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Fuzzy design logic for value creation in the digital society

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Abstract

Today ICT has been got inseparable sector of human life and emergence of new forms of communication, large networks of information and communication have become a new social spaces, unlimited spaces that affect relations, and social skills of people. Now digitization influences all aspects of our lives, individuals and communities. Digitization may make our lives better or worse.However, the digitization also has the potential to be involved in community development in the future. Now people are communicating properly with technology, machines, devices, networks and operating systems that deal with them daily. Digital society makes us able to connect anything to our mind. In this article we discuss the importance of understanding the impact of information technology and communications. And the main question of the article is how to create value in the digital society.

Keywords: digital society, value creation, design thinking

1. Introduction

The concept of smart city, smart environment, and smart house has been recently introduced in our society. One of several definitions of smart cities is "use of intelligent computing technologies in order to make municipal services more intelligent, more interconnected and more efficient- that include management, education, health, public safety, real estate, transportation and facilities." The use of new technologies in business models and substructure of sectors is driven by the Internet and globalization.

In the past decade the increasing use of technology in all sectors of society has put pressure on cities both economically and politically, to integrate the latest and best technology in their city development. Cities have gained more control over their development and progress in the 21st century, faced with an extensive range of challenges and threats. Whereas cities play the main role of economic and social aspects all over the world, it can be understood that why cities are key elements for the future.

Economic and social aspects including turbulent business environment, lack of resources, globalization and excessive competition, put substantial competitive pressures on many businesses. Rapid professional technology changes and increasing of global access to unlimited geographic markets allow consumers to have unlimited choices in their intended product selection. But to understand and control the products and services in response to network and rapid globalization has become hard and hard. Hence value creation for customers has become

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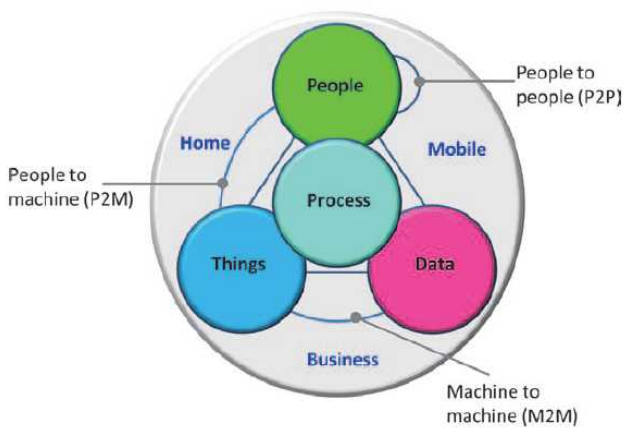
vital for any organization to have sustainable business in the future.

Analysts have predicted that internet products and new services of intelligent community will grow exponentially in the coming years. Digital society areas have caused to increase competitiveness in European countries and made the daily life easier. Also it will be led better service, huge savings and more careful use of resources. For example, relationships between objects which are one of the substructure conditions of a digital society, help patients to receive continuous cares, and companies to provide their resources best and make their work easier.

Today, it can clearly state that the digital society has dominated in many different areas and it's going to be recognized. Researchers and many organizations are trying to examine the influence of ICT growth on human societies. Also they're trying to propel communities into making intelligent by essential tools and substructure and to take advantage of all the capabilities in this field.

In digital society, Internet is not only a network of computers, but as it shown in Figure 1 it has evolved into a network of any type and size devices such as vehicles, smart phones, household appliances, toys, cameras, medical instruments and industrial systems all connected to the global network, communicating and sharing information all the time.

Figure1. Internet of any things in digital society



Until recently digital society had different meanings at different levels of abstraction through the value chain. The digital society has been a "global concept" and requires a common definition. Considering the wide background and required technologies, such as sensing device, communication subsystem, data aggregation and pre-processing to create object sample and finally service presentation and provision, generating an unambiguous definition of the "digital society" is important.

The value of an artifact is not determined solely by its functionality. This problem has become more important in the 21st century in light of rapid globalization of markets and explosive networking of information. Market globalization has brought changes in industrial structures and has promoted international specialization of labor. Moreover, it intensifies severe price competition and widens economic disparity among nations. The word "commoditization" means transformation of differential goods or services into commodities (Davenport, 2005). In other words, a certain product with good functionality loses its particularity and becomes an ordinary product because other products have identical functionality (perhaps at a lower price). Therefore, rather than

considering mere functionality, producers must infer what would increase the value of their products to the likely users. Many manufacturing industries are rapidly shifting their attention to marketing and service businesses to increase their products' value (Fry, Steele and Saladin, 1994). Globalization therefore presents two conflicting goals: specialization to survive price competition and expansion of business activities to survive value competition.

In this paper, design thinking solves problems that existing solutions are not able to solve or have no value creation, by utilizing principles of creativity and methods that designers use to solve their problems. Design thinking is undoubtedly one of the methods of Inventive Solving of problems that can be more efficient and effective than others in solving of challenging and complex issues, by using the unique principles and prototypes creating.

2. Background

As a review we can refer to recent researches. For example, Altinay et al. (2016) presented a study on how to create social value through Tourism Company, and also De Paz et al. (2016) presented an intelligent lighting control system on a smart city. At the same year Martínez-Rojas et al. (2016) presented an intelligent system that is used to collect and retrieve required information for internet based designing and management of software project.

The new wave of innovation has been a review on operating systems of smart city. Zhuhadar et al. (2016) made a review on intelligent operating systems used in smart city. In their opinion new wave of human innovations in this area is human abilities in communicating with new machines, and information that is between them (human and machines).

By 2020 we will see the development of integrated and branded huge cities with mesh networks. It is expected that more than 60 percent of the world population will live in urban areas by 2025. This process of urbanization will have divergent effects and influence on the future of personal life. The rapid expansion of cities, getting cities larger by increasing population, and substructure development enforced cities borders to be extended toward the outside and merged the small towns around and formed huge cities with population of over 10 million people.

In 2023 there will be more than 30 megacities in the world, 55 percent of which will be in developing countries; India, China, Russia and Latin America. This situation will lead to the evolution of smart cities with eight smart features including smart economy, smart buildings, smart mobility, smart energy, smart ICT, smart planning, smart citizen and smart government.

Role of the government will be crucial for establishment of digital society. Urban operation is running day to day and creation of urban development strategies will be guided towards using digital society.

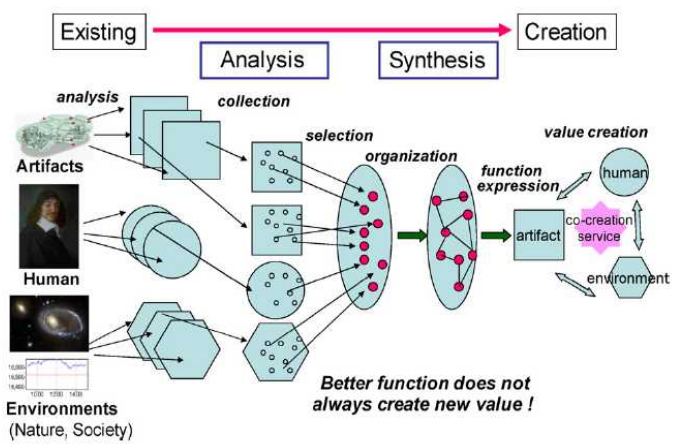
2.1 History of axiology

Historically in Europe, the first academic investigation of value was undertaken by sages of ancient Greece. Axiology, from the Greek "axios" (worthy, valuable) and "logos" (discourse, reasoning), is the discipline that deals with values in a systematic way. Nevertheless, the name axiology has been introduced only recently, not earlier than the beginning of the 1900s; ever since it has become common in academic essays.

In the 18th century, on the other hand, philosophers started to study the subjectivity of values. Epistemology (Hacking, 1979) (or Theory of Knowledge) is a branch of philosophy concerned with the nature of knowledge (such as truth, belief, and justification). Kant founded German Epistemology (MacFarlane, 2002). He integrated Rationalism, which had been originated by Descartes, and the Empiricism of Locke (Ayers, 1981), Bacon (Daniel, 1982), and Hume (McBreen, 2007). Although Kant's thought is difficult to explain in detail here, humans form perceptions using natural abilities of sensibility and understanding. Humans also have a scheme for understanding the world: perception does not follow objects, but objects follow perception. His thought passed to Rickert, who established Wertphilosophie, which examines human value judgment (Lyne, 2000), to Hegel, who insisted on absolute idealism according to a dialectic (Brandom, 1999). His thought affected that of Husserl, who is known as a founder of Phenomenology (Moran, 2005), by which values can be treated as intersubjective phenomena rather than subjective judgments.

Subsequently, some philosophers after the late 19th century mounted radical challenges of historical assumptions to values such as objectiveness and subjectiveness. Nietzsche vehemently denied the objectivity of values with his idea of Nihilism (Reginster, 2003). Wittgenstein insisted that all traditional philosophical problems such as virtue, value, and freedom are nothing but linguistic problems (Jacquette, 1997). Their challenges could be understood as Metaphilosophical or Meta-knowledge-related approaches to values.

Figure 2. From analysis of existing things to value creation



As depicted in Figure 2, the creation of an artifact begins with acquisition of knowledge about existing things; it starts with obtaining knowledge about the existing environment (natural and social), knowledge about human beings, and existing artifacts (Ueda, Takenaka and Fujita, 2008). Creation is accomplished through analyses of comprehensible knowledge, even if it is incomplete. Disciplines that cover these objects are regarded as natural sciences for existing nature, social science for existing society, humanities for existing humans, and engineering for existing artifacts. For creation of a new artifact, it is necessary to obtain a set of knowledge by collecting and selecting these acquired pieces of knowledge. It must be structured to obtain an attribute through connection of knowledge. In other words, the artifact is embodied by structure. In general, several possible combinations of connections or potential solutions can satisfy the requirements; in some cases, their number might be nearly infinite. Therefore, a common practice is to introduce an objective function and seek the optimal structure from among possible structure solutions.

3. Fuzzy logic

Fuzzy logic is a form of many-valued logic in which the truth values of variables may be any real number between 0 and 1. By contrast, in Boolean logic, the truth values of variables may only be the "crisp" values 0 or 1. Fuzzy logic has been employed to handle the concept of partial truth, where the truth value may range between completely true and completely false. Furthermore, when linguistic variables are used, these degrees may be managed by specific (membership) functions (Zadeh, 1965).

Humans and animals often operate using fuzzy evaluations in many everyday situations. In the case where someone is tossing an object into a container from a distance, the person does not compute exact values for the object weight, density, distance, direction, container height and width, and air resistance to determine the force and angle to toss the object. Instead the person instinctively applies quick "fuzzy" estimates, based upon previous experience, to determine what output values of force, direction and vertical angle to use to make the toss.

3.1 Linguistic variables

While variables in mathematics usually take numerical values, in fuzzy logic applications non-numeric values are often used to facilitate the expression of rules and facts. A linguistic variable such as age may accept values such as young and its antonym old. Because natural languages do not always contain enough value terms to express a fuzzy value scale, it is common practice to modify linguistic values with adjectives or adverbs. For example, we can use the hedges rather and somewhat to construct the additional values rather old or somewhat young.

Fuzzification operations can map mathematical input values into fuzzy membership functions. And the opposite de-fuzzifying operations can be used to map a fuzzy output membership functions into a "crisp" output value that can be then used for decision or control purposes.

3.2 Process

- Fuzzify all input values into fuzzy membership functions.
- Execute all applicable rules in the rulebase to compute the fuzzy output functions.
- De-fuzzify the fuzzy output functions to get "crisp" output values.

4. Method

We amuse the Smart Society model that product and service producers as well as customers are defined independently of their values. The objectives and environment are clearly specified. The model can be described completely using a closed system. However, in most cases, too many feasible solutions exist, which engenders combinatorial explosion and creates so-called NP-hard problems. Therefore, it is necessary to develop efficient and robust search methods to identify optimal solutions. In the real world, this model can apply to mass-produced products or routine services in smart city. In mass production, a designer determines the specification of a product based on available information about the environment (e.g., consumers' average demand or production costs) in advance. Consequently, the designer treats the information as complete information. In a routine service such as a fast-food service, the service must always be provided in the same way. Figure 3 shows the proposed value creation model in smart society.

Figure 3. Proposed value creation model in smart society

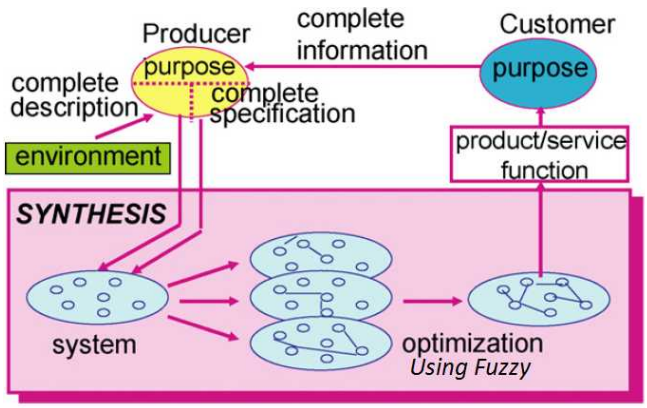
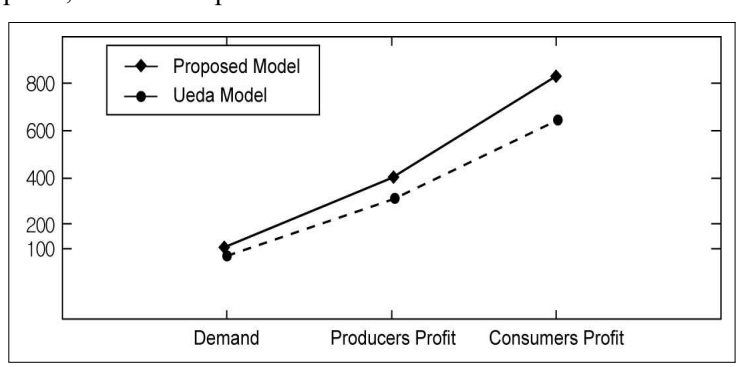


Figure 3 shows that producers, customers, and products and services in smart society are treatable as agents. The value for the product or service provider (producer) and receiver (customer) can be specified independently and the environment can be determined in smart society. The model can be described as a closed system. The problem to be addressed is the search for the optimal solution using fuzzy logic.

5. Experimental result

For investigations of proposed model, reveal concerns about services: customers' demands, satisfaction, evaluation, customization, and recommendation. In addition to the problem of discerning individual customers' profit, the value of a service in a smart society emerges through dynamic interaction among producers and consumers. Ueda et al. examined service diffusion in a society considering consumers' lifestyles and network externalities (Ueda, Takenaka and Fujita, 2008; Kito, Fujita, Takenaka and Ueda, 2008; Ueda, Kito and Takenaka, 2008). In this section our model is compared with Ueda Model, and Figure 4 presents results obtained using each model: the number of each case corresponds to that of each value creation model. The producer can gain the greatest profit under a predictable service environment in the proposed model (because of using Fuzzy Method).

Figure 4. Producer's profit, consumers' profit and their total demand in value creation models



There are 2 types of fuzzy inference systems: Mamdani and Sugeno or Takagi-Sugeno-Kang (TSK). In another simulation we study the effect of these two types of fuzzy inference system in the proposed model. For this purpose the benefits of the consumers and the producers (according to previous simulation) have been measured by different inferences in fuzzy logic. The results are shown in Figure 5.

Figure 5. Producers and consumer profit by Mamdani and TSK fuzzy inference in proposed model

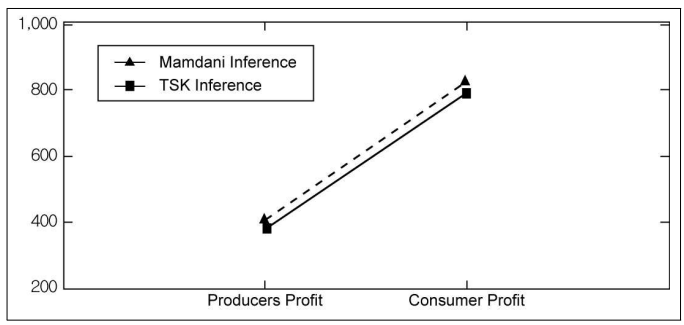


Figure 5 shows that Mamdani inference system has more profit for consumers and producers than TSK inference system used in fuzzy system of proposed model. Earned profit is shown in Table 1.

Table 1. Producers and consumers profit by Mamdani and TSK fuzzy inference in proposed model

	Producers Profit	Consumer Profit
Mamdani Inf.	400	820
TSK Inf.	380	790

6. Conclusion

Fuzzy logic can help our model to reach better performance in value creation in smart society. To evaluate the efficiency of the proposed method, the proposed model was compared to Ueda method. In this case 3 criteria has been used including producer's profit, consumer's profit and their total demand. In conducted simulation proposed method could create better profit criteria for consumers and producers in digital society because of using fuzzy logic.

For improvement of service productivity, we must address not only efficiency or optimization of service provision but also expansion of the value of services. To this end, we must pay more attention to the concept of valuation and the value mechanism in a smart society. Furthermore, sustainability is expected to be a good target for studies of services because individual happiness and the overall purpose (environmental and social sustainability) were solved simultaneously through dynamic interaction among various stakeholders. Recommendation and mass customization are also important topics in recent service studies in response to rapidly increasing customer purchasing and demand data. For those purposes, intelligent methods such as Bayesian networks or collaborative filtering that can calculate customers' preferences play important roles. Moreover, those problems are applicable to both service and manufacturing businesses.

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