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**Challenges of a new approach in the management
of ICT: the service management perspective in the
Smart City context**

MASTER'S THESIS
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Declaration

I hereby declare, that this paper is my original authorial work, which I have worked out on my own. All the sources, references and literature used or excerpted during elaboration of this work are properly cited and listed in complete reference to the due source.

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Abstract

Service perspective is considerably new theory, still not widely implemented and used. This thesis focuses on aspects of Service-Dominant logic, Service Science and the relationship of service perspective towards the concept of Smart Cities while paying special attention to the Information and Communication Technologies supporting the integration of Smart Cities. The thesis proposes new approach and outlines benefit gained by looking at Smart Cities management from the perspective of service logic.

Key words

service-dominant logic, service science, smart city, service systems, information and communication technologies, service perspective,

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1. Introduction

Changing and developing technologies vastly influence the approach to a certain issue and strategy. This thesis searches for a new approach using research of already existing theories and combining them.

As first is described current situation or a situation from not that far ago. This is supported by brief description of Goods-Dominant logic (G-D logic) (chapter 2.1.1.), as that was the model used at the time. Following is Service-Dominant logic (G-D logic) (chapter 2.2.). The intention behind this slight deviation from the main theme was to better illustrate the differences of S-D logic approach and showing how the previous model is not sufficient today. S-D logic was given large space in the research because its thorough understanding is not trivial and is essential for building new theories later. In next parts there is description of the contribution of S-D logic (chapter 2.3.) and what role play people, technologies and service system in this concept (chapter 2.4.). Following is introduction and brief description of Service Science (SS) (chapter 2.5.). Even though, SS is older term than S-D logic, after researching it it was found out that it has a lot in common with S-D logic and its understanding is easier once understanding S-D logic. So the service approach would become more distinguishable from other approaches, there is a brief description of Viable Service Systems (chapter 2.6) as they look at things from the perspective of a system theory and can bring in better understanding of the issue as a whole.

Chapter 3 gives room to Smart Cities. Firstly introducing them from the service point of view as smart service systems (chapter 3.1.) then follows description based upon multiple definitions found in publications, how a Smart City should

look and a description of a conceptual framework for making any city smart (chapter 3.2.). Chapter 3.3. depicts the important role of Information and Communication Technologies (ICT) in the Smart City concept and is followed by short information about Digital Cities as they are closely related to usage of ICT in urban areas but are different than Smart Cities.

Last but not least, chapter 4 applies gained knowledge and tries to come up with new approach to the management of Smart Cities, by applying service perspective to the use of ICT while preserving the goals of a Smart City and later introduces new smart operant resources (chapter 4.1.).

2. Service as a foundation

It is not easy to grasp the meaning and importance of service science. In past, marketing revolved around products. Ownership of tangible goods was a sign of profit and wealth. Producer produced, consumer consumed. This model ensured easy management and efficiency. However, circumstances have changed and priorities shifted from product to service. Service perspective offers new collaborative approach to management of business and society. This chapter describes transition into a service economy as something that is past manufacturing but involves creation of value.

2.1. Need for service perspective

2.1.1. Brief introduction of Goods-Dominant Logic

Even prior to the Industrial Revolution, production of goods began to shift to factories and organization in firms took on a more structured and hierarchical form. The production and sales became managed and planned out by the firm. Here, product was still the main focus and “production” and “profit” encompassed the manufacture of surplus goods that could be exported (Smith, 1776). As communication was poor at best, digitization and modern technologies were not yet developed, it was not possible (or it was hard) to sell knowledge and/or skills. Therefore, it was believed that profit lied in the physical properties of products. In the spirit of Newtonian Mechanics, economy embraced product as an element with its properties and relationships to other

products. Economy was then proclaimed science and the emerging marketing truly embodied this G-D logic in the beginning of the 20th century.

Producer (firm) and consumer (customer) were clearly separated with no communication or interaction during the production process. This logic can also be called logic of separation (Greer et al., 2016) as separation was present even inside firms and companies. Because of the slow flow of information, bureaucratic and hierarchical structure of firm helped managing separated positions within the company. In each company, employees had clearly specified jobs which rarely overlapped in their descriptions. In the concept of G-D logic products are seen as units of output (Vargo and Lusch, 2004). These units can be tangible or intangible. What is important is that they are measurable and somehow possible to be standardized, inventoried and to be sold for a set price. For example, automobile company focuses on number of cars sold or bus transportation company focuses on passenger miles. These homogeneous units coupled with separated management of the company helped to achieve the most possible profit at the lowest possible cost, resulting in creation of quanta of the same goods.

G-D logic believed in control of employees and even the customers with company's best interests in mind (Greer et al., 2016).



figure 1 – Illustration of G-D logic marketing concept. (source: Vargo and Lusch (2013). *Service-Dominant Logic: Premises, Perspectives, Possibilities. Presented in 2013 Naples Forum on Service. 19-21 June, Ischia -Italy.*)

G-D logic kept the model simple. The roles of participants did not overlap in their descriptions and they had set procedures and processes. The most noticeable is the difference between firm and customer. But even management of the firm was divided. There was a person who analyzed the market and the firm’s place in the market, different person made long-term plans and yet another different person controlled the firm (Greer et al., 2016). With the technology as it was at the time, this separation kept the business as efficient and profitable as it was possible. Communication was poor at best, thus flow of information was slow. Therefore, frequent interaction with the customer would be in most cases waste of time and money. This, however, changed with the arrival of “Information Revolution”¹.

1 “The current information revolution, sometimes called “the third industrial revolution,” is based on rapid technological advances in computers and communications that in turn have led to dramatic decreases in the cost of creating, processing and transmitting, and searching for information.” (Nye, Jr., 2014, p.1)

2.1.2. Introducing new concept

With the development of modern technology, namely progress in communication and transportation, exchange of information between people became easy, frequent and fast. Networks now connect organizations and entities worldwide. Today, sellers realize that customers have access to anything anywhere and the competition is stronger than ever before. Therefore, they have to offer something more to the customers than the product only. The seller needs to ensure customer's loyalty and get new customers. They still need to sell their goods for a price profitable for them and affordable to the customer, but they need traits that distinguish them from their competition. This is now usually ensured by services rendered by the seller. For example simple electronics shop does not only sell computers, but offers maintenance and servicing, initial installation of any software or even an advice during purchase can win them a customer. Consumers nowadays are more open to a higher price with better additional services than cheap price and poor service and more than 50% customers are willing to leave from the seller after bad experience with customer service². Through all this, the customer is an active player and all depends on the interaction between them and the seller. Company's name is very easily reflected in feedback from customers and further affects company's reputation and prosperity. People nowadays do not buy goods because they are good for them but because of the things they will do for them. They buy brand and image, whose meaning can variate to every customer. They buy knowledge and/or specialized skills. Added service elements are now often far more greater and profitable than the goods themselves. (e.g. Apple sells and distributes

² <http://www.providesupport.com/blog/cost-poor-customer-service/>

products but their iTunes service is very profitable and great revenue generator.) It becomes obvious that here, the previous focus on creation of quanta of unified units of products can fail in its efficiency. On top of that, we now have something that is intangible, impossible to measure and standardize and completely apart from the previous concept where producer produces value, while consumer consumes or destroys it and then has to buy new value.

2.2. The contribution of Service-Dominant logic

Firstly, it is important to realize that “service” is not a new concept and has existed for hundreds of years. What is new, is the approach to economy and management through service. Also, in this thesis as well as in the works of Vargo and Lusch (2006 and 2008), “service” has different meaning than “services”. G-D logic uses “services” in plural form and in the meaning of added value to (usually) tangible products - units of outputs. S-D logic uses “service” in its singular form. In this concept, service is the application of specialized knowledge or skills for the benefit of another party or the entity itself (Vargo and Lush, 2004). S-D logic also takes into account relationships between service and goods and distinguishes two types of goods. Goods that have some added value as a service and goods that are intangible (e. g. specialized knowledge or skills). In both cases, service is the main part that brings value. As a simplification, service can be considered a process and product an appliance helping to achieve value through some process. The concept of S-D logic does not exclude services’ involvement in G-D logic. However, their importance was shadowed by products and they did not appear

to have enough of a competitive power or advantage. In S-D logic, all competition is played out through service provision (Lusch et al., 2007).

The transition from G-D logic to S-D logic cannot be sudden and developing countries are gradually trying to adapt this new concept. In the concept of G-D logic, at the beginning of the development of marketing, goods were manufactured and taken “to market” where they were sold to customers (*Figure 1*). After 1945, customer and market were researched so that goods would meet customers’ requirements and would find more secure place on the market. This marketing was looked upon in the concept of “market to” and is considered to be in something of a transitional concept from G-D logic to S-D logic (Vargo and Lusch, 2006a). Here, G-D logic was still present, but the customers were divided and targeted while goods were promoted to them. Contrary to this, S-D logic embraces *collaboration* with the customers and views them as *value co-creators* (Vargo and Lusch, 2004a). This marketing paradigm is also called as “market with”, because both, firm and the customers are actors in the whole marketing process. Customer and firm stand in the role of an *operant resource* – resource able to act upon other resource in order to create value (more on operant resources in chapter 2.4.1.). In order to achieve higher profit and mirror collaboration between the customer and the firm, the Marketing Mix has to adapt to this new paradigm as well. “Products” are the outcomes of processes that create value (intangible product – service or product as an appliance used in the process of creation of value). “Promotion” obtains mostly interaction with the customer, “place” is replaced by networks and processes and “price” is

proceeded by value proposition given by both sides of the trade (Lusch and Vargo, 2006).

S-D logic has since its first publication come through series of modification, but based on the work of Greer et al.,(2016) its integrative focus lies in four axioms, which serve as its basis. First says that “service is the application of resources (primarily knowledge and skills) for the benefit of another individual or organization (the beneficiary)” (Greer et al., 2016, p. 2). This implies that tangible goods are just means to obtain value through their usage and that service is also usage of competencies for the benefit of another party. No matter what the product is, customer buys it for the attributes it provides. A car does not have value unless someone is using it. To someone its brand can bring prestige, someone uses it to spend time with family on a vacation, someone just for transport. On the other hand, we have money, which represent rights to further service. Therefore, society today runs as a service-for-service exchange and it can be concluded that every business is service business and every economy is service economy (Vargo and Akaka, 2009).

Second axiom explains that the “customer is always a co-creator (joint or collaborating contributor) of value” (Greer et al., 2016, p. 2). This axiom is in stark contrast to G-D logic, where consumer was only seen as destroyer of value and customer and producer were clearly separated. Customer can interfere directly and benefit is gained through interaction with the customer. This allows rendered services to be customizable and much more targeted to different groups of customer. Customer can also create value indirectly, through usage of bought goods. In case of a car, the customer rides it – thus co-creates its value.

Customers are no longer just users, they are actors in the creation and consumption cycle. Meaning, value is dependent on the customer and dynamically changes over time.

Next axiom informs that “all economies and social actors (entities) are resource integrators”(Greer et al., 2016, p. 2). Resource is anything helpful in the process of gaining profit. S-D logic differs three types of resources: private, market and public. Private resource can be self, family or friends. Market includes trade or counter-trade and public resources can vary from communal to governmental. Final value is usually a product of different combinations of these resources integrated together. Entities exchanging services with each other and even within themselves create networks of integrated resources called *service ecosystems* (see Figure 2).

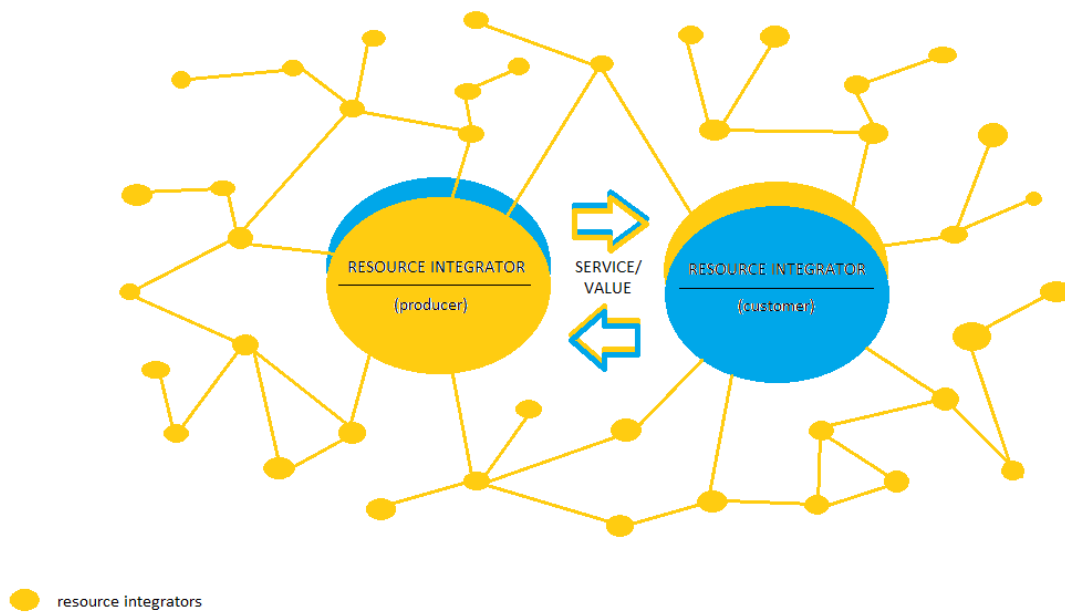


Figure 2 - S-D logic marketing concept (source: Vargo and Lusch (2013). *Service-Dominant Logic: Premises, Perspectives, Possibilities*. Presented in 2013 Naples Forum on Service. 19-21 June, Ischia -Italy.)

In the last axiom, “value is always uniquely and phenomenologically determined by the beneficiary”(Greer et al., 2016, p. 3). Based on previous axioms, it is obvious that value is always unique and there is infinite amount of potential outcomes. Because value has different meaning to everyone, varies based on input factors and the value determines recipient, producer (firm) makes only *value proposition*. Value proposition is an estimation of possible benefit (profit), the other entity can gain.

2.2.1. Overall service’s advantage

One of the many benefits of integrating service logic into common life and into companies’ and markets’ business strategies is the possibility and capability of competing through service.

S-D logic strives to point out the importance of collaborative work and in most cases collaboration is super-ordinate to competition. That does not mean, that competition is not important or is absent. One of the propositions for competing through service by Lusch et al. (2007) says, that better absorptive competency (the ability to absorb new know-how and information from other resource integrators on the market), adaptive competency (the ability to act upon newly acquired information and adjust) combined with collaborative competency (balanced combination of adaptive and absorptive competency) are used by companies to lower its expenses and increase its value proposition.

The proposition is further extended saying “collaborative competence is a primary determinant of firm’s acquiring the knowledge for firm’s competitive

advantage”(Lusch et al., 2009, p. 9) in the meaning of a relationship between collaboration and information technology. IT has large influence on collaboration and each entity within the cooperating service system (including the customer). It is the primary factor allowing communication and collaboration through networks of service systems and therefor enabling and helping with innovation.

2.3. The role of people, technologies and relationships in Service Ecosystems

People overestimate competition and underestimate cooperation whereas cooperation is the foundation of value co-creation. S-D logic aims to repent this thought by embracing broader service ecosystems compared to G-D logic. “A service ecosystem is relatively self-contained, self-adjusting system of resource-integrating entities that are connected by shared institutional logics and mutual value creation trough service exchange” (C. R. Greer et al. 2016, pg 3). Most simple understanding comes from imagining these systems as markets, where:

- “Relatively self-contained” means they are considerably independent on other ecosystems.
- They manage and balance themselves – supply and demand are constantly trying to reach equilibrium while each actor aims to utility maximization. That is why they are considered “self-adjusting”.
- Each resource integrator having a role in the market is part of and influences the ecosystem (resource integrators are anything that assists individuals while creating value).

- “Institutional logics (arrangements)” cover a set of rules determining competencies of resource integrators and allowed and prohibited actions within a system. They also furthermore describe processes which must be followed and handling of information.
- “Mutual value creation” is final product of exchange on the market or within the ecosystem. Each participant aims to the same goal – gain benefit. This benefit differs from actor to actor, even its value dynamically changes over time and thus does not have to be present for everyone at the same time. What is important is, that everyone strives to create value, everyone gains value and this can be obtained only through cooperation. This also implies, that value cannot be created by only one party. (It is not beneficiary to make cars for an automobile company without customers.)
- Last but not least, bases of all mentioned above lies in “service exchange”. Foundation is in interaction among active participants (resource integrators) while creating value. It can be argued that money are what stands behind the interaction, but as it was explained in chapter 2.2. one must see the service hidden behind the money. Partners do not offer just money to the firm, but assurance and possibilities. Beside money, partners lend their name to the firm, which helps with drawing in new customers. In return, company can promise a percentage of their profit, giving new possibilities to the partner. On top of that, good company’s name helps with reputation both ways and aids as much to the company as to the partner.

Basically all service ecosystems are markets and every market is a service ecosystem. Illustrated in *Figure 3*, service ecosystem can be comprised of

organization's employees, customers, partners, different organizations and even other ecosystems. As the ecosystems are not only created but are constantly developing and have rising number of resources, S-D logic differentiates three levels of structure based on system's complexity. At the bottom is "micro-level structure" (norms concerning relationships and interaction between specific company and customers, e.g. an individual interacting with others), which evolves into "meso-level structure". Meso-level structure is represented by brands, company's image and surrounding community and standards. This level develops further into "macro-level" structure which comprises global economy, consisting of cultures and societies lead by generalized languages, laws and cultural norms (e.g. cities, city departments, business, nations, etc.).

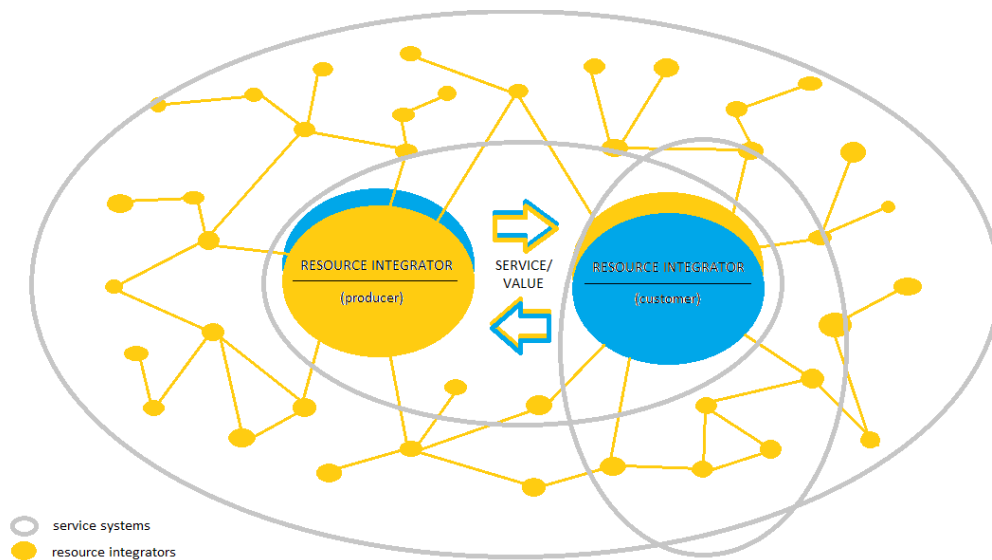


Figure 3 – Shows resource integrators (yellow ovals) interacting with each other and their partners, creating a service ecosystem (gray ovals). (source: Vargo and Lusch (2013). *Service-Dominant Logic: Premises, Perspectives, Possibilities*. Presented in 2013 Naples Forum on Service. 19-21 June, Ischia -Italy.)

Technology, and ICT in general, are the most quickly changing industries. They are much more receptive than the old established industries that have their own set of rules, norms, policies and procedures. It was rapid development of technology that affected changes in business practices. There are two perspectives in which technology can be seen. One shows technology as physical connectors between entities, thus creating links, networks and service systems. The interaction between resource integrator on the level as it is now known and used is namely thanks to modern technology. The second view, depicts technology as subject of interest in the meaning where technology represents goods on the market. As it was mentioned before (chapter 2.2.), S-D logic views goods as means to obtain service and it is no different with technology. Behind every new technology stand people with skills and knowledge. Thus selling technology is actually landing skills, knowledge and competencies to another party in order to help them simplify or automatize their processes, thus offering further services.

While progress in technology remarkably lowered costs, paradoxically, new costs in IT emerged. During the last 35 years, microprocessor computational ability has increased from 60,000 instructions per second to 10 billion at much lower cost. On the other hand the quanta of information available now are hard to filter and search through in order to be used effectively. Despite these added and unexpected costs, Lusch et al. (2007, p. 9) claims that “information technology, by facilitating the service-integration function, both within the firm and across the entire value-creation network including the customer has dramatic effect on the ability of all entities in the value-creation network to

collaborate". Said more simply, collaboration with IT leads to innovation and enables value-creation. This notion is driven by four factors (Lusch et al., 2007, p. 10):

- *Open Standards* – basis of open standards is shared information, consequentially collaboration and co-production. The foundation lies in shared rules and standards and as a result information is progressively symmetric and asymmetric (as more and more information is exchanged).
- *Specialization* – as resource integrators become more and more specialized in their domain, they need others specialized in other domains. Therefore, creating and enlarging markets with increased dependency among all participants, therefore supporting the need for collaboration.
- *Connectivity* – views technology as links connecting entities inside networks and networks to one another. It simplifies communication and makes exchange of information timely and capable of long distance transmissions.
- *Network ubiquity* – claims that everything is connected to everyone and enhances value of open standards, specialization and connectivity.

Most companies today face incidents inside separated departments, fixing local error and not focusing on the system as a whole. The goal of this proposition is, thus, in usage of technology in cooperative manner so to avoid errors and failures in offered services.

2.3.1. Operand Resources and Operant Resources

While creating goods, in the past and also in the present, it is important to have necessary resources. Thomas Malthus (1789) described resources as natural resources, from which people obtain assistance (land, flora, fauna, minerals, etc.). In these times, resources were tangible and, what is more important, exhaustible, which added to their price. Amount of resources an individual possessed showed their wealth and social standing. Over years, people learned resources are not just things but can also be intangible and comprise of people's actions, capabilities and knowledge. Much later, people started to realize, that each resource is worthless until people learn how to use it. That implies that "*resources are not, they become*". S-D logic later classifies "operand resources" (static, and mostly tangible, resources which are acted upon to gain usefulness) and "operant resources" (competences, able to productively act on other resources) (Vargo and Lusch, 2004). Any service ecosystem or market is driven by the relationship between operand and operant resources.

Services were not completely absent in G-D logic model but the attention was on products that could be inventoried and operand resources were considered primary (Lusch and Vargo, 2004). A firm had resources for production (operand resources) and machines that processed the resources (operant resources). Value of operant resources could rise only to the amount of value gained while processing original goods into outputs with relatively small expenses. The company's main source of income was in changing operand resources into units of output. Every actor on the market was considered resource operand and the market itself the operand. Customers were captured and acted upon, while

products were “promoted to” them. Because of that, marketing was represented at the time by “market to” model.

In comparison to G-D logic, S-D logic makes services super-ordinate to goods. Service is seen as usage of one’s competencies (skill and/or knowledge) for someone else’s profit. Operant resources are dynamic and mostly intangible – in the service S-D logic service definition, they are the skills and knowledge. Service is, therefore viewed as application of operant resources for the benefit of other entity. From another S-D logic definition, saying that customer is always co-creator of value, and final product (tangible or intangible) gains its value only if someone is using it, the beneficiary is also regarded as operant resource. Operant resources produce the effect, thus are considered primary resources. On the contrary, while trying to compete on the market through service, service itself is not thought of as primary source of sustainable competitive advantage, but neither are goods. Applied knowledge and skills are the main basis for competitive advantage for companies. Even if production of goods is limited or on the same level as their competition, companies can always do better by providing better or new services. Services are then focus of innovation and subject of continuous improvement. All this, of course, influences perspective and approach to exchange processes, customers and markets. Depending on the level of complexity, service ecosystem can also be preserved as operant resource, as it is affected by external resources (technical, physical, social, competitive or legal environments and more). Systems can draw resources from these factor and act upon them to create value or the systems themselves (Lusch et al., 2007).

G-D logic	S-D logic
Tangible goods	Intangible goods (information, knowledge and skills)
No, or almost none, interaction among participants of the trade	Interaction among participants is essential
Logic of <i>separation</i>	Focus lies in <i>collaboration</i> (Closely depending actors in a market, multitasking positions)
company's best interest is priority	Customers' interests are priority
Value is <i>created</i> (by the producer)	Value is <i>co-created</i> (by all engaged actors)
Money for goods exchange	Service for service exchange
Slow or none information flow	Aware citizens
Mostly tangible (natural) and exhaustible resources	Anything helpful can be resource
Operand resources	Operand resources and <i>Operant</i> resources

Table 1: Differences between G-D logic and S-D logic. Based on collected key factors of both concepts introduced through out the thesis.

2.4. From Service Science to Service-Dominant Logic

SS is short for Service Science Management Engineering and Design (SSMED). It is an interdisciplinary field studying service systems their types and categorization and aiming to accomplish continuous and organized service innovation. There are many disciplines that somehow touch the subject of service systems (law, economics, organization theory, marketing, operations research, industrial engineering, computer science, service oriented architecture, web services, multi-agent systems, game theory and mechanism design, management of information systems, cognitive science and anthropology). All

focus on certain aspects of service systems, and because of that there is need for common (shared) rules and vocabulary (Maglio and Spohrer, 2008).

SS is the study of service systems. (see chapter 2.3.) Every service system is benefiting from some resources. These resources can be: physical-with-rights (people and organizations), not-physical-with-no-rights (usually intangible, such as shared information), physical-with-no-rights (resources as properties - technology or shared information) and not-physical-with-rights (socially constructed entities, organizations or business) (Spohrer et al., 2008; Maglio and Spohrer 2008). Everything useful can be considered as a resource, e.g. rights are derived from laws and laws are a form of not-physical-with-no-rights resource. Also, every service system is considered to be a resource but not every resource can be service system entity.

SS helps with understanding relationships among resources, service systems and between resources and service systems. Because it views any economic entity as a collection of people, technology, organizations and information and believes that value can come only from collaboration of these resources, it brings much more human approach into management and highlights the need of better control and orchestration of any service system (company, organization, city, etc.). From service's perspective, the key aspect is interaction between entities and frequent interaction helps any company to avoid errors which leads to lower costs. Also a company where employees are engaged and customers have great customer service experience is enjoyable place to work at and supports motivation. It is overall right way of managing business and has impact in the long run of a company's accomplishments (reduced errors, engaged people, lower costs, enhanced revenue, higher quality and overall performance).

2.4.1 S-D logic's contribution to Service Science

There were several options considered that could serve as foundation for SS. Among them were: fundamental elements upon which G-D logic was based on, G-D logic and S-D logic. After emergence of S-D logic and contemplating all characteristics of these other concepts, S-D logic was found to be the best fit (Vargo and Akaka 2009; Maglio and Spohrer 2008; Lusch et al., 2008).

S-D logic uses the same vocabulary (terms) and explanation as is needed in SS. *Service* in the meaning of S-D logic is a process of using competencies benefiting another entity. According to work of Vargo and Akaka (2009) there is still a lot of inconsistencies and common misunderstandings concerning service science. These issues come from wrong understanding of S-D logic, mostly taking aspects of S-D logic from the view of G-D logic.

- *“Services” is often mistaken for “service”*. S-D logic uses singular form, meaning process (usage) of competencies on behalf of someone else. Service can be carried out directly or through someone else, but services (in plural form) suggests, that services are type of goods. (more in chapter 2.2.)
- *There is no new service economy*. With the trend, that every exchange is service-for-service exchange, there is no need for service revolution in S-D logic concept, only “service realization”.
- *Co-creation of value* – even tangible goods do not have any actual value unless they are used, thus on creation of value partakes in the producer and the customer both (in S-D logic, they are both in a role of a resource integrator – see chapter 2.2.).

Seeing clearly these main aspects helps with understanding of SS and S-D logic can be therefor considered as a foundation for SS (Vargo et al., 2010; Vargo and Akaka, 2009; Spohrer et al. 2008).

2.5. Viable System Approach

While S-D logic and SS are looking at things from the service theory point of view, Viable System Approach (VSA) is a system theory and rooted in system thinking (Barile and Polese, 2010). "VSA focuses on analysis of relationships among socio-economic entities in search of viable interacting conditions." (Barile and Polese, 2010, p. 27) VSA is based on a Viable System Model (VSM) is "a tool used for understanding systems and organizations, redesigning them (where appropriate) and supporting the management of change."(Espejo and Gill, 2011, p. 1). Its main concern is to bring new model for flatter, network-type organizations (in comparison to previously used hierarchical structure) with wide data broadcast to reach all active workers in real time. It is more about communication between workers than reporting to others in order to find synergy.

Organizations are less complex then their environment and teams within the organization (e.g. management team) is, unsurprisingly, less complex then the organization, but the organization itself cannot see its own complexity from its point of view, as well as, the management team cannot see theirs. VSM can then be seen as a framework for building flexible and adaptable organizations, which are able to balance internal and external perspectives.

Another important concept that VSM brings is recurivity and is based on the fact that all systems are comprised of sub-systems and the sub-systems are comprised of other sub-systems. They are, to some extent, autonomic, able to adapt to change in their environment and deal with their own complexity.

2.5.1. Viable Service Systems

VSA can bring a lot to the understanding of smart service systems as it has roots in complexity theory and system theory. As VSA searches for ways to balance and satisfy the needs of both supra-system and sub-system, smart systems investigate how to use resources in an intelligent ways (mainly with the help of technology). They react to needs and requests from their environment.

“Viable systems are systems in which the sub-systems share a common goal and the system, as a whole, has a determined finality.” (Barile and Polese 2010, pg. 34). Smart service systems aim for long-lasting performance and satisfaction, while they have to deal with high complexity. As mentioned before, they can benefit from VSA by using IT models and tools providing complexity management. Because, the viable service system aims toward a certain goal, there is a need for a governance directing the system towards the goal, while considering all the relationships between its actors and transforming them into dynamic interactions. Each node supports the whole system and contributes to its competitiveness. VSS should be centered with a directing and/or managing body leading the system to shared objectives. By continuously improving service management and strategic planning, the systems are able to balance the development, control systems, innovation and planning systems among all participants, thus ensuring ensuring the competitiveness and performance of

the system. VSS are therefor mainly characterized by strong competitive and value creation capacity. Because of this, the system needs to have knowledge about all its entities, which are: internal factors (technology, know-how, skills, socio-economic communities, etc.), opportunities and threats.

The decision making process, operational flexibility and independence of the system can be sometimes limited by the composition of its internal and external needs. What is more important, it makes the balancing process more complex.

3. Smart Cities

In the last decades, people have been moving from country to cities. This leads to higher population density and cities' rapid growth and consequentially leads to series of complications in city management (such as transport, pollution, waste management, etc.). It has become obvious that management of a such large ecosystem cannot be in hands of just several people, but has to be a combined effort. On the other hand it is not possible to listen and comply to all requests. And academics, researchers and engineers are currently looking for ways to improve management of large conglomerations of people and overall living situation in cities. Several approaches have been proposed, combining service and system theory with technology.

Based on description of a service ecosystem (see chapter 2.3.), it is safe to proclaim that a city is just a type of a service system. Therefor smart city is smart service ecosystem. Transformation of a city into a smart city is not easy task, and to this day is not fully implemented. However, there are theories, concepts, frameworks and plans for obtaining this goal in, considerably, near future. These theories and concepts often do not have common denominator and have different points of view on a what a smart city should be like. This chapter focuses on introduction and explanation of the concept of a smart city from several perspectives.

3.1. Smart Service Systems

As explained in previous chapters, S-D logic introduces the term “Service Systems”, which later SS builds upon. Taking both into consideration, Service Systems are seen as networks of resources (resource integrators), where the basis of exchange is a service. Nowadays, service provision is knowledge-intensive and highly customized, which demands customer interaction and active participation in the value creation process. Also, both S-D logic and SS support collaboration and competition. Not only customers interaction, but active engagement of every entity is necessary in order to effective functioning of a service system (firm, suppliers, partners, customers, stakeholders, etc.). Value creation inside a service system is driven by interaction of all its participants and through improving their relationships, service systems can provide competitive advantage (Barile and Polese, 2010). This is viewed as essential, because collaboration and competition are what leads to service innovation – one of main goals of service science and overall service theory (Spohrer and Maglio, 2006).

The next step to keep up with the competition, and more importantly, the overall modernization of all aspects of people’s lives and support service innovation is to make service systems smart. “Smart service systems may be intended as service systems designed for a wise and interacting management of their assets and goals, capable of self-reconfiguration (or at least an easy inducted re-configuration) in order to perform enduring behavior capable of satisfying all the involved participants in time.” (Barile and Polese, 2010, p. 31). As service systems are focused on interaction, smart service systems deal with

this via e.g.: *Intelligent Utility and Network Management, Consumer Driven Supply Chain, Intelligent Transportation, Intelligent Oilfields.*

As service improvement goes hand in hand with advances in technology, noticeable impact on service provision and management has ICT. Here, ICT is viewed as an enabler, which facilitates reconfiguration and intelligent behavior with systematic service innovation as the main focus. Service systems can be divided into front and back stage parts, where both parts need to have smart aspects. At the front stage (provider-customer interactions), the systems need monitoring and analysis to be capable of self-adjustment and reconfiguration. At the back stage (concerned about operational efficiency) needs to use intelligent tools and models – nowadays, thanks to the progress in technology, represented by “smart systems”. A lot of this research is done by IBM, and is described in the concept of “smarter planet”³. This project refers to an interconnected globe and believes, that “information and communication technologies have to address the problems of the world today in a smarter and more reactive way” (Barile and Polese 2010, pg. 31). Emphasis is on data measurement, development of networks, enhanced learning and responsive adaptation process, in order to improve quality of life in a sustainable way.

As mentioned above, IT (and/or ICT) plays major role in smart service systems. Such IT-based systems can be characterized as a system with intelligent management of its resources (assets) and objectives while being capable of self-adjustment to sustain enough capacity to satisfy all participants (e.g. Intelligent Transportation) (Barile and Polese 2010).

³ <http://www.ibm.com/smarterplanet/us/en/>

Beside the fact, that interaction inside a service ecosystem is not only dyadic but is between several actors (resource integrators) at a time, a resource integrator can be a smaller sub-system (micro-level structure), as well as resources can communicate with other resources outside of the system and therefore create together bigger supra-system (macro-level structure). One can imagine any services system as an organization of entities (firm, market, city, etc.). All this points to system with high complexity. One of the approaches to complexity management in smart service systems is through Viable System Approach (see chapter ___).

3.2. Design and planning of a Smart City

The concept of smart city is still new and differs in its definitions (Dameri, 2013; Chourabi et al., 2012; Dameri and Cocchia, 2013; Washburn and Sindhu, 2010). Even though the definitions differ, there are several common trades, such as:

- Responsive provision of services
- Resource allocation and long-term planning
- Sustainability
- Changes and improvements in transportation
- Usage of information and technology
- Consideration towards environment
- Improved over all quality of life

These are not stand-alone aspects and usually one affects another. Services are provided in consideration towards citizens and their needs and at the same time citizens are aware of changes in their environment. Thus resources are not wasted when there is no need and, on the other hand, are not insufficient when not necessary. This helps with prudent allocation of resources, creating long-term plans and ensuring city's sustainability. In more inhabited cities, transportation is managed and changed according to current needs. All of the above can be done with help of modern technology. Obtaining live real-world data from sensors and social networks, consequentially using this data (from sensors monitoring parts of infrastructure like roads, bridges, tunnels, rails, important buildings, energy, waste, etc.) provides better information on resource planning and allocation, therefor supports improvement in economy, mobility, governance, etc. Intelligent management of waste and energy and natural resources secures clean and livable environment, reduces pollution and everything combined provides better quality of life.

As a new concept proposed for cities innovation, Chourabi et al. (2012) proposed 8 key features, by which a city can be considered as smart. These concepts are not supposed to serve as a model for rating cities and determining the smartest one. Rather to help projects attempting integration of smart city aspects and serve as some kind of guide through many challenges such a city faces. The factors are:

1. *Management and organization* – management is not widely covered subject, but because cities' initiatives are mostly driven by government it can be compared to e-government⁴.

4 E-Government or Electronic Government “refers to the simplification and the transaction of business processes by the use of information and communication technology (ICT) in the

2. *Technology* – as mentioned above, a smart city relies heavily on the technology, namely ICT and smart computing⁵. Smart computing enables cities to use and analyze real-time data in order to help other users making intelligent choices. Digital cities is a different term, but because of the use of ICT in smart cities, it is sometimes considered to have synonymous meaning (Dameri and Cocchia, 2013)(more on digital cities in chapter 3.5.). Concerning smart cities technologies and platform, the term Internet of Things (IoT)⁶, is also often mentioned. (Dameri and Cocchia, 2013; Mitchell et al., 2013; Soto et al. 2015).
3. *Governance* – is important for management of projects and initiatives. Governance implements processes, rules and standards for exchange of information but the constituents. As well as in other aspects, ICT has noticeable impact here, too. ICT-based governance is called “smart governance” and can be summarized as a collection of policies, practices, social norms, resources, technology, people and information participating in governing activities. According to Bolívar (2015) development of effective and “smart” government forgoes further development of a smart city. He came with three major principles for initiation of governance for smart cities, saying that plans should be: achievable,

context of governance and public administration.”

<http://www.egov-conference.org/glossary/electronic-government>

- 5 Smart computing is “a new generation of integrated hardware, software, and network technologies that provide IT systems with real-time awareness of the real world and advanced analytics to help people make more intelligent decisions about alternatives and actions that will optimize business processes and business balance sheet results.” (Washburn and Sindhu, 2010, p. 2)
- 6 IoT is a network of interconnected physical objects and devices and serves as an enabler for smart cities (Mitchell et al, 2013; Soto et al., 2015).

financially doable and based on citizens and local business so it would not collide with city's plans and challenges.

4. *Policy* – it is important to realize all the factors affecting changes in the system and one of them is policy context. Regulatory and policy restrictions can often prevent technological initiatives. There are two types of political components affecting smooth implementation of proposed changes. On one hand there are various political elements (such as city council, city government and city major) and on the other external political pressures (such as politics, agendas). It is also recommended to take into consideration other regulations, norms, actions and accepted behavior.
5. *People and communities* – as can be seen in previous factors, people play major role in the smart city concept. One of objectives of a smart city is to have informed (aware) citizens – actively participating in the governance and management processes. Another important fact is, to see people not as individuals but groups and communities. This furthermore opens another question on balancing people's needs and systems' requirements. Up to this day, the people point of view is often neglected in favor of technological and political issues.
6. *Economy* – in the thought of S-D logic and SS, the main objective is economic competitiveness. High economic competitiveness is an indicator of city's growth as well as an indicator of present smart city aspects. With the connection to smart cities, term "smart industry" is often used, which implies usage of ICT in industry fields (Lombardi et. al., 2012). Another usage of ICT is seen in series of studies by IBM, where

they identify smart business systems as usage of ICT by firms in development of new smart business processes and strategies and smart technology sectors (Chourabi et al, 2012).

7. *Infrastructure* – there are two types of infrastructure in smart cities. One is *physical* (roads, streets, bridges, buildings, broadband, railways, etc.) and the other one is *virtual* with elements of ICT as wireless infrastructure (fibre optic channels, Wi-Fi network, hotspots, etc.) and software (service-oriented information systems)(Dameri and Cocchia, 2013). The ICT infrastructure is a one of the main attributes that distinguishes smart city from a typical city and its availability and performance are immensely important (Chourabi et.al, 2012).
8. *Natural Environment* – more healthy environment can be considered one of the long-term goals of a smart city. Paradoxically it is taken care of by complying to other, previously mentioned, initiatives. With the use of technology it is possible to optimize energy consumption, smartly manage waste disposal, prudently plan out resource consumption and ensure sustainability. All this serves to spare the environment and consequentially to increase quality of life.

As mentioned before, these factors listed above are not supposed to serve for ranking smart cities. They are merely elements and challenges, which are to be considered while working and proposing smart city integration projects. Since they are highly dependent on each other and usually have two way impact (are affecting something and are affected by something) it is hard to determine which one has more importance or could be left out. More often, is a problem of prerequisites rather than importance.

3.3. The role of ICT

Information has become one of the major economic factors (with materials, work and capital), meaning that “information has to be available to the right group of people, at the right place, at the right time, in the right quantity, in the required structures and with low costs” (Teufel, p.1, 2001). From the description of a smart city above (chapter 3.2.) it is visible that technology plays important role in building, maintaining and operating smart cities. Nam and Pardo (2011) consider it one of the core components of a smart city (along with people and institution). Infrastructure and enabling technologies are often viewed as a backbone to a smart city and one of the most important technologies supporting smart cities is ICT (Dameri, 2013). ICT can be seen as an enabler of services essential for smart city and its citizens (Kowalkowski et al, 2013; Nam and Pardo, 2011), because a city can be capable of reacting to given situation it can be all in vain if the reaction is not provided in time. ICT can be viewed as ideal tool for sharing accurate information and in real-time.

Several studies focus on a determining key factors of ICTs affecting and enabling smart city services. Following ones are chosen from the work of Escher Group (2014), supported by several different ones. Based on their theory, there are five essential aspects of ICT that have impact on smart cities.

1. *Deployment of Broadband Networks* – Broadband is part of a physical infrastructure (Dameri and Cocchia, 2013) and can be build upon cable, optical fiber and wireless networks. For everything to run smoothly, it is important that the network is available to all citizens in every part of the city. Fiber-optic networks connect critical parts of the city and facilitate

sensors (mentioned in previous chapter 3.4.) and open up access to electronic public services. On the other hand, “mobile, virtual and ubiquitous technologies gain importance” (Nam and Pardo, 2011, p. 286) and wireless broadband helps out to keep the city mobile while the network is still accessible. It increases connectivity, and therefore sharing of information, through smartphones, smart devices and IoT.

2. *Use of Smart Devices and Agents* – To benefit from the network a smart city plan has to contain embedded systems, smart devices, sensors and actuators. These process information for the city administration and operation (e.g. real-time data management and alerting on change in environment). (Combined with networks, one can imagine this like a nervous system where network connections are the nerves and devices are the nerve endings.) Schaffers et al. (2012, p. 4) support this by arguing that “working of a city is made by measurable by sensors, smart devices and meters”.
3. *Developing Smart Urban Places* – By connecting the embedded systems, smart devices and sensors across the city *smart places* are created. They employ ICT to create more efficient and sustainable city or its part and rendering services like electric car charge points, Smart Grids⁷, WiFi hotspots and information kiosks, etc. Smart Urban Places are areas of innovation (motivation for creation of applications for data collection and processing, web-based collaboration, etc.) and environmental and

⁷ According to US Department of Energy, Smart Grids are networks for power distribution in an intelligent way. They use ICTs like smart monitoring, measuring and communicating systems and are capable of storing electric power for later use ensuring more efficiency, lower costs for the consumer and are more considerate towards the environment. More can be found at <https://energy.gov/oe/services/technology-development/smart-grid>

economic benefits. Smart Places also face several challenges. Namely between private and public sectors or between ICT and energy industry. This is mainly common problem even in every day life, because proprietary systems cannot be combined to operate together.

4. *Developing Web-based Applications and e-Services* – To turn possibilities acquired from data to services and solutions there is a need for available ICT infrastructure as was discussed above. Nowadays, this is facilitated by Living Lab⁸ networks and other participatory models (Schaffers, 2012; Vanobberghen, 2013), which can help with testing of new applications and e-services (e.g. services for local economy development, tourism, entertainment, transport services, education services, health services, etc.) (Escher Group, 2014). Because services can have among them building management services, energy or transport services, it becomes necessary to use smart meters, sensors or monitoring devices. ICT services are innovative and can change the way people work (remote working, e-commerce services) and improve quality of life (improving health with electronic records, remote assistance, medical surveillance, etc or security services by location aware enhanced security systems, estimation and risk prevention systems, etc).

5. *Opening up Government Data* – There are two movements running opening up data held by public. One is *Right to Information* (focusing on

8 From the description found on Living Labs' web page, they are "defined as user-centred, open innovation ecosystems based on a systematic user co-creation approach integrating research and innovation processes in real life communities and settings. In practice, Living Labs place the citizen at the centre of innovation, and have thus shown the ability to better mould the opportunities offered by new ICT concepts and solutions to the specific needs and aspirations of local contexts, cultures, and creativity potentials."
<http://openlivinglabs.eu/aboutus>

right to access to information) and the second one is *Open Government data (OGD)*. OGD has several benefits, such as better participation from citizens and consequentially more social inclusive service delivery. Both movements claim to improve economy and support transparency, which brings another advantages for smart city, such as: motivating citizens to be more engaged, improving government accountability, transparency, responsiveness and democratic control thus enhancing government's effectiveness and efficiency and rising new generation of aware citizens. For any city, that wants to become smart, it is crucial to understand OGD initiatives and development of OGD portals (Escher Group, 2014).

Through all the factors it is important, that the network is accessible to everyone and services are available to all stakeholders for whom their usage is intended. It is also important to ensure stability and reliability of the network. And, again, as it was with the aspects of smart city, these factors are highly dependent on each other and can be hardly designed as a stand-alone features of ICTs.

3.4. Beyond the Digital City

Considering previous chapter (3.5.) it may seem that technology is the main actor in smart city. While it is true that well functioning infrastructure is essential for a smart city, it is not what makes a city smart (Nam and Pardo, 2011; Dameri, 2013). This misleading fact also happens to be the reason why the terms *Digital City* and *Smart City* are often used as synonyms (Dameri and Cocchia, 2013).

The concept of a Digital City was brought to attention in the second half of the 1990s by the spread of commercial use of the Internet (Dameri and Cocchia,

2013; Schaffers et al., 2012). At first, the basis comprised of virtual environment and ICT (mainly static web sites offering information about certain urban areas with news, events, maps, commerce, etc.) and before the concept had been named Digital City was represented by e-Government projects and policies. Digital Cities have been evolving with ICT and are completely in virtual space, where people share information through Internet, IoT, cloud and ubiquitous computing and Web 2.0, etc. People are considered *enablers* (stimulating the city) or *recipients* (using offered e-services), where e-government and e-governance take care of the relationships between citizens (Dameri and Cocchia, 2013).

Concept of Smart Cities comes into attention years later (around 2010) helped by popularization of wireless networks and embedded systems (Schaffers et al., 2012). Smart Cities looks at the use of ICT with optimizing and improving the urban space in mind.

4. Management of a Smart City from the service perspective

Based on previous research, this thesis attempts to bring different perspective on the approach to management of a Smart City. For this purpose, chapter 3.2. contains overview of key concepts of a Smart city and description of proposed framework for a Smart City by Chourabi et al. (2012) supported by ideas from other sources (Dameri and Cocchia, 2013; Mitchell et al.,2013; Bolívar, 2015). Now, this chapter focuses on applying service perspective to the elements of ICT, while keeping in mind the key aspects of Smart City, and tries to prove that this approach is beneficiary for Smart City management.

Following is brief recapitulation of S-D logic integration axioms (Greer et al., 2016) described in chapter 2.2.:

1. Service is looked at as using resources for the benefit of another party.
2. Value is always co-created by the customer
3. Anything can be resource integrator
4. Value is always unique and different depending on the beneficiary

It was already covered in chapters 2.3. and 3.1. that a city is just a type of a service system. By looking at a Smart City as a smart service ecosystem, it becomes more visible that it is build upon services. It was also mentioned (in chapter 2.3.) that from the service perspective, there are two ways of looking at technology.

Sustainability is one of the main concerns of Smart Cities (Dameri 2013; Chourabi, 2012; Dameri and Cochia, 2013; etc.). While the cities want to be self-sufficient and independent, the goal is not to isolate the city rather support its inner economy. Whether talking about service systems or a city, while the communication and exchange of services is going on on the inside, abiding the axioms of S-D logic can very easily ensure sustainability of a service system.

Once realizing, that *application of resources for the benefit of another entity renders services* it is not hard to see every exchange inside a service system as a service-for-service exchange. No matter if it is between persons, person and device or devices themselves. The usage of information kiosk, obviously, renders services to the person using them at the moment. By its usage, however, the city management can collect useful information on most searched places, most populated places, most popular trends or even gender and age of the user. This, in return, helps with designing plans for infrastructure, commercial and recreational purposes, etc.

That *customer is always co-creator of value* implies the importance of communication and collaboration, which leads to innovation. Since the value comes from a service, it also implies that services are customized based on requirements. The fact that requirements change from user to user, the services need to be able to react on change. The value co-creation can have another, not so popularly discussed effect of self-accomplishment. This can serve as a great motivator for more interaction among entities inside the service system rather than outsourcing outside the system, thus enhancing its sustainability.

Knowing that *anything can be a resource integrator* changes people's point of view of resources altogether. This fact provides three realizations:

1. Importance of skills, knowledge, information and capabilities – that people are now able to sell or land these services motivates them in search for new ways on how to utilize these attributes and thus supports innovation.
2. Importance of natural (exhaustible) resources – the problem with disappearing natural resources is not new, here it is more about finding other alternative resources. (E.g. development of new agar-based fuel. See more in a National Geographic Channel's documentary on Smart Cities: San Diego⁹)
3. Combining knowledge and skills with natural resources – Using capabilities (mostly subjects of ICT) in order to preserve and manage (exhaustible) resources (water, minerals, fossil fuels, etc.). Here belongs: Smart Grid, Smart Water Management¹⁰, etc.

That *value is always determined by the beneficiary* means that each participant approaches the exchange with their own goals, but because of communication and cooperation they are able to reach their separate aims.

Following are examples (Table 2) of above-mentioned axioms applied to a subject of ICT and their implications for use in a Smart City.

9 National Geographic Channel's World's Smart Cities: San Diego
<https://www.youtube.com/watch?v=LAjznAJe5uQ&t=4s>

10 Smart Water Management involves distribution of water through the city based on monitoring and analysis and linked with other crucial systems of a city through networks.
<http://www.waterworld.com/articles/print/volume-29/issue-12/water-utility-management/smart-water-a-key-building-block-of-the-smart-city-of-the-future.html>

ICT	S-D logic paradigms	Implication for a Smart City
Broadband	Broadband (generally any networks) are viewed as connectors enabling and simplifying communication between entities.	Networks create basis for infrastructure and support quick responsiveness of other systems.
Monitoring (sensors, smart meters, etc.)	<ul style="list-style-type: none"> - Co-creation of value - Different value for each beneficiary 	<ul style="list-style-type: none"> - The monitoring would amount to nothing if it was not used by other actors. - Also, the monitoring has different meaning for common people on the street – medical assistance or security interference. (value is created unintentionally/indirectly) For the worker in healthcare or security company it simplifies their job by providing quicker and more accurate information. (value is created directly)

ICT	S-D logic paradigms	Implication for a Smart City
Web-based applications and e-services	<ul style="list-style-type: none"> - Service-for-service exchange - Different value for each beneficiary 	<ul style="list-style-type: none"> - The possibility to file a tax return online supports e-government services - Also has different meaning for the accountant (more time, less stressful working environment) and the applicant (less time, less complicated, comfortable)
Building management services (sensors, smart meters, smart devices, etc.)	<ul style="list-style-type: none"> - Service-for-service exchange - Different value for each beneficiary + anything can be resource integrator 	<p>Usage of sensors renders different kind of resources (from the outer temperature, to the frequency of people going in/out of the building)</p> <p>consequential usage of these resources helps with management of natural resources</p>

Table 2: Applications of S-D logic on given subjects of ICT and results towards a Smart city concepts

4.1. Proposing Smart Operant Resources

While integrating S-D logic to a service system it is important to know what are the operand resources and who or what are operant resources. In smart service systems, these operant resources need to be capable of making informed and intelligent decisions. Thus arises demand for *smart* operant resources. These resources can be people or physical objects, e.g. smart devices. Smart device operating traffic management reacts on data obtained from monitoring, and has the capability to timely react on changes in an intelligent way. Thus, can be considered a smart operant resource acting upon operand resources. For a smart service system to be cost-effective, there needs to be a combination of operand resources and smart operant resources. The sensors monitoring traffic do not need any additional computing force beside monitoring roads and the ability to send information over the network, while the “hard work” is taken care of by the smart operant device at the end. This brings up a question of what exactly needs to be smart in a smart service system?

Following are, again, summarized key aspects of Smart Cities:

- responsive provision of services
- resource allocation and long-term planning
- sustainability
- reactive traffic management
- usage of ICT
- healthier environment

- improved quality of life

This thesis proposes that smart operand resources should be center of focus in designing a Smart City as it is present in each aspect, whether in form of a human or technology. Smart service systems aim for the citizens to be aware and informed (Chourabi et al., 2012) meaning that even though people were considered to be operand resources before, in the concept of Smart City they could stand in a position of smart operand resources.

Responsive provision of services: Can be represented by a person (service provider) or, for example, with help of smart computing, based on analysis of the market, survey, customers' feedback, monitoring, etc. In both cases, smart operand resource is what makes the service provision responsive, by using provided operand resources.

Resource allocation and long-term planning: Concerning this topic, operand resources (mostly natural resources) have gained higher importance than was given to them in S-D logic (Vargo and Lusch, 2004). Their distribution and allocation is controlled by a smart service operand (e.g. smart grid).

Sustainability: Service systems strive to be independent and sustainable (Dameri 2013; Chourabi, 2012; Dameri and Cochia, 2013; etc.). Smart operand resources are usually in a role a managing system balancing the supply and demand and need to be able to react in case the sides are not equal.

Reactive traffic management: Smart operand resources obtain information from sensors (classic operand resources) monitoring roads, crossroads, bridges, etc. They need to be capable to analyze the data (operand resources) in timely manner and react upon changes.

Usage of ICT: It was already covered in what manners ICTs can represent smart operant resources (smart devices, web sites, web-based and/or mobile applications, etc.). In case of a person as well as in case of a technology they act upon operand resources (e.g. data from monitoring)

Healthier environment: environment improvement is a long-term goal of Smart Cities and can be hardly shown on one example as it is affected by a combination of several other aspects. In any case, the use of smart operant resources now ensures better environment in the future as they use methods of analysis and prediction to choose ideal approach to given issue.

Improved quality of live: Smart operant resources are aware of possibilities, risks and take into account several conditions while making decision. This can prove essential in the strategy to improve overall quality of life. It is an issue similar to environment, in its long-term presentation.

Additionally, it may seem that smart operant resources can also represent the role of an operand resources. One could argue, that in that case, the operand resource would also be smart. But for the beneficiary does not have to be the offered resource complicated. Going back to the example with traffic management system, the system obtains information about congestion, time delay on the flow of cars. By checking information from surrounding systems and analyzing given data (operand resources) it deduces that an accident happened and it needs to be reported to the medical assistance and authorities. This is not a trivial task, therefor the need for smart operant resource. By handing over the information another operant resources (medical assistant) is given data but from their point of view the data is the data is the actual resource operand. Meaning, smart operant resources are always just that but their output

can serve as operand resource for others. It is not to be assumed that smart operand resources shove other actors in smart service systems and other aspects of Smart Cities into the background or that are more important. In the spirit of collaboration smart operand resource alone would be for nothing, since without another engaged entity there is no value co-creation, and the resource alone does not bring any value. Understanding the importance of smart operand resources helps with strategy and long-term planning while designing smart service system and prioritizing tasks according to dependence of resources on each other.

Usually first are needed operand resources gained or processed by the help of operand resources and then handed over to smart operand resources for further processing and analysis. While building digital infrastructure to cover traffic on a road, besides networks (seen as an enabler) first are integrated sensors monitoring the roads (operand resources). These send data (operand resources) to systems build upon smart computing (smart operand resources). The same pattern can be seen in integrating waste management of a city as it also uses sensors and smart computing and almost every other feature of a smart city.

Smart operand resources do not only affect the feature making the city smart are often the reason the feature makes the city smart. The basis lies in distinguishing between smart operand resources, (classic) operand resources and operand resources. While designing plans for a Smart City integration balancing resources is beneficial to the costs and efforts given to the planning. When managing a Smart City, paying proper attention to smart operand resources helps with allocation of operand resources.

5. Conclusion

In this thesis shows a summary of old concept of thinking - G-D logic and explains why there is a need for a new perspective. G-D is proven to be ineffective in today's world, especially on the market and is being slowly replaced by service thinking. This thesis also describes how vast is the coverage of topics by the S-D logic and SS. From simple service exchange among two participants, through zooming in to a fact that an exchange of services is usually affected by several other stakeholders besides the main participants creating large markets and complex service systems. Through the research, service perspective has shown how it can be benefiting for an individual, a company, markets or larger service systems like cities. It also introduced the concept of Smart Cities as a future possibility of improving quality of life in urban districts. The focus lied in usage of ICT, which is in Smart Cities used as a mean to obtaining goals.

Main objective of the thesis was to apply paradigms of service logic to subjects of ICT and show how they can add to the knowledge of smart cities and benefit their management. By considering the axioms for integration of S-D logic (Greer et al., 2016) and applying them to certain ICTs it is demonstrated that by following paradigms of S-D logic it is possible to obtain goals of a Smart City just through a slightly different approach. After looking back at this approach and seeing the system as a whole the need for collaboration becomes more visible. People and devices would need to cooperate in a new ways and take on jobs requiring different skills which in return provokes innovation and education. Smart Cities were compared to smart service systems and by applying S-D logic standards, emergence of a new concept cam into attention –

smart operant resources. Smart operant resources are thoroughly described in the last chapter and their benefits and main traits are outlined as well. By understanding their position in a Smart City, planners can design strategy with prioritized smart operant resources. This can prove effective towards the founding of such a project and also, for preventing risks of bottleneck and redundancy problems in a future functioning city.

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