Technology Objectives*, MIS Quarterly 24(1), March 2000, pp. 81-113.

[13] Greefhorst D., Proper E.*, Architecture Principles. The Cornerstones of Enterprise Architecture*, Springer 2011, pp. 46.

approach is a widely accepted means of managing the complexity of an organization as a whole, and a tool to ensure the appropriate and optimal use of its technical resources[14].

In the literature, many methods that support IT architecture development have been described, i.e.: Zachman matrix[15], TOGAF[16], FEAF[17], ADMIT[18] or the approach presented by J. W. Ross, P. Weil and D. Robertson[19]. There are also methods dedicated to the design of IT architecture aimed at building a smart city. These methods include i.e.: the architectural cascade proposed by A. Sobczak[20], the method presented by N. Z. Bawany and J. A. Shamsi[21]. There are also IT architecture frameworks developed by smart city solutions providers, i.e.: T-Mobile[22], Huawei[23] and Forrester Research[24]. Critically looking at the above-mentioned methods in context of application them in Polish cities, it should be noted that in the case of universal methods the methods based on the enterprise architecture are currently dominant. In case of smart cities, most methods provide a framework for IT architecture that needs to be adapted and developed in the city. This approach in the Polish context may be difficult to implement, as the reference architectures usually do not take into account e.g. central systems (i.e. the *Źródło* system) provided and managed by individual ministries.

[14] Shah H., Kourdi M., *Frameworks for Enterprise Architecture*, IT Professional, IEEE, September-October 2007, pp.36.

[15] Zachman J., *A Framework for Information Systems Architecture*, IBM Systems Journal, Vol. 26 Issue 3, 1987.

[16] http://pubs.opengroup.org/architecture/togaf9-doc/arch/index.html (January 11, 2017).

[17] http://ocio.ca.gov/ea/docs/CommonApproachToFederalEA.pdf (January 11, 2017).

[18] Pradhan S. K., *IT Architecture Design Framework: ADMIT*, September 2013, (https://www.infoq.com/articles/admit-architecture-framework) (March 28, 2017).

[19] Ross J.W., Weil P., Robertson D.C., Enterprise Architecture as Strategy, Harvard Business Press, Boston 2006.

[20] Sobczak A., *Zastosowanie architektury korporacyjnej jako narzędzia przeprowadzenia transformacji jednostek administracji publicznej*, Monografie i Opracowania, Szkoła Główna Handlowa, Warszawa 2010, p. 113-124.

[21] Bawany N. Z., Shamsi A., *Smart City Architecture: Vision and Challenges*, International Journal of Advanced Computer Science and Applications, Vol. 6, nr 11, 2015.

[22] *Inteligentne miasta. Jak zintegrowana infrastruktura otwiera drogę do cyfrowej transformacji przestrzeni miejskiej*, Warszawa 2016 (http://biznes.t-mobile.pl/upload/files/Smart-cities-opracowanie, April 8, 2017).

[23] *Huawei Smart City Solution*, Huawei Technologies Co., Ltd., 2013 r (http://enterprise.huawei.com/ilink/cnenterprise/download/HW_315743, April 9, 2017).

[24] Bélissent J., Giron F., *Service Providers Accelerate Smart City Projects*, Forrester Research Report, July 30, 2013.

During the design of the IT architecture, architectural choices that should be documented are being made. The methods of documenting architectural choices are complementary to architecture design methods. These notations include i.e.: ArchiMate[25] (Motivation Extension), Business Motivation Model (BMM)[26], i*[27], Goal-oriented Requirements Language[28] (GRL), and Knowledge Acquisition in autOmated Specification[29] - KAOS. Unfortunately, the listed graphic notations do not fully address the specificities of a city and issues related with the implementation of an smart city concept. It is not possible to point out the public benefits achieved by the residents of the city or businesses operating in its area. In addition, the described notations do not take into account the differences between the legal constraints (that must be met by the IT infrastructure) and other requirements, which leads to architectural compromises. Many of the mentioned notations do not take into account the interests and perspectives of individual stakeholders. Another important point is the lack of documentation of architectural alternatives that haven't been selected (this is important for future change management).

IT professionals working in city halls need a method that - based on the designed city's IT architecture, aimed at the implementation of the smart cities concept - will help them to create a list of implementation initiatives that will deliver specific benefits to residents of the city and organizations operating in its area in a coordinated and structured way.

Based on literature research conducted by the author of this thesis, an observation about methodology gap in area of IT architecture design methods which support implementation of smart city concept, was formulated.

DOCTORAL THESIS GOALS

The following main thesis goal was formulated: **to create a method for designing IT architecture of a city, which will be aligned with its strategic IT goals, supporting overall implementation of smart city concept** (pl. *Metoda projektowania ARchitektury informatycznej miaSta* - MARS)**.** The main goal was decomposed into the following specific goals:

- **CSz.1:** To analyze of current approaches to: a) implementation of the smart cities concept in polish cities; b) design and implementation of the city's IT architecture aimed at implementing the concept of smart cities.
- **CSz.2:** To design MARS method procedures that would structure a city IT architecture design approach tailored to its strategic IT goals, supporting the overall implementation of the smart city concept.

[25] *ArchiMate 3.0 Specification*, An Open Group Standard, 2016, http://pubs.opengroup.org/architecture/archimate3-doc/toc.html (April 3, 2017).

[26] *Business Motivation Model*, version 1.3, Object Management Group, May 2015.

[27] *i Star Quick Guide*, http://istar.rwth-aachen.de/tiki-index.php?page=iStarQuickGuide (April 4, 2017).

[28] *Goal-oriented Requirement Language*, University of Toronto, Canada, https://www.cs.toronto.edu/km/GRL/ (April 4, 2017).

[29] *A KAOS Tutorial*, Respect-IT SA, 2007, https://www.cse.msu.edu/~cse870/Materials/GoalModeling/KaosTutorial-2007.pdf (April 11, 2017).

- **CSz.3:** To develop a graphical notation allowing to document activities performed while designing IT architecture of a city and being a communication platform for all stakeholders involved in its design.
- **CSz.4:** To develop a prototype of a tool supporting the MARS method procedures.
- **CSz.5**: To make a pilot implementation of the MARS method in one of the Polish cities to evaluate the suitability of the method and validate delivered benefits.

RESEARCH HYPOTHESES

The main research hypothesis was formulated as follows: **it is possible to create a method[30] for designing IT architecture of a city, which will be aligned with its strategic IT goals, supporting overall implementation of smart city concept**.

To prove the main hypothesis, additional supporting hypotheses were formulated:

- **HP.1:** In majority of cities in Poland, IT infrastructure is developed in unstructured manner and taking into account temporary needs.
- **HP.2:** Simultaneously with increase of complexity of city's IT landscape, increases frequency where cities have a formal IT strategy document.
- **HP.3:** Cities that have formal IT strategy in place, encounter on number of barriers which lower efficiency of strategic IT goals realization.
- **HP.4:** Cities are realizing increasing number of projects in which selected elements of smart cities idea are taken into account.
- **HP.5:** There is no method aimed at IT architecture design that support overall implementation of smart city concept.

DESCRIPTION OF MARS METHOD

In general, strategic IT management process consists of three phases[31]:

1. Definition of strategic IT goals;
2. Operationalization of strategic IT goals;
3. Implementation of strategic initiatives (in programs and project portfolios).

The MARS method is aimed at helping employees of city halls during the second phase of strategic IT management process (see Figure 1). The method – in structured way – supports the design of the city's IT architecture by decomposing and coordinating the strategic IT goals, defining and analyzing architectural alternatives and identifying and setting the sequence of strategic

[30] According to Słownik Języka Polskiego PWN, method [gr. méthodos] is consciusulsy used way of doing things aimed to reach chosen goal; (http://sjp.pwn.pl/szukaj/metoda.html, Febryary 14, 2017). P. Szamrowski draws attention to the relation between the concepts of method and technique. The author, citing the British Encyclopedia of Management, states that the technique is part of a detailed method dedicated for special purpose (see Szamrowski P., *Ewolucja i dyfuzja metod organizacji i zarządzania*, in: Metody organizacji i zarządzania, J. Mioduszewski, edit., Wydawnictwo Uniwersytetu Warmińsko-Mazurskiego w Olsztynie, Olsztyn, 2013., p. 27).

[31] Thompson J., Martin F., *Strategic Management. Awareness & Change*, South-Western Cengage Learning, 6th edition, 2010, p. 34.

initiatives. The implementation of these initiatives deliver IT systems and thus enables the achievement of the strategic IT goals set forth in the first stage.

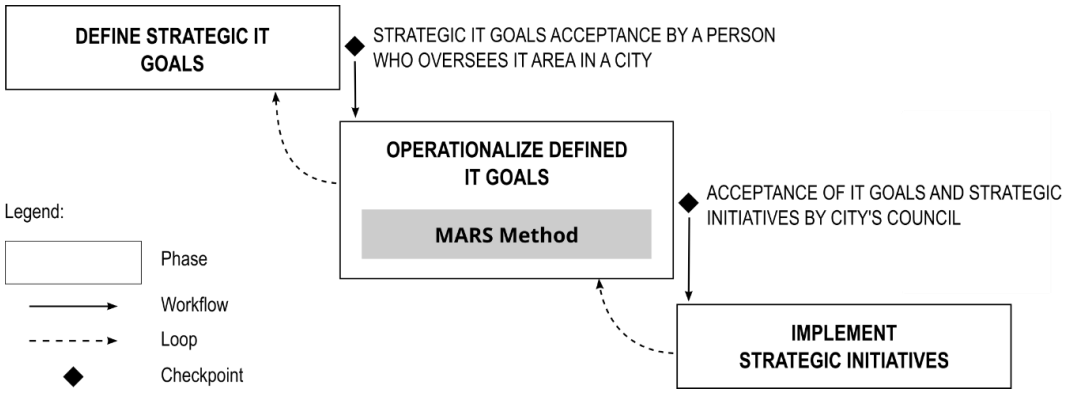

Figure 1. Context of MARS method.
Source: own elaboration.

In the MARS method there are ten types of elements that are used in the procedure and are the basic elements of graphic notation (see Figure 2). These are:

- **Strategic IT Goal** – formally established and anticipated to achieve in the future the intention to build new or develop existing IT system of the city hall or subordinate units;
- **Benefit** – improvement in the functioning of the city hall/subordinate unit or residents /businesses operating in the city's area, accomplished through the achievement of one or more strategic IT goal;
- **Information system** - a set of interoperable devices, programs, information processing routines and software tools used to process data;
- **Architectural constraint** - a condition restricting the set of acceptable architectural alternatives that must be met by the architecture of the IT system;
- **Architectural requirement** - a condition that should be met by the architecture of the IT system;
- **Architectural problem** - a problem concerning an architecture of IT system which is solved by selecting one of at least two architectural alternatives;
- **Architectural alternative** - a high-level concept of the possible solution of the architectural problem;
- **Stakeholder** - a person, group or organization interested in activities taken in the IT area (as a result of these activities, stakeholders may benefit or lose) and having a real impact on the implementation of these activities;
- **Argument** - the motivation (justification) of choosing a particular architectural alternative, which cannot be shown as a requirement or constraint; is the premise of "for" or "against" some architectural alternative;
- **Strategic Initiative** - a project whose implementation aims at achieving certain strategic IT goal or goals.

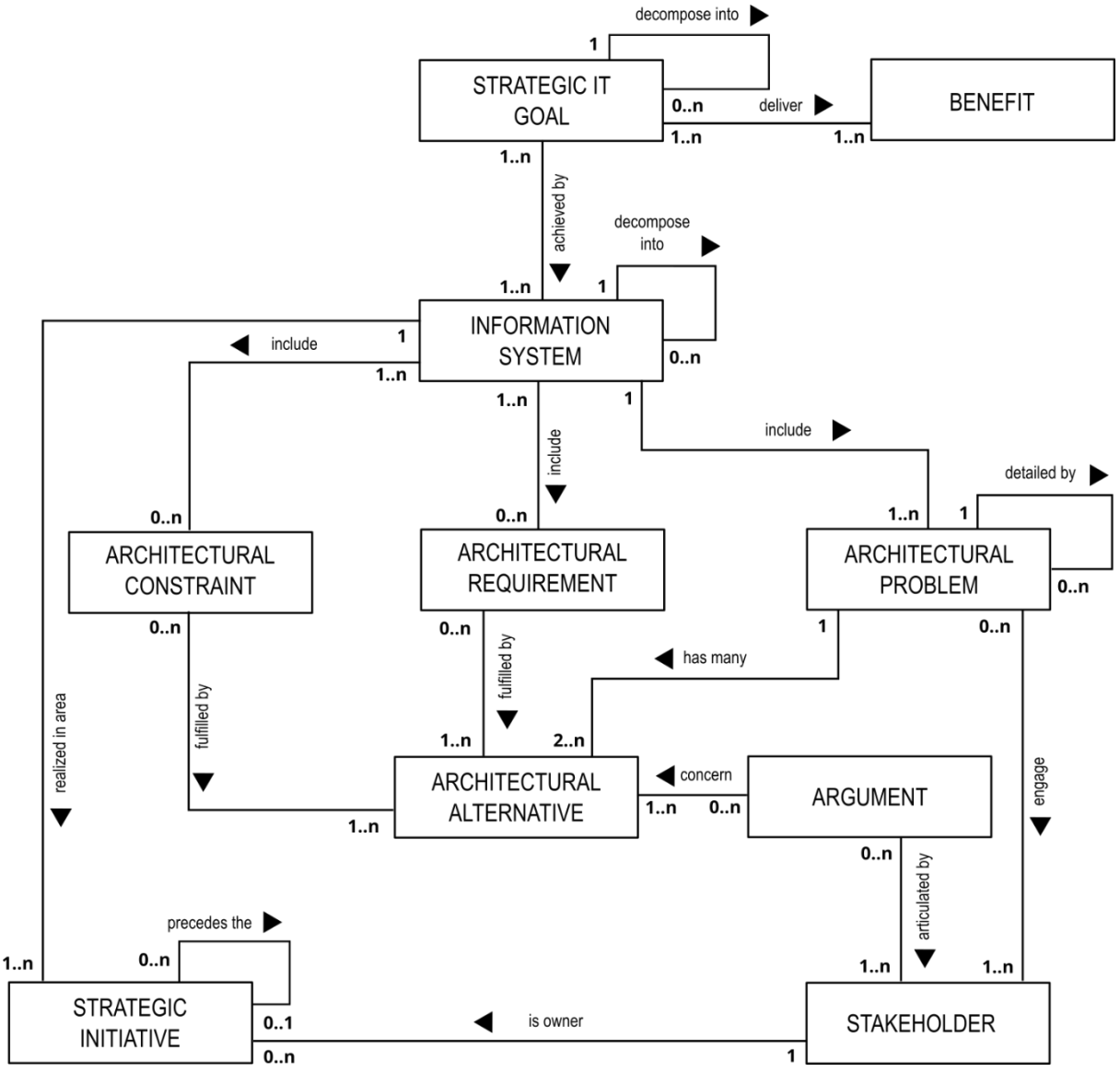

Figure 2. Meta-model of elements of MARS method.
Source: own elaboration.

The MARS procedure consists of three main phases and a preparatory phase. Each phase ends with the development of defined phase products that are passed to the next one, or in the case of the third phase, for further implementation within the IT strategy management process.

In the **preparatory phase**, the preparatory actions are done consisting of forming a team that will be working in IT architecture with use of the MARS method.

During the **1st phase – elicitation and detailing of strategic IT goals** - the strategic documents of the city are analyzed. The strategic IT goals are identified and – if included in the documents – benefits, information systems, architectural requirements and architectural constraints. A hierarchical tree structure is built from the strategic IT goals, where each goal is combined with corresponding benefits, information systems, architectural constraints and architectural requirements.

During **2nd phase - the identification and selection of architectural alternatives and design of the city's IT architecture** – for each information system, key architectural choices within the identified architectural problems are made. During selection of architectural alternatives, architectural constraints and architectural requirements as well as stakeholders' arguments are analyzed. During this phase, the IT architecture of the city is designed.

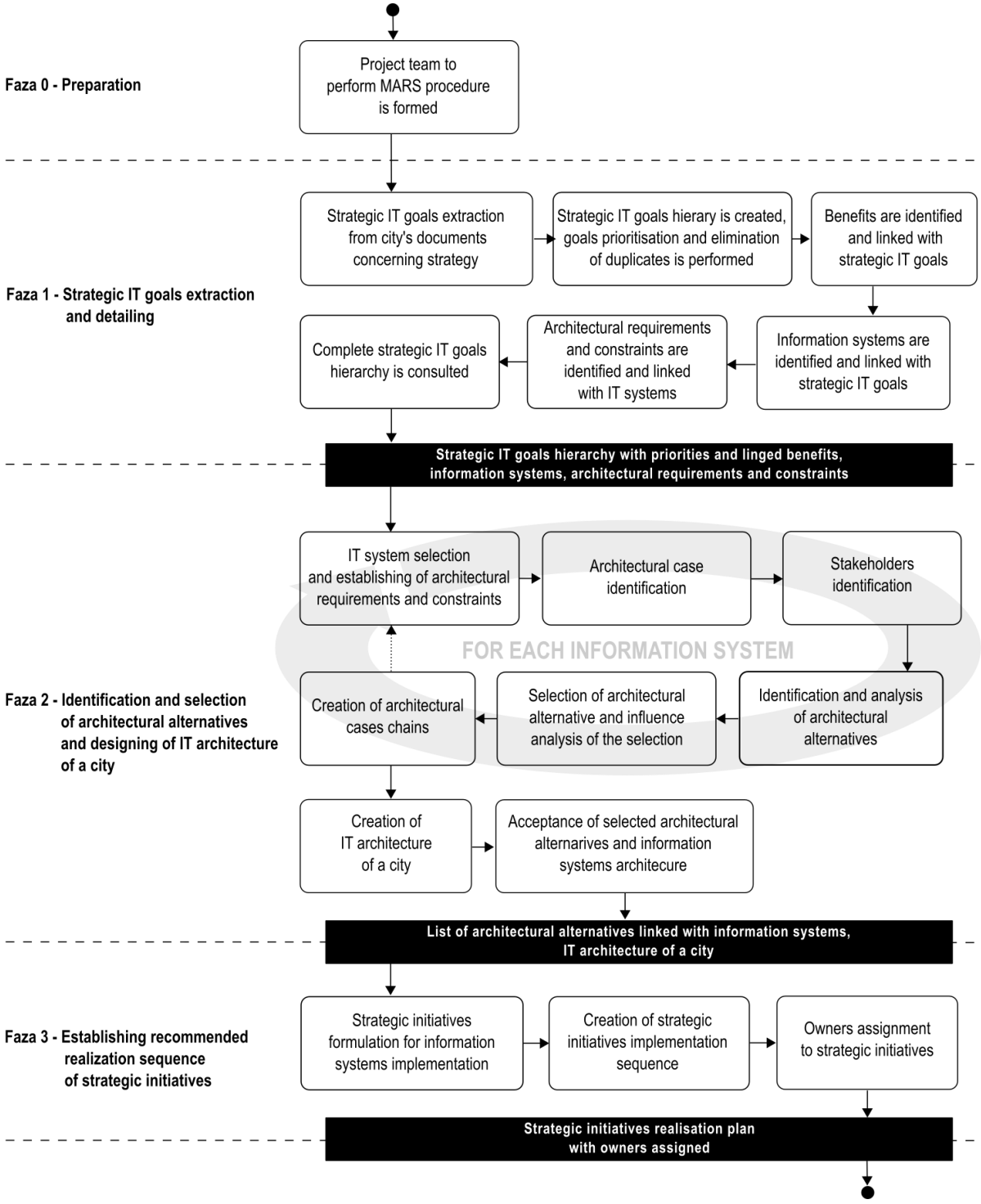

Figure 3. High-level view on MARS procedure.
Source: own elaboration.

During **3rd phase - establishing recommended sequence of strategic initiatives** - development or modification of information systems is mapped into strategic initiatives. The relationships between selected strategic initiatives are then created. Each of the strategic initiative is attributed to the person responsible for its implementation - the owner of the initiative.

In order to make documentation of activities taken during MARS procedure easier and to accelerate it and keep cohesion of communication between stakeholders, a dedicated graphical notation was designed. The notation consists of ten types of graphical elements that correspond to the elements used in the procedure.

In the MARS graphical notation, six types of relationships are used: aggregation (the line ended with a diamond), influence relation (line ended with "+" or "-"), simple association (simple ending), association relationship with data flow (dashed line with simple ending), directed association (the line ended with an arrow) and the grouping relationship (bounding around the grouped elements).

Graphic documentation in the MARS method is divided into logically interconnected diagrams. These diagrams are as follows:

- **Strategic Goals Diagram – DCS —** showing the hierarchy of strategic IT goals along with the representation of the impact of achieving each goal on delivering benefits. The diagram also represents associated IT systems, architectural constraints and architectural requirements.
- **Architectural Problems Chain Diagram– DŁZA —** showing chains of interrelated architectural problems that concern certain information system.
- **Architectural Problem Map – MZA —** illustrating the architectural problem situation – stakeholders, analysed architectural alternatives, architectural constraints and architectural requirements.
- **City's IT Architecture Diagram – DAIM** – presenting the IT architecture of a city that is a result of selected architectural alternatives.
- **Diagram of Strategic Initiatives Realisation Sequence - DSRIS** - which presents strategic initiatives and their interrelationships.

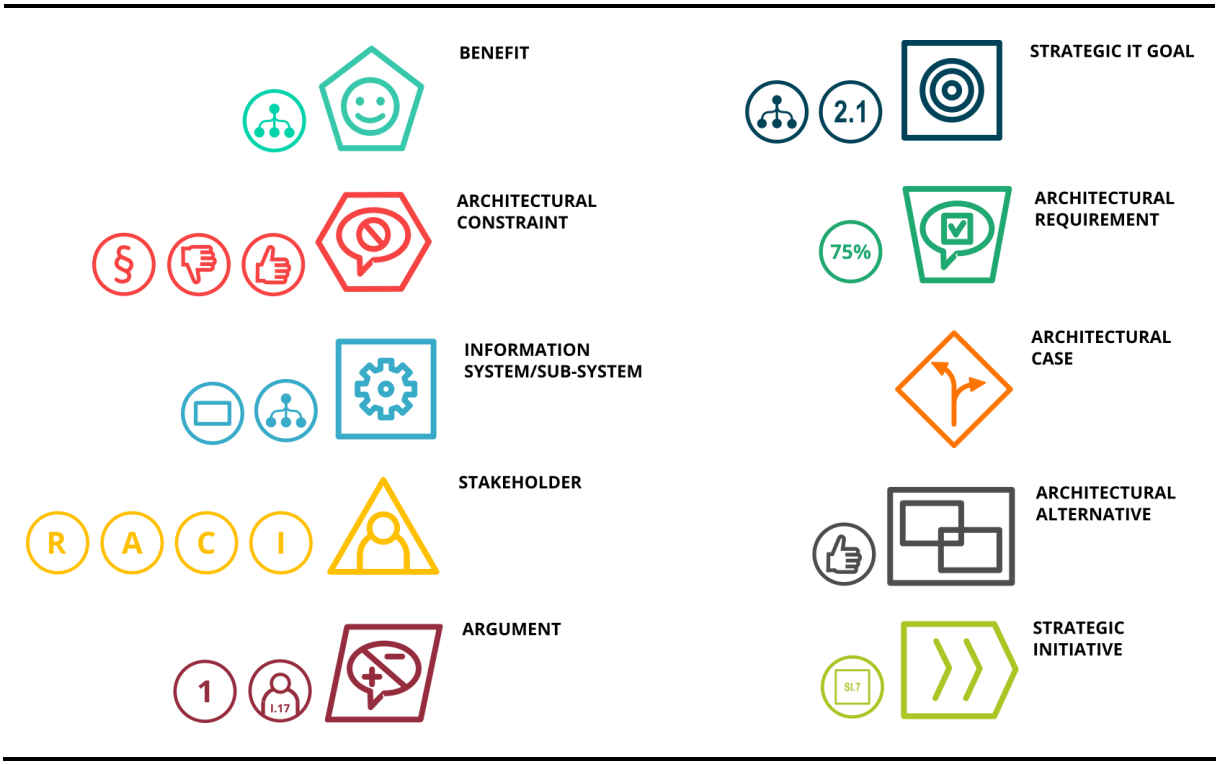

Figure 4. Graphical representation of elements from MARS method.
Source: own elaboration.

Diagrams are created in subsequent stages of the MARS procedure. The diagrams complement each other and together form a coherent and comprehensive documentation of performed activities.

RESULTS OF IMPLEMENTATION OF THE MARS METHOD

In order to verify both the procedure and the graphic notation of the MARS method, a pilot implementation of the developed method was hold in city A. The city A is a large industrial, cultural and scientific centre in the northern part of Poland.

During the verification, the strategic IT goals were developed. There were obtained as a result of the MARS procedure: a list of strategic IT goals, a list of strategic initiatives, the IT architecture of the city, the recommended sequence of strategic initiatives with assigned owners, as well as the basic architectural assumptions for each IT system identified during the MARS procedure.

The pilot implementation of MARS method was conducted in 2016 and 2017. It was preceded by two meetings with representatives of the city hall. During those meetings the expected benefits of MARS method application and the assumption of the pilot implementation were presented. A number of working meetings and a summary meeting took place during the implementation.

The verification demonstrated the practical effectiveness and usefulness of the proposed approach. The MARS method has proven to be effective and targeted at delivering benefits. The application of the procedure has positively influenced the structure of the process of operationalization of the strategic IT goals. The order of steps was logical and intuitive. As the Director of the

IT Department pointed out, the analysis of architectural issues allowed for a more informed design of the city's IT architecture.

The documentation in the form of graphical diagrams was created as a basis for communication during the implementation process. Particular usefulness was presented by the Architectural Problem Maps, which presents possible architectural alternatives, along with architectural constraints, architectural requirements and arguments. This form of documentation proved to be clear for people who are not familiar with modelling. Created diagrams significantly contributed to easing communication during working meetings.

On the other hand, several potential areas for further research and methodological work have been identified. In its present shape the MARS procedure consists of several steps where all of them are mandatory. Only if the step is inadequate to the situation, it can be omitted. However, in the case of simpler systems or smaller cities, not all steps may be necessary to perform. In the future, a lean version of the procedure – that could be used in less complex cases – should be designed.

CONCLUSIONS AND DIRECTIONS FOR FURTHER RESEARCH

To prove the hypothesis of the dissertation, the author formed the main objective to develop the MARS method. It was created for the design of the city's IT architecture aimed at realising an smart city concept. The main objective was then decomposed into specific objectives, which were implemented in subsequent sections of this dissertation.

The first chapter of the PhD thesis presents an overview of the main concepts of the smart city concept. The presented consideration shows that the concept of smart cities is quite well recognized, despite the doubt of a definition.

It is worth mentioning that there is no extensive literature that covers strategic IT management matter in the context of developing a smart city. In the second chapter, the author focuses on the analysis of selected methods and trends in IT architecture as a means of implementing IT strategies. The author concludes the review of the literature with an observation that there is a methodological gap in IT architectural design methods intended to support the implementation of smart cities concept.

The third chapter contains the description and the results of the research conducted by the author. The obtained results allowed to formulate the following conclusions:

1. The development of the city's IT infrastructure using the implementation of a well-thought and cohesive IT strategy is rare. In most of the asked city halls there was a lack of organized and coordinated approach to the IT strategy;
2. The received answers indicate that the measures taken to implement ICT solutions are mostly ad hoc and not coordinated with other initiatives.
3. The most important problems in achieving the strategic IT goals – indicated by the respondents – include: insufficient financial resources, difficulties in identifying architectural (especially regulatory) constraints and requirements, unrealistic expectations regarding due dates of achievement of strategic IT goals, difficulties in coordinating activities;

4. The most important requirements for methods supporting the development of the architecture and the implementation of strategic IT goals include facilitating communication between the IT department and the city hall officials and employees, structuring a process that translates strategic IT goals into adequate actions and solutions, facilitating the detection of contradictions between strategic initiatives and projects implementing strategic IT goals.

Summing up the presented conclusions, the **first objective of the work was realized.**

The MARS method, described in the fourth chapter, fills a gap among the city's IT architecture design methods, supporting the implementation of strategic IT goals, aimed at implementing the smart cities concept. The developed method takes into account the specificity of the design process of the IT architecture in municipal offices, including the involvement of a number of subsidiaries, involvement of many stakeholders during the design of the IT architecture process, the regulatory constraints with which the IT infrastructure must comply, and the architectural guidelines applicable to the Polish local administration.

Unlike existing approaches, MARS method:

- provides a transition process from strategic IT goals aimed at realizing of smart cities concept to IT architecture at strategic level;
- provides knowledge essential for making architectural choices in line with existing formal and legal conditions;
- is flexible because it does not propose a ready-made reference architecture that would require significant financial resources for its implementation in cities;
- provides a new graphical notation for documenting activities that takes into account the usability paradigms of graphic notation design.

The arguments described above allows to conclude that the **second and third objectives of the work are fulfilled.**

The fifth chapter was of great importance in proving the hypothesis of the dissertation. This chapter describes the pilot implementation of MARS method in one of the large city in Poland. In the summary of the fifth chapter, the following conclusions were made:

1. The verification demonstrated the practical effectiveness and usefulness of the approach proposed by the MARS method;
2. The application of the MARS procedure positively influenced the structure of the city's IT architecture design process and consequently the realization of the strategic IT goals;
3. Graphic documentation created with use of the MARS notation proved to be clear for people who are not familiar with modelling on a daily basis;
4. Graphic documentation has significantly contributed to easing communication during working meetings.

These arguments provide a basis for concluding that the main objective of the thesis has been achieved. It is therefore assumed that this and the other arguments raised in the course of the discussions are evidence of a positive verification of the main dissertation hypothesis.

The author's contribution to the development of information economics discipline

includes:

- an in-depth review of the concepts of smart city and approaches for implementing the IT strategy;
- formulation of author's definition of smart city;
- comparing the methods of designing and documenting the IT architecture;
- conducting research on selected aspects of digitalization of cities in Poland and in-depth analysis of obtained results;
- developing the author's method of designing the city's IT architecture aimed at implementing the concept of smart cities (including implementation procedure and graphical notation).

In future research related to the MARS methodology, more portfolio management elements should be considered. It is expected that the addition of the portfolio management approach will have a positive impact on the achievement of cohesion between the ongoing strategic initiatives aimed at developing a smart city.

Other development directions may include:

- introduction of mechanisms for formal analysis of the contradiction of architectural requirements and architectural constraints that are identified in the first phase of the MARS procedure;
- developing light version of the MARS procedure that could be applied to less complex IT environments.

In conclusion, given the current trends in the use of information technology in organizations, the concept of smart cities will be the most important for cities development in the near future. The implementation of the smart cities concept in IT strategy is a key success factor of developing a smart city. The author hopes that the proposed MARS method will find a wide range of users in city halls in Poland, thus contributing to the modernization of cities and the formulation of modern civil society.

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