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Customer Knowledge and Service Development, the Web 2.0 Role in Co-production

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***Abstract*—**The paper is concerned with relationships between SSME and ICTs and focuses on the role of Web 2.0 tools in the service development process. The research presented aims at exploring how collaborative technologies can support and improve service processes, highlighting customer centrality and value co-production. The core idea of the paper is the centrality of user participation and the collaborative technologies as enabling factors; Wikipedia is analyzed as an example. The result of such analysis is the identification and description of a pattern characterising specific services in which users collaborate by means of web tools with value co-producers during the service process. The pattern of collaborative co-production concerning several categories of services including knowledge based services is then discussed.

***Keywords*—**Service Interaction Patterns, Services Science, Web 2.0 tools, Service Development Process.

I. Introduction

The peculiar nature of services requires a multidisciplinary approach to investigate on their impact in the economic growth, to define models, to identify terminology, to describe scenarios and user profiles. The integration of several disciplines is a key point for the improvement of the Service Science capacity to find solutions and answers for services, especially for studying and designing new ICT services, the fastest growing segment within the service sector.

One of the main goals of this paper is to analyse the existing relationships among SSME and ICTs, focusing on the potential of Web 2.0 and in general of collaborative technologies which can enable and foster innovation in the service sector. Such technologies innovate both the service development process and the design phases. We show the role of Web 2.0 tools in the value co-production activities carried out by both service providers and customers. The collaborative technologies play an important role in services focusing on knowledge and information management because they promote customer involvement and foster knowledge sharing. We introduce a pattern describing the role of collaborative tools in co-production processes starting from the analysis of Wikipedia [30] as an example of Web 2.0 service. The pattern helps customer to interact during the service development process.

The paper is structured as follows: section II analyses the state of the art of the main topic discussed as well as service development research. Section III illustrates how Web 2.0 tools can support the co-production process in the streamline of the Wikipedia case study, and a summary of co-production concepts is proposed; in section IV the pattern just mentioned and its applications are discussed using a service classification framework as found in literature. Section V presents the conclusions and foreseeable future developments.

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II. Service development

The remarkable development of the service sector induced the international scientific community and companies to design academic courses in Service Science [6][24] giving rise to a new academic curricula known as "Services Science, Management and Engineering (SSME)"[1]. This new specific discipline is evolving to scientifically study services and their role in the changing economy, and courses are aimed at shaping expertise in the inherent topics.

A. Service definitions

The service concept is dynamic and evolves in time mainly given its close relation with the evolving states of economy and technology. There are many definitions of service in the literature, but there is not yet an exhaustive one. Some well known definitions are, for example:

- A time-perishable, intangible experience performed for a customer acting in the role of co-producer [9].
- A change in condition or state of an economic entity (or thing) caused by another [15].
- A value that can be rented (in the broad sense) by the application of some process that the renter (client) participates in. This is a contrast with goods, whose value (once purchased) is owned by the customer [22].

We would like to suggest a definition that may be a combination and a summarization of the above ones: *a time-perishable, intangible experience performed for a client who is also acting in the role of the value coproducer in a process that transforms a state of the client*. In literature some service characteristics are fixed and their clarifying view derives from Lovelock's work where he expressed and described the IHIP acronim: inseparability, heterogeneity, intangibility, and perishability [21]. The definition presented here outlines some other essential characteristics: the client plays a key role in the value co-production, the client has responsibilities in the process and often the value is a transformed state of the client or some possession of the client. In many services, the clients carry out some activities (in addition to those performed by the providers) that transform the customer states, otherwise the benefit or value of the service will not be fully attained [27]. This paper draws on the latter concept analyzing the process

[1] http://www.research.ibm.com/ssme/

of value production related to service customers knowledge exchange.

B. Co-production in services

The attention of experts is being drawn to the value co-production process, as seen during the recent Nordic Service Science Summit where Jim Spohrer of IBM's Almaden Research Center defined services *as value co-production*[2]. Certainly, the co-production is not a new aspect in the service sector and scholars have studied it long before now. Fuchs (1968) may have been the first to define services effectively as co-production [11].

Service dimensions as a co-production process, customer contact, and client involvement are topics studied in the operation-oriented field of service literature. In this branch of studies service is considered mainly as a process, characterised by the IHIP peculiarities and customer centrality. It is necessary to explore briefly these studies of customer participation in service processes following the literature review provided by Xue and Harker [32], focusing on the co-production concept. Chase (1978) was one of the main researchers interested in customers' involvement in service operations and in its potential influence on the service delivery process [3][4]. Chase focused on the definition of the *customer contact* concept, that is the physical presence of the customer in the service process and his relation with the dimension of time in the service delivery process. In 1983, Chase and Tansik proposed the Customer Contact Model (CCM) based on the definition [5] that influenced many following works. Another important suggestion was provided by Karmarkar and Pitbladdo [17], who identified an important research topic: how a customer's engagement in service delivery process can influence the process design.

The impact of customer participation in service co-production processes enabled by information technology and the concept of the customer role as a co-producer [32] is worth to pointing out. In many of the above works the co-production concept is measured as the proportion of the whole service task outsourced to the customer by the service provider. However, in the operation-oriented perspective the co-production studies seem to neglect the service value as a result of a relationship between users, knowledge and technology. Nevertheless, in the authors' opinion the impact of knowledge co-creation supported by technology in the whole service development and delivery process is a very important and pregnant research topic.

C. Models of service design and process

Recent research works have focused on defining more precisely what service design and process is, such works have highlighted the need of establishing models and patterns. By some works it is claimed that the first characteristic of the service process is a customer-oriented dimension, or customer intensity. The relevance of customer-intensity is acknowledged by some scholars, for instance, Gadrey's [12] definition of services clearly encompasses the idea of customer input. Pinhanez comes to ask if all services are customer-intensive [25]. However, this acknowledgment is the result of a long debate of two different visions.

For a long time, the service process was commonly compared to a production process typical of manufacturing and other goods-producing industries. However, the latter process follows an *engineering model*, in which the product design comes before the process design [1]. According to this, the production process is defined as a process in which inputs are transformed into outputs by a producer using capital, labor, knowledge and facilities. The customers take possession of the outputs after the production. In this view the producers are those who received most of the value created by the production process, while customers participate in the process by selecting and consuming the outputs. The service production and the delivery process, however, are characterised by various essential elements: 1) a continuous contact with the customer or client during the whole process, 2) the customer provides inputs into the process, contributing with his ideas during the process design phase [26]. These differences calls for a new model to interpret the service process.

The engineering model is used in services in which outputs can be well defined (e.g. fast foods, commodity banking products). Generally, services require human judgment, for example, the producer makes a subjective decision about suitability whereas there is little space to do so during the production process in the engineering model. Another problem is that often the attributes of a service may be inseparable from the production process (e.g. a restaurant). Therefore, it is difficult to predict improvements within the engineering model.

Engineering model	**Interpretive model**
Design comes before process	Product and process intertwined, Product design emerges from the process, not specified in advance
Workers execute tasks	Workers interpret needs and execute tasks
Improvements come from changes to design or process	Improvements follow from improving worker's ability to elicit and interpret, respond to the situation to select work practices from repertoire or learn or invent new services

TABLE I
DIFFERENT IMPLICATIONS OF THE ENGINEERING AND INTERPRETIVE MODEL. SOURCE: IBM ALMADEN SERVICES RESEARCH

Indeed, some services particularly those based on knowledge vary too widely (e.g. education, health) and are difficult to design using the engineering model.

Considering these differences Hertzenberg et al. suggest a replacement for the engineering model: *the interpretive model* [14]. The interpretive model takes as problematic what engineering takes as certain, as summarized in the Table I (the prior definition of the product and the independence of the production from the product design process). In the interpretive model, workers develop skills in understanding customer requirements and needs, they translate those into services they provide, and if the worker finds this is not producing the

[2]During a talk given on the 28th of February, 2007 in Helsinki, Finland.

desired or intended effect then he or she modifies the service or method of delivery or even his/her interpretation of what the customer wants or needs. This occurs continually until the worker perceives that the services or delivery match the customer's desiderata. An example of this is medical diagnosis and treatment.

Although goods-producing and service-producing industries draw on a common knowledge base, the processes by which knowledge is transformed into economic outputs differ systematically. In particular, the balance between knowledge creation and knowledge utilization is one of the fundamental factors of service process improvement. Customer knowledge is at the core of the interpretive model. That is, the more a service provider knows customer needs and expectations, the better the service gains its scope. Furthermore, customers perceive the service more positively if providers take time to know and understand the customer desiderata. Therefore, customer knowledge and time reduction are two basic dimensions for service improvement, as explained in the next subsection.

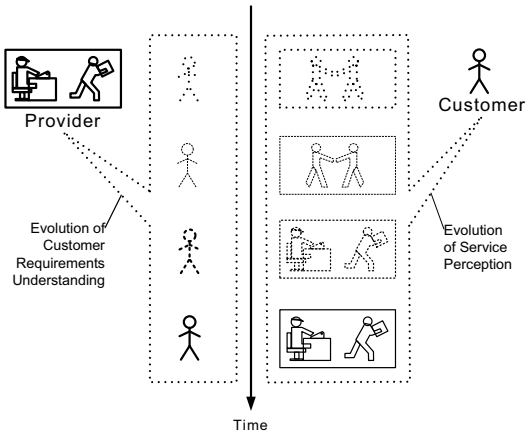

Fig. 1. Knowledge evolution within a service.

D. Service improvement model

Knowledge transfer and sharing holds considerable potential for service performance gains. In the engineering model, performance improvement comes from improved product designs and production process performances, as far as cost is concerned. In the interpretive model, performance gains follow from improvements in the ability of workers to elicit, understand, and respond to the customer or the situation, to select and follow work practices from an available repertoire, and to learn or to invent new practices. The sources of performance and productivity improvement differ radically between the two models [14]. Sampson and Froehle [26] defined a model in this direction considering customer input as the main difference between production and service.

Time is frequently seen as a key factor in the customer contact literature, but some more factors have to be considered. Chase incorporated richer notions of contact by identifying detailed contact modes, such as Face-to-Face/Loose Specifications and Face-to-Face/Tight Specifications [4]. Thus, it becomes evident that not only time must be considered, but also other dimensions of the process, for example the ability to react and to customize the service offering. In this way, Kellogg and Chase tried to empirically calculate the measure of customer contact [18] defining it through three concepts: time, richness of information exchange and the direction of information flow in the process.

The relationship between time and knowledge should be considered carefully when designing service improvement models. In order to gain improvements a better customer knowledge is needed as indeed knowledge of the whole service by the providers. This approach is explained by three key points, that once unified and implemented in a design pattern allow better service effectiveness (figure 1):

- Knowledge exchange between provider and customer;
- Reduction of time needed for customer knowledge acquisition;
- Fostering of the value co-production.

This approach can be effectively supported by particular kind of ICT-based services which emerge from Web 2.0. The following sections on Web 2.0 and on Wikipedia case study help to better explain the pattern, afterwards the service improvements are deeply debated in the section IV-D.

III. Web 2.0 in co-production

A. User involvement in co-production

Between 2004 and 2005 the World Wide Web, as it is known and used so far, came to a turning point: becoming Web 2.0, a commonly accepted term for this new era of the network. The term Web 2.0 refers to a class of Web-based applications sharing certain design patterns radically modifying the design and the use of ICTs. Web 2.0 is a set of principles and procedures that link sites and especially users. Tim O'Reilly defines Web 2.0 with a set of oppositions against classic Web techniques and design metaphors: tag systems versus directories, RSS syndication versus Web site stickiness, wikis versus content management systems, open Web APIs versus screen scraping, blogs versus personal Web pages, massive user participation versus client/server style publishing [23]. Technology and services such as Wikipedia [30], Flikr [10] or Youtube [33], which spotlight Web 2.0, show how it is more and more people-oriented, rather than data-oriented. These applications share some common themes representing the key factors of Web 2.0:

- weaving together different Web-accessible data and services (especially with UI technologies such as AJAX and powerful scripting languages);
- depending on collective intelligence [19], social networks, user-contributed content and tags;
- addressing long-tail markets and scenarios [2];
- repurposing and remixing Web-based data; and
- enhancing existing Web-based data with personalization capabilities, such as tailored feeds and contextual recommendation systems.

Users add more and more contents to the Web 2.0 and the connections they create organically grow together with their participatory activities. For example, the reviews and the comments that users voluntarily insert is information which adds value to the Web. The applications of the Web 2.0 increase the capacity of knowledge sharing and exchange between users. Some of the most thrilling Web-based applications are: mashups, blogs, wikis, folksonomies, tagging systems, user-created publication systems and social networking applications, require shared knowledge to link their various components and data sources as well as to integrate and organize data in response to user needs.

The Web 2.0 technologies enable services, most of which were not conceivable before their on-line delivered version. These services evolved at the same time of the enabling technologies and the user interaction capacity. In Web 2.0 power is handled by the mass of sites and services emerging from people collaboration, and not by companies with specific products. The *collective power* of Web 2.0 influences and shapes the ICT service market leveraging on customer self-service processes and on collective knowledge management methods. Furthermore, the Web 2.0 is seen as a free platform, with open standards and cooperation agreements, integrating products and technologies provided by the collectivity. Its force lies in a solid union of ideas, technologies and business models which are highly customizable and interoperable. The key principle at the core of the Web 2.0 philosophy is that *the service improves with the growth of cooperation and user involvement*, confirmed by O'Reilly's sentence [23]: *There's an implicit "architecture of participation", a built-in ethic of cooperation, in which the service acts primarily as an intelligent broker, connecting the edges to each other and harnessing the power of the users themselves.*

An example of this trend is represented by Wikipedia as we explain in the next section.

B. Wikipedia case study

The free online encyclopedia Wikipedia is one of the better examples of collective intelligence at work. The Wikipedia numbers are surprising: since its birth in January 2001, Wikipedia has grown to encompass 10 million articles in more than 250 languages generated from more than 480 million edits by more than 7 million contributors[3]. Its growth has been exponential in key metrics such as the number of editors and the number of articles. Wikipedia allows any user to modify any article or to create new articles, virtually eliminating barrier to contribution. This scheme facilitates a rapid expansion, but it is also a weakness because of the uncertainty of article quality and value. Therefore, the understanding of Wikipedia's growth and the assessment of the quality and of the value of its articles to evaluate Wikipedia as a cooperative and popular process is of great interest for research. A number of recent studies have focused on these goals [20][29][8][28].

Even though this paper can not give space to these topics, it was worth outlining the existing interests in the Wikipedia quality and innovation issues of the scientific community.

Wikipedia is built on the understanding that user collaboration can improve article quality in time, similarly to the free software domain [31]. The creation and editing of the Wikipedia article process presupposes that more and more accuracy is gained through an exposure of articles to the whole community of "wikipedians". Users can contribute in editing, modifying and removing articles following the simple ethical code which shapes the Wikipedia organization[4]:

- a neutral point of view,
- respect,
- freedom in choice of contents,
- articles have to be verified and can not be the result of personal research,
- care in biographies,
- only these rules apply.

Wikipedia may be considered a service in which users are both providers and customers, while the value they produce is knowledge. They co-produce value by inputting the delivery process and by exchanging knowledge within the whole community. Wikipedia offers users a complete set of means for creating knowledge, such as: collaborative editing, feedback and peer review, multilinguism, tracing of article versions, article quality and user reputation evaluation, knowledge organization through topic lists, search engines, control of citations, a consensus creation system, policies of control and editorial revision.

What innovation has Wikipedia introduced in the encyclopedia genre [7]? Being a free online encyclopedia Wikipedia brings down the traditional barriers of the genre allowing to participate anyone who wants to edit an article for an encyclopedia. The evolution and the improvement of ICTs allowed faster and broader access to the Web, and technologies such wiki software gave significant help.

The added value of Wikipedia is knowledge provided and inserted by users, whose collaboration updates it constantly. Wiki technology however, is the keystone of the project, without which Wikipedia could not have attained its success. Therefore, the success of this phenomenon is related to a specific technology and to the contribution of users in co-producing value.

Wikipedia and other Web 2.0 services are based on transparency, easy access to contents, reduced barriers to user contribution and, furthermore, an enabling technology, a close interaction among customers, a value co-production, and a process of input by users. All these elements characterise Wikipedia and Web 2.0 services making them the most innovative services in the ICT service market.

C. Concept of co-production

A co-production process is a key element of service delivery and it has many features which make it distinct from more ordinary examples of purchasing situations. The customer makes decision in short time and with little effort in purchasing activities. Hence, the customers' degree of involvement in the information search and examination of materials and/or

[3]http://stats.wikimedia.org/, last update February 2008.

[4]http://en.wikipedia.org/wiki/Category:Wikipedia_official_policy.

processes is low, typically focusing on price and some tangible aspects of the item. Co-production in knowledge services is essentially different from the above described case because the process involves mutual exchanges and the customer accesses the provider expertise rather than a process or a good. The service provider at the same time needs to access the customer's situational knowledge to be able to deliver meaningful services. Co-production is essentially interaction implying a strong knowledge exchange: the provider must offer specific knowledge that fits the customer specific needs, and combine it successfully with the customer's knowledge base [13]. Furthermore, in some ICT services, such as Web 2.0 services, the customer's involvement may be deeper. That is, it can be expressed in a major operative work by the customer who creates and provides more inputs than in an ordinary service delivery process.

Therefore, the co-production concept in knowledge services should be understood as a combination of two key dimensions of provider/customer interaction : 1) knowledge exchange and 2) operative work.

IV. Pattern of co-production based on collaborative technologies

As fore mentioned, Web 2.0 tool exploitation is becoming more and more common in service provision, to the point that it can be viewed as a common pattern that the authors name "co-production based on collaborative technologies". The rationale is that Web 2.0 tools support collaborative work (especially knowledge work) and collaboration is a key component of co-production. Web 2.0 tools are well suited for information and knowledge management, which are also important themes in Service Science. Knowledge and information management have several implications in the service world, but we only wish to consider the knowledge aspects affecting the customer/provider relationship. As reported in [6], knowledge sharing among providers and customers is a problem in the service framework. The intangible nature of services lacks of the coordination support that a product can provide among customer and producer, therefore, an alternative knowledge sharing process has to be carried out among service costumers and providers. The Web 2.0 tools provides an easy and cost effective way to support collaboration and knowledge sharing among a producer and a customer. Furthermore, it can exploit the "Community economy of scale". Web 2.0 tools connect not only a customer with her/his provider, but also allow all customers and providers to contact each other creating a virtual community of people with similar problems in which knowledge about problems and solutions can circulate. The Web 2.0 tools are very useful tools to carry out "community supported work" (an example of community supported work is the open source software development process) since they can coordinate the contribution of several actors with different roles. Such a paradigm well fits the customer/provider relationships involved in co-production, since customers and providers can be viewed as some of the actors providing contributions to a community supported work. The pattern where Web 2.0 tools are used to support service provision can be extensively observed in information and knowledge based services, where knowledge and information are not only the "cultural ground" for coordinating customers and providers but are part of the core service provided to the customer. In such scenarios, where knowledge and information not only play a coordination role but are also the core of the services, the exploitation of Web 2.0 tools for managing knowledge and information provides a strong impact on the co-production activities.

A. Pattern extent discussion

The above mentioned pattern has been observed in services strongly Web 2.0 oriented. It can be argued that the pattern can only fit such kind of services.

The question that arises is whether the previously introduced pattern is feasible for a broader set of services with respect to Web 2.0 based service sets. Anyway, the relationship between knowledge, technology and services has to be explored more deeply before attempting to address such a question.

B. Kang framework

Services are usually classified using the Lovelock dimensions and characteristics [21]. The same scheme is used by many experts who refer to the goods-service distinction typical of service marketing literature. Till now the resulting service classification schemes have not given enough emphasis to technology and knowledge dimensions, both identified as essential for the previously introduced pattern. Given this limit, alternative approaches in the field of knowledge services need to be explored. So far we have focused on Kang [16] who proposed a framework that clusters the service sector. According to the latter framework knowledge services are classified in two categories: *knowledge-embedded* where the majority of customer value is provided by the technological system which holds the knowledge (thus knowledge embedded); *knowledge-based* where the majority of customer value is provided by the knowledge held by the actors providing the service (see Table II for some examples).

Knowledge-based services	*Knowledge-embedded services*
Computer graphic	Automated car washes
Computer aided design	Fast food
Beauty salons	Passenger/freight transportation
Exercise clinics	Laundry
Haircutting	Dry cleaning
Education	Vending machines
Professional services	Package delivery
Legal services	Shipping and distribution
Health care	Broadcasting
Information services	Telephone operator
Management consultants	Security services
Accountants	Banking/insurance
	Theatres/museums
	Travel/recreation

TABLE II
Example of services classified according to the Kang Framework

Kang focuses on the technological and knowledge related aspects without investigating the co-production aspects and their relationship to knowledge-embedded and knowledge based services.

C. The pattern in different service types

This section is concerned with the classification of both knowledge-based and knowledge-embedded services. The two co-production key dimensions previously described (knowledge exchange and operative work) can be supported by Web 2.0 tools in several ways and Web 2.0 tools are enabling factors in these cases. In knowledge-based services focusing on information, data, or knowledge production, Web 2.0 tools (or collaborative technologies in general) can support both the knowledge exchange and the operative work aspects of co-production. Wikipedia is an example of these services, as by the characteristics previously described. The co-production process in Wikipedia is fulfilled by technology and user involvement enabling both knowledge exchange and operative work.

The pattern of co-production based on collaborative technologies can be exploited in knowledge-based services in which the multidisciplinary approach plays an important role (e.g. advice or professional services). In this case the Web 2.0 tools and the collaborative technology support the various actors who have different skills, capabilities, diverse cultural backgrounds, and a different interpretation framework for knowledge sharing, thus improving the overall service quality. In this scenario, the Web 2.0 tools support mostly the knowledge exchange dimension of co-production.

The relationships among the pattern and the knowledge embedded scenarios are not being investigated in this paper, but are left as future work. Concerning the question of section IV-A, this section has proved that Web 2.0 tools can support not only the Web 2.0 (strongly oriented) service sets or the knowledge-based service set, but also a broader set of services.

D. Pattern impact in the service life cycle

Web 2.0 exploitation can also affect the service life cycle. In service design and improvement it is very important to share knowledge with customers, to better understand their needs, to identify clusters of people with similar needs, and to make the customers exploit the provided services in the best way. Customer participation in service design and production helps knowledge sharing. Knowledge sharing means that customers and providers can obtain more value from their relationships. The previously introduced engineering and interpretative models differ in the way knowledge sharing is managed; the impact of knowledge in the service improvement activities is different too. In the engineering model, service improvement is limited to the the service life cycle design and re-engineering phases, while in the interpretative model, service improvement is achieved also in the production phase.

Figure 2 summarizes the knowledge sharing effect in the interpretive and in the engineering model, the time related aspects, and the impact of co-production on knowledge sharing in the interpretive model. Figure 2 does not represent real data but is an attempt of conceptual representation, therefore, it should be interpreted qualitatively and not quantitatively.

Considering the product and service life cycle, the engineering model can be represented by a 4 phases iterative process: analysis/improvement, design, production, and delivery. The interpretive model can be represented by a 2 phases iteration: the first being an analysis step and the second including design, production, and delivery activities. In the engineering model knowledge transfer among customers and providers mostly takes place in the analysis and delivery phases, while during the design and production phases the provider mostly achieve domain, technology, and project specific knowledge. Knowledge sharing takes place faster in the interpretive model with respect to the engineering model cause the customer interaction exploitation during the design, production, and deliver activities. Therefore, in the interpretive model a target level of transferred knowledge is faster reached, or a knowledge gap is observable within the two models at a specific time.

Within the interpretive model, the co-production contribution allows to reach a (shared) knowledge level more quickly, although it doesn't provide any significant extra knowledge in the long time period. Customer and provider interaction foster knowledge sharing. Therefore, during the analysis phase no gaps can be observed between the engineering and the interpretive model, since customers are hardly (directly) involved in such a phase. In both models, customers can be either surveyed or interviewed to classify preferences and interests, but they rarely have an active role in such a phase.

V. Conclusion

In this paper we presented a research focusing on the role of collaborative technologies supporting co-production in services. We have identified a pattern that can be observed in services for managing knowledge. The pattern is based on Web 2.0 tools supporting the value co-production during the service process. We analyzed Wikipedia as a special kind of service where the creation and sharing of knowledge are supported by collaborative tools and the users have the role of value co-producers. We verified the soundness of the pattern in several service types, considering not only Web 2.0 and technology oriented services. We realized that the pattern could be observed in several categories of knowledge-based service. We believe that collaborative technologies can play an important role in knowledge-embedded services too, however, the impact in such cases still has to be monitored. Finally, we explored the role of co-production in the service life cycle grounding in some well known frameworks and models of service design and classification.

References

[1] J.A. Alic. Postindustrial technology policy. *Research Policy*, 30:873–889, 2001.
[2] C. Anderson. *The Long Tail*. Random House Business, 2006.
[3] R. B. Chase. Where does the customer fit in a service operation? *Harvard Business Review*, November-December:138–139, 1978.
[4] R. B. Chase. The customer contact approach to services: Theoretical bases and practical extensions. *Operations Research*, 29(4):698–706, 1981.
[5] R. B. Chase and D. A. Tansik. The customer contact model for organization design. *Management Science*, 29(9):1037–1050, 1983.
[6] H. Chesbrough and J. Spohrer. A research manifesto for services science. *Commun. ACM*, 49(7):35–40, 2006.
[7] R. Collison. *Encyclopedias; their history throughout the ages*. Hafner, New York / London, 1964.

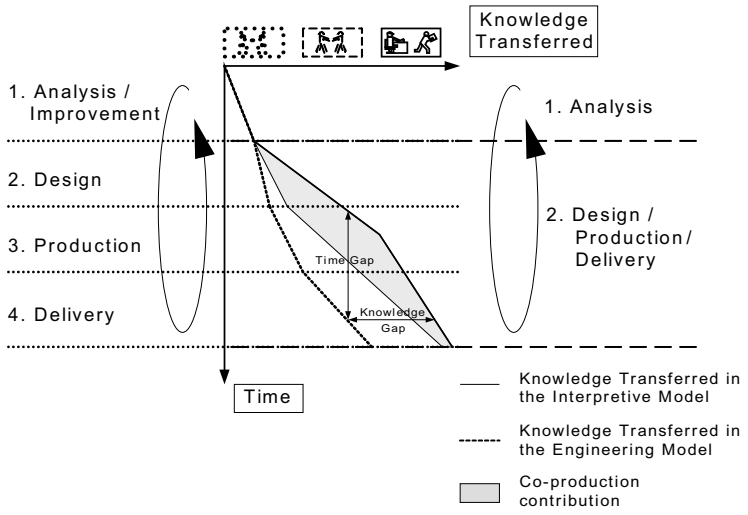

Fig. 2. Knowledge transfer gap between the engineering model and the interpretative model (with co-production).

[8] W. Emigh and S. C. Herring. Collaborative Authoring on the Web: A Genre Analysis of Online Encyclopedias. In *Proceedings of the 38th Annual Hawaii International Conference on System Sciences, HICSS'05.*, 2005.

[9] J.A. Fitzsimmons and M.J. Fitzsimmons. *Service Management: Operations, Strategy, and Information Technology*. McGraw-Hill, New York, NY, 2001.

[10] http://www.flikr.com/.

[11] V. R. Fuchs. *The service economy*. National Bureau of Economic Research, New York, 1968.

[12] J. Gadrey. The Misuse of Productivity Concepts in Services: Lessons from a Comparison between France and the United States. In J. Gadrey and F. Gallouj, editors, *Productivity, Innovation, and Knowledge in Services: New Economic and Socio-Economic Approaches*. Edward Elgar Publishing, Cheltenham, UK and Northampton, MA, 2002.

[13] P. d. Hertog. Co-producers of innovation: on the role of knowledge-intensive business services in innovation. In J. Gadrey and F. Gallouj, editors, *Productivity, Innovation, and Knowledge in Services: New Economic and Socio-Economic Approaches*. Edward Elgar Publishing, Cheltenham, UK and Northampton, MA, 2002.

[14] J. A. Herzenberg, S. A. Alic and H. Wial. *New rules for a new economy: employment and opportunity in post-industrial America*. Cornell University Press, Ithaca, NY, 1998.

[15] T. P. Hill. On goods and services. *Review of Income and Wealth*, 23(4):315–38, December 1977.

[16] H. Kang. Technology management in services: knowledge-based vs. knowledge-embedded services. *Strategic Change*, 15(2):67–74, 2006.

[17] U. Karmarkar and R. Pitbladdo. Service markets and competition. *Journal of Operations Management*, 12:397–411, 1995.

[18] D. L. Kellogg and R. B. Chase. Constructing an empirically derived measure for customer contact. *Manage. Sci.*, 41(11):1734–1749, 1995.

[19] P. Levy. *L'intelligence collective*. La Découverte, Paris, 1997.

[20] A. Lih. Wikipedia as participatory journalism: Reliable sources? metrics for evaluating collaborative media as a news resource. In *5th International Symposium on Online Journalism*, April 2004.

[21] C. H. Lovelock. Classifying services to gain strategic marketing insights. *Journal of Marketing*, 47(3):9–20, 1983.

[22] C.H. Lovelock and E. Gummesson. Wither services marketing? In search of a new paradigm and fresh perspectives. *Journal of Service Research*, 7(1):20–41, 2004.

[23] T. O'Reilly. What Is Web 2.0: Design Patterns and Business Models for the Next Generation of Software, September 2005.

[24] L. D. Paulson. Services science: A new field for today's economy. *Computer*, 39(8):18–21, 2006.

[25] C. Pinhanez. Service systems as customer-intensive systems and its implications for service science and engineering. In *Proceedings of the 41st Annual Hawaii International Conference on System Sciences, HICSS '08*, pages 117–126, Washington, DC, USA, 2008. IEEE Computer Society.

[26] S. E. Sampson and C. M. Froehle. Foundations and implications of a proposed unified services theory. *Production and Operations Management*, 15:329–343, 2006.

[27] J. Spohrer and P. Maglio. Emergence of service science: Toward systematic service innovations to accelerate co-creation of value. *Production and Operations Management*, 2007.

[28] B. Stvilia, M. B. Twidale, and L.C. Smith. Information Quality: Discussions in Wikipedia. In *Proceedings of the International Conference on Knowledge Management, ICKM'05*, October 2005.

[29] M. Viégas, F. B. Wattenberg and K. Dave. Studying cooperation and conflict between authors with history flow visualizations. In *Proceedings of the SIGCHI conference on Human factors in computing systems, CHI '04*, pages 575–582, New York, NY, USA, 2004. ACM Press.

[30] http://www.wikipedia.org/.

[31] D. M. Wilkinson and B. A. Huberman. Assessing the value of cooperation in Wikipedia. *First Monday*, 12, 2007.

[32] M. Xue and P. T. Harker. Service co-production, customer efficiency and market competition. Center for Financial Institutions Working Papers 03-03, Wharton School Center for Financial Institutions, University of Pennsylvania, January 2003.

[33] http://www.youtube.com/.