Automated Systems & Technologies
25-26 May 2015 • St. Petersburg, Russia

NEW APPROACH TO SMART SERVICES CLASSIFICATION

Stanislav Vlasov, Tatiana Gavrilova, Liudmila Kokoulina

Graduate School of Management
St. Petersburg University
Volkhovsky per., 1-3
199004 St. Petersburg, Russia
tgavrilova@gmail.com

Abstract

The main goal of the study is the analysis of the current state of research and development in the field of smart services as well as the development of the new classification system of smart services, which is based on the knowledge management system analysis approach. This article uses explorative and analytical approaches to review the key issues related to smart services. First, we analyze available definitions of the "smart services" concept and concepts related to it: smart services are based on the idea of co-creation of value and rely on machine intelligence in connected systems. Second, we propose a new extended approach of the smart services classification based on the list of criteria of the knowledge portals` services: types of the elements comprising the smart service and the structure of their interconnection; the level of how "smart" or "intelligent" is the service; and dynamic aspects of the service process.
Hence, the contribution of the article is twofold: on the one hand, the smart service concept is approached from different angles and the working definition of this concept is obtained; on the other hand, the smart service system is analyzed through the lenses of established knowledge management methods and new smart services classification is proposed.

INTRODUCTION

First, we analyze available definitions of the "smart services" concept and concepts related to it. By now, there are very few peer-reviewed publications on this topic. Most of these publications do not provide any formal definitions. The available definitions are mostly inconsistent with each other, too general or vague. For example, the special issue in Journal of Service Science introduces a new research area of smart service systems and defines it as broadly as:

"… capable of self-detection, self-diagnostic, self-corrective, or self-controlled functions through the incorporation of technologies for sensing, actuation, coordination, communication, control, and more" [1].

Other definitions of smart services try to define these technologies through particular distinctive features and comparing it with other types:

"Smart services are a wholly different animal from the service offerings of the past. To begin with, they are fundamentally preemptive rather than reactive or even proactive. Preemptive means your actions are based upon hard field intelligence; you launch a preemptive strike to head off an undesirable event when you have real-world evidence that the event is in the offing" [2].

Some studies are skeptical about usefulness of a term and speculate that smart services are simply "…a marketing term to bring together various meanings of the term Service (economic, technical, political, business- and end-user- oriented) with an adjective to make it sound clever" [3].

The term "service" is used here as "…a function of an enterprise that is exposed through various technology-supported channels, and is amenable to re-use and composition into larger services which add value" [3]. It is necessary to note that recently a whole new research stream related the study of services appeared, labeled as "service science". Service science takes most of its inspiration in recent information technology and has been actively supported by IBM. Scholars in this field are still providing rather general definitions of term "services" such as "…as clients and providers working together to transform some state, such as material goods, information goods, organizations, which bears some ownership relation to the client" [4]. The two main issues that are recognized as basic tenets of the service science are: (1) co-creation of value by producer and client and (2) broad implementation of information technology [1].

The term "smart" in the context of smart services implies two main properties. First, it indicates anthropomorphic features of some machine that supports or provides a service. In one of the recent research note the world's leading information technology research and advisory company Gartner, Inc. states that smart technologies are "… technologies that do what we thought

only people could do. Do what we thought machines couldn't do" [5]. Second, term "smart" is often related to artificial intelligence (i.e. intelligence of machine) "[…] because it is impractical to deploy humans to gather and analyze the real-time field data required, smart services depend on "machine intelligence" [2].

In summary, it is clear from this short review that there is no consensus on what "smart services" are. Nevertheless, based on emerging discussions, we can identify some key elements which are common in most definitions and which can help to come up with the working definition. Those key elements are 1) machine intelligence, 2) connectedness and 3) value co-creation by client and provider of a service. Thus, smart services are based on the idea of co-creation of value and rely on machine intelligence in connected systems.

ENTERPRISE INFORMATION PORTAL LENSE

Because the theory behind smart services is still in its infancy, we decided to turn to the real-world examples of these emerging technologies in order to get a better understanding of what are the directions of smart services development. We believe that the best way to obtain the understanding of smart services is by approaching this new concept with an established method of knowledge management portal services analyses. Particularly, we think that looking through the lenses of the knowledge management system analysis will be valuable approach to the creation of the smart services classification.

Intellectual services as a subject of studies lies on the intersection of the scientific and technological paradigms of the information systems, knowledge management systems (KMS), enterprise information portals, service systems and "smart" services.

At the roots of the artificial intelligence studies there was a concept of "knowledge-based system" (KBS) [6], while the notion of knowledge management system (KMS) appeared much later in the management literature, and it is much wider, than KBS. KMS include methods and techniques for the search, analyses, structuring, systematization, update and distribution of the information [7].

The term "enterprise information portal" (EIP) was introduced in 1998. EIP is comprised of applications allowing companies to disclose information stored internally and externally, and to give the users the unique point of access and personalized information necessary for the decision making process in business [8]. The body of literature of this subject distinguishes two types of enterprise information portals: enterprise information portals and enterprise knowledge portals. The former type includes portals with services of search, exchange and sharing of the information. The latter type includes services developed with

artificial intelligence methods. For our purposes, we define knowledge portals as the systems of knowledge management with the system of access embedded through enterprise portal.

While considering only technological component of the service systems (which is a composition of the interconnected information systems) a property of intelligence is identified. The property of intelligence is achieved by knowledge base inclusion and/or context awareness obtained by sensors, dynamic scalability, etc. [9; 10]. This type of intelligence is closely related to big data analytics. Recently scholars have argued that as more software and embedded intelligence are integrated in industrial products and systems, predictive technologies based on big data will be used to predict product performance degradation, and autonomously manage and optimize product service needs. [11]

Smart service systems could be considered as a sub-category of the intelligent systems. Smart service systems often have the following characteristics of the intelligent system:

- Self-configuration (or at least easy-triggered reconfiguration) [12; 13],
- Proactive behavior (capability for prognosis or preventive actions, as opposed to the reactive behavior) [2],
- Interconnectedness and continuous interactivity with internal and external system elements [14].

However, there are no commonly accepted definitions of intelligent and smart services – these terms are still developing [2].

EIP structures are based on the service-oriented architecture where services are located in the separate module. Basic portals` services include information search and exchange, communication among users, collaborative usage of the information. The technical services, which support EIP, are presented in Table 2.

Table 2. Examples of the Enterprise Information Portal

	Services	Functions
Basic	communicational	Information exchange, collaboration between users and portal`s technical support group, realization of the modern voting and survey tools
	informational	notification of users about changes of events in their spheres of interests
	navigational	Information search, increasing of the search efficiency
	Analysis and visualization of the spatial data	Thematic search services, services of the analysis and visualization of the spatial

		data (GIS portals)
	Personalized/identification	Identification, authorization and authentication of the portal`s users, portal visualization adaptation based on the user`s preferences (e.g., personal "cabinet" on the portal which stores the user`s profile and preferred system settings)
	educational	Education of the employees
Technical	statistical	Collection and analysis of the statistical information accumulated in the portal
	audit	Logging of all actions included in the security system list
	monitoring	Monitoring service

In this paper we propose a new extended approach of the Intellectual services classification based on the list of criteria of the knowledge portals` services:

- Types of the elements comprising the service [2],
- Structure of the interactions among different types of the elements comprising the service [1; 2; 14; 15],
- The level of "intellectuality" or "intelligence" of the service [9; 10; 12],
- Dynamic aspects of the service working process [2; 14],
- Types of the information available to the service [7; 16], etc.
- Physical realization of the service (Software-as-a-Service, Hybrid cloud, own servers of the organization).

These criteria could be further divided into two sub-groups: first-order criteria, which reflect physical realization of the Intellectual services and organization of the elements, and second-order criteria, which point our actual functionality of the service. Therefore, the final classification of the Intellectual services is presented in Figure 1.

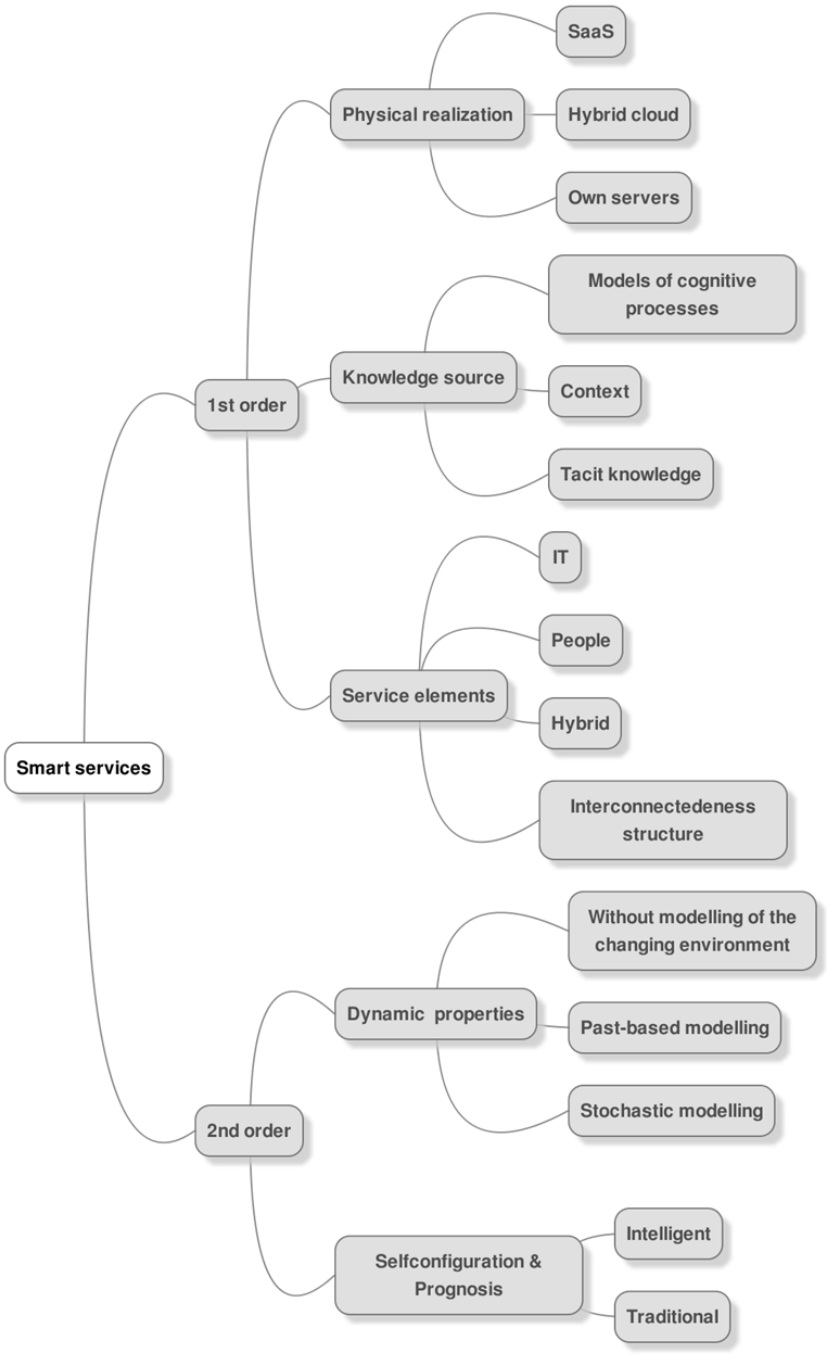

Figure 1. Smart services classification criteria

We propose classification of smart services based on two-order criteria which can be explained as follows: the 1st order criteria are related to the physical structure and architecture of the service, while the 2nd order criteria refer to the features and properties of the service.

CONCLUSIONS

The main results of this exploratory study can be summarized as following. First, smart services are a relatively new concept that emerged as a result of progress in machine intelligence, global connectivity and big data.
Second, the smart service system is analyzed through the lenses of established knowledge management methods. The main contribution from this perspective is the development of new smart services classification based on the criteria derived from knowledge portal services analysis.
Obviously, more research on smart services is needed. There are multiple angles from which the issues of smart services can be approached. A possible topic to study smart services are the ethical issues of ownership of data and security. From an economic and managerial point of view, research estimating efficiency and productivity gains obtained with the adoption of smart services is warranted. From an engineering point of view methodologies and algorithms for developing smart services represent a fruitful area for further research. As our short review demonstrated, the field of smart services is at the infant stage of development. Therefore both developers and businesses are in a good position now to start exploring the opportunities offered by the smart services.

REFERENCES

[1] P. P. Maglio. (2014). Smart Service Systems. *Service Science*, **6**(1), 13–15.

[2] G. Allmendinger, R. Lombreglia. (2005). Four strategies for the age of smart services. *Harvard Business Review*, 1–11.

[3] K. Duddy (2009). What Would Smart Services Look Like. In G. Feuerlicht & W. Lamersdorf (Eds.), *Service-Oriented Computing – ICSOC 2008 Workshops* (Vol. 5472, pp. 5–14). Springer Berlin Heidelberg.

[4] J. Spohrer, P. P. Maglio. (2008). The Emergence of Service Science: Toward Systematic Service Innovations to Accelerate Co-Creation of Value. *Production and Operations Management*, **17**(3), 238–246.

[5] T. Austin. (2013). The Disruptive Era of Smart Machines Is Upon Us. Gartner, Inc.

[6] L. Shu-Hsien. (2005). Expert system methodologies and applications—a decade review from 1995 to 2004. *Expert Systems with Applications* **28**(1), 93-103.

[7] D. G. Schwartz. (2006). *Encyclopedia of knowledge management*. IGI Global.

[8] *Enterprise Information Portals*. 1998. Merrill Lynch.

[9] H. A. Simon (1996).*The Sciences of the Artificial*. MIT Press.

[10] R. A. Brooks. (1991). Intelligence without representation. Artificial Intelligence **47** (1), 139-159.

[11] Procedia CIRP 16 (2014). Product Services Systems and Value Creation. Proceedings of the 6th CIRP Conference on Industrial Product-Service Systems.

[12] S. Barile, F. Polese. (2010). Smart service systems and viable service systems: Applying systems theory to service science. Service Science **2**(1), 21-40.

[13] D. Tranfield, D. Denyer, P. Smart. (2003). Towards a methodology for developing evidence-informed management knowledge by means of systematic review. *British Journal of Management* 14(3), 207-222.

[14] N. Gershenfeld, R. Krikorian, D. Cohen. (2004). The Internet of things. *Scientific American* 291 (4), 76.

[15] A. Fano, A. Gershman. (2002). The future of business services in the age of ubiquitous computing. *Communications of the ACM* **45**(12), 83-87.

[16] M. Alavi, D. Leidner. (2001). Review: Knowledge Management and Knowledge Management Systems: Conceptual Foundations and Research Issues. MIS Quarterly **25**(1), 107-136.