Embedding the New Discipline of Service Science

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Embedding the new Discipline of Service Science

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Abstract

This chapter presents a conceptual discourse for embedding the new discipline of service science. It argues for service science to be free of paradigmatic research influences of existing disciplines, proposing service science as an integrative discipline of engineering, technological and, social sciences for the *purpose of value cocreation with customers*. The chapter argues that thinking of a service organisation from a systems perspective will complement the traditional reductionist position and that together they will provide a sound foundation for the discipline of service science. The chapter then goes on to put forward a research agenda for service science, considering five salient issues for knowledge production. The argument for service science knowledge production is located alongside disciplinary knowledge of service, in so doing, suggesting that service science is not a logical development within any discipline and that the time is right for it to emerge into a discipline of its own.

Key Words

Service science, systems theory, complex service systems, viable systems model, value-in-use, value co-creation,

Introduction

Today's world economy is going through the largest labor force migration ever known to mankind. With globalization spurred on by rapid technological innovation, business growth has been phenomenal in providing employment particularly in the service sector. Indeed, this sector now accounts for more than 50 percent of

the labor force in Brazil, Russia, Japan and Germany, as well as 75 percent in the United States and the United Kingdom[1].

The growth of the service sector is changing the nature of the organization, and it is becoming apparent that there is a lack of research and knowledge in service with most academics working within a manufacturing rather than a service paradigm (Spohrer and Maglio 2008). For historically, research has supported the manufacturing sector (e.g. in engineering, management, technology etc.), but with economies shifting to service economies, research needs to focus on the technology and techniques that will enable organizations in the service economy to function effectively and productively. Even traditional manufacturing companies (e.g. Kone, Rolls Royce) now attribute more than 50% of their revenues to service. Yet, the technology, knowledge and expertise required for an organization to deliver a *service* which may include intangible value being delivered that is perishable by nature and heterogeneous in characteristic, are clearly deficient. It is widely recognized that service research has not kept up with the demands of the economy (Grönroos 2001).

In 2006, Chesbrough and Spohrer published a manifesto for research in service science. The article was a 'call to action' for academia, industry and government to create and pursue a shared agenda of service research. Chesbrough & Spohrer put forward the 'Grand Challenge' of service science, a common set of research problems meant to unite multiple groups in a common cause. Through the pursuit of these problems and by the means of a systematic, interdisciplinary approach, common terminology and methods they proposed the way forward for reconnecting theory with the needs of the service economy.

What began as a 'call to action' has now become a global initiative in service science or SSMED research, which is short for Service Science, Management, Engineering and Design. This emerging discipline advocates an interdisciplinary approach to the study, design, and implementation of service systems, that is complex systems in which specific arrangements of people and technologies take actions that provide value for others. As one might expect extant research in SSMED has focussed on the description of core problems and outline concepts behind the phenomena of service science (see for example, Maglio et al. 2006; Chesbrough & Spohrer 2006; Spohrer et al. 2007; IfM & IBM 2008). For it is through shared problems and concepts that foundations for interdisciplinary research are built.

Spohrer et al (2007) followed the manifesto with a general theory of service systems, which presented service science as an emerging field that should 'tap into' and integrate science, management and engineering for the advancement of

[1] IBM SSME website, http://www.research.ibm.com/ssme/

three primary goals; to understand service systems, how they improve and how they scale. In doing so they called for interdisciplinary, scientifically rigorous research into the three types of resource that make up all service, namely people, technology and shared information. IfM & IBM's (2008) report 'Succeeding through Service Innovation' drew upon the expertise and experience of leading academics and senior practitioners to propose a set of recommendations for key stakeholders of service science. The report set out the following recommendations for researchers intending to formulate service innovation action plans: to develop an interdisciplinary and intercultural approach to service research; to build bridges between disciplines through grand research challenges; to establish *service system* and *value proposition* as foundational concepts; to work with practitioners to create data sets to understand the nature and behaviour of service systems and to create modeling and simulation tools for service systems. Both of these articles set out an agenda for the advancement of service science, through the assimilation of interdisciplinary knowledge and skill that exists between the stakeholders of service science towards a shared set of issues.

Extant literature has provided us with a manifesto, a common cause and a set of questions from which to base the integrative discipline of service science. Thus, agendas have been presented which address the 'what' and the 'why'. In this chapter we develop the conversation on the fundamentals behind the 'how'. It is commonly noted that integration of disciplines requires a common purpose and the development of common language, platforms, units of analysis and research philosophies towards that purpose (Wild et al. 2009). Yet, the vision of service science is to discover the underlying principles of complex service systems and the value propositions that interconnect them. This will not be achieved through traditional approaches to scientific research alone; the answers lie deeper than interdisciplinary collaboration towards a shared cause. Certain aspects of the way we approach research need to be addressed if we are to produce new knowledge in service research.

This chapter begins by presenting service science as a distinctive field of study that places the co-creation of value between service provider and customer at its core. This definition means that service science has many founding disciplines including business, engineering and many of the social sciences. However we would argue that the development of service science will not emerge from any singular discipline but rather from the integration of research across these disciplines, that is, it should be trans-disciplinary. This in itself is not new, for Spohrer (2009) has called for

> *an integrated approach that spans not only existing discipline-based silos within academic organizations (i.e., marketing, operations, and human resource management within a business school)*

> *but also across academic organizations (i.e., business, engineering, and liberal arts)* (Spohrer 2009)

In our view the approach we take to this new discipline is crucial. We set out the case that there are two alternative but complementary scientific perspectives from which we can conceive of the new discipline. The first and historically dominant perspective is based on reductionism, the second takes a systems perspective. It is our view that thinking of a service organisation from a systems perspective offers many insights into integration that will complement the reductionist position and that together they will provide a sound foundation for the development and embedding of the new discipline of service science. We then move on to set out a research agenda for producing new knowledge in service, incorporating the implications of the two approaches presented. Finally, we provide the argument for service science as an emerging discipline and how it is conceptually located with service research within disciplines plus implications of the proposed agenda for research and practice.

Service Science and its distinctiveness

Service, as it was traditionally understood, comprised of activities, deeds and performances (Berry and Parasuraman 1993; Zeithaml et al. 2006). However, the new understanding of service is now broader, one where service "*is the application of competences (skills and knowledge) for the benefit of another party"* and such competencies could be manifested in a complex combination of goods, money, activities and institutions within a service system (Vargo and Lusch 2008). This service-dominant logic embraces the concept of value co-creation, where the value is no longer *value-in-exchange* (i.e. a tangible product solely created within the firm and exchanged with the customer), but *value-in-use*, i.e. jointly co-created between the customer and the firm for benefits (Ng et al. 2008; Payne et al. 2008; Prahalad and Ramaswamy 2003). The concept of value co-creation subsumes previous service research that have emphasized the role of the customer within a service system such as the customer contact model as proposed by (Chase and Apte 2007; Chase and Tansik 1983), customer interactions (Johnson et al. 2005), value co-production with the customer (Ramirez 1999). The understanding of "customer" here is taken in the broadest sense of the word e.g. the end customers who actually pay and receive the service or organizations/customers in public services and even customers who use the service and do not directly 'pay' for it (e.g. Broadcasting and Google).

Despite subsuming previous literature on customer centricity, the new concept of value co-creation in service systems extends the ideas further with two major implications for the design, delivery, evaluation and purchase of service. The first is the notion that customers are an integral part of the service systems and they contribute the resources accessible to themselves into the system to achieve the outcomes just as firms deploy resources into the service system to deliver the ser-

vice. This implies customers' *abilities* to co-create value i.e. *their* resources (e.g. in knowing how to use an ATM, informing the hairdresser how s/he would like his hair cut, understanding how to get around an airport, or a leasing company's ability to operate aircraft) is now *part* of the organization's service capability to deliver, particularly if it aims to achieve service excellence (Ng et al. 2008). This also implies a far more proportionate view of a service system, with equal emphasis on customer and the firm's systems, is needed in understanding value co-creation. Second, as an extension of the first, is that firm's competency to deliver on a service, and perhaps its potential source of competitive advantage, includes the customer "as the source of competence", and the firm has to find ways to harness the competency (or improve the lack of competency) of the customer in the service system (Prahalad and Ramaswamy 2000). Seen in this light, value co-creation thus demands a major rethink of traditional disciplines from management and technology to the engineering and manufacturing of tangible products. Traditional disciplines are strongly goods-based, more often involving linear supply chain models and linear models from design to manufacture. This may impede organizations' potential to construct optimal systems for value co-creation since, in contrast to linear models, service often involves "value constellations" (Normann and Ramarez 1993) which are networked and complex (Demirkan and Goul 2006) and which suggest a multi-faceted and iterative approach with the customer system within the whole system. The move towards that understanding is a process commonly known as *service transformation* (Ng, Williams and Neely 2009). With newer technologies such as computing and web-based technologies in which such IT-related capabilities could be provided "as a service", the time has come to allow service to emerge as its own discipline of service science, which will enable it to focus on producing knowledge on how best value could be co-created, and how a service system of people, technologies and products could be configured in order to integrate the best from all disciplines.

The understanding of value co-creation also compels the firm to better understand customer needs and usage requirements across differing environmental conditions so that customers are able to realise the the firm's value proposition through their part in the co-creation process. In so doing, customers' use and achievement of outcomes could result in changing the firm's business model (Ng, Nudurupati and Tasker 2009). Customer usage could result in different types of access rights to tangible goods and intangible activities within a service system for example hybrid revenue models of ownership/lease of goods and privileged access to activities and physical locations,

How, then should the new discipline of service science approach the understanding of service systems? Science proposes two different perspectives. The first is reductionism which is widely adopted and is implicit in many of the disciplines that combine to make up service science. The second is systems thinking, which we would argue is much less used but has the potential to offer a different set of

insights for research. In no sense are these two approaches in competition. Rather, they are complementary and both provide insights into the study of service organisations. We shall now consider the features of both perspectives.

Reductionism

It has notably been argued that the standard scientific approach is based around the 3 R's of reduction, repeatability and refutation (Popper 1972). That is we reduce the world through the selection of variables and we run repeated experiments until exceptions occur (refutation). Checkland (1981) points out the three ways in which much of scientific thinking throughout history has been reductionist (Checkland 1981).

1. Because many problems are highly complex and messy scientists focus their effort and select some aspects of a problem from all those that are possible for further detailed investigation.
2. Science progresses by applying the principle of Occams razor: the removal of all extraneous factors for a parsimonious explanation of the facts.
3. Science follows Descartes' advice to analyse problems piecemeal, that is, breaking down a phenomena into its elemental parts. Accordingly, scientific thinking is very closely associated with analytical (divided into its constituent elements) thinking.

This approach to scientific thinking strongly influences the manner in which management academics approach their research. For example, Schroeder (2008) in his recent article on theory in operations management states that "*not only should theory be parsimonious, but it should be falsifiable*". He then calls on operations management scholars to develop *"good" theory that can be tested and possibly refuted, confirmed, or refined.* Clearly for Schroeder, good theory is closely associated with reduction.

Yet we would argue that the reductionist approach is based on a number of assumptions that we should consider before applying it to the problems of service research.

Assumptions in Reductionist thinking. The first and most crucial assumption, the division of the complex problem into separate parts, is that the elements of the whole are the same when examined independently of the whole as when they are examined as a whole. This needs careful consideration. If the elements are loosely connected then we can take them apart, analyse them, improve or change them and then put them back together and the whole will be improved. Whilst this may be true for the problems of physics at the atomic level, does this assumption hold for complex wholes? For example can we take out a part of the body e.g. heart, modify it replace it back within the body and not expect affects elsewhere?

It is also not just that the parts of the whole in service that are interconnected, their relationships are also highly complex and non-linear. Forrester (1956) in his seminal work on organisational dynamics points to the importance of time delays, amplification and structure on the dynamic behaviour of the system (Forrester 2003). These can occur across supply chains (the Forrester or Bullwhip effect) or within organisations. Ackerman and Voss (2003) provide an excellent example of a Telco implementing a new customer service process that includes four separate activities, selling, installing, provisioning an billing each of which is carried out by a different department. The interactions between the departments led to enormous amplification where a 10% increase in sales order volumes leads to a 250% increase in provisioning, 140% in installing and 175% in billing (Akkermans and Vos 2003).

Finally, Lipsey and Lancaster (1956) and Goldratt (1994) have identified implications for the performance of parts where there is a close relationship. Lipsey and Lancaster in their theory of the second best showed that if one optimality condition is not satisfied, it is possible that the next-best solution will involve changing other variables away from their positions of optimality (Lipsey and Lancaster 1956). Similarly Goldratt pointed out the implications of optimising one part of a whole process that was not the limiting step. In his theory of constraints he points out that optimising the performance of a process step upstream of the bottleneck will only increase work in progress and working harder downstream is limited by the output of the bottleneck (Goldratt 1994). Sprague (2007) sums this up neatly proposing that *"Optimizing the supply chain" means convincing elements within that system to accept local sub optimums for the good of the whole (Sprague 2007)*. We would simply add that this holds for any system not just supply chains. Thus, if we want to understand the performance of the whole service system and we if we have begun the understanding by following the method of reduction we are making three highly questionable assumptions; First, the connections between the parts must be very weak; second, the relationship between the parts must be linear so that the parts can be summed together to make the whole; and third, optimising each part will optimise the whole.

To address the problems caused by these assumptions an approach is required that begins with the whole and concentrates on the relationship of the parts in the whole. This is the perspective taken by systems thinkers which we will now consider in some detail.

Systems Thinking

In the introduction to Systems Thinking, Systems Practice, Peter Checkland (1981) states that;

> *the central concept of a system embodies the idea of a set of elements connected together which form a whole this showing properties which are properties of the whole rather than properties of its component parts.*

There are a number of important ideas in here that need to be drawn out. Firstly, the definition draws attention to elements (other systems writers use words such as components or parts) which are interdependent, that is elements which affect one another, system thinking is particularly associated with the study of elements that have strong connections (Weinberg 1975) as problems with weak connections are amenable to reduction. Secondly, there is the notion of the study of 'wholes'. Thirdly, there is the idea that there are properties which occur in the whole not in the component parts, which is of course the essence of the famous phrase attributed to Aristotle that 'the whole is greater than the sum of its parts'. In short systems thinking is concerned with the study of wholes that exhibit strong interconnections and that as a result of these interconnections properties emerge at the level of the whole that are not present in the elements.

Emergence. Of central importance to seeing the world from a systems perspective is this concept of emergence which is probably the most important and challenging idea in systems thinking. Understanding emergence sheds light on what appears as a paradox; that the whole is made up of a set of elements, yet the whole is also different from the elemental parts. Take for example the harmony of a group of musicians. The property harmony is not found in the component parts, e.g. the vocalist and guitar, but only occurs when they interact. Other frequently used examples include colour (a phenomenon that can only occur because of the arrangement of the constituent parts in an atom) the swarming of bees, hurricanes, traffic jams and many would argue, life itself.

A fundamental principle is that emergent properties are essentially unpredictable, indeed one well used definition of emergence is that it cannot be predicted (otherwise it would be deterministic) and that it is 'subjectively surprising' (Klüver 2000). Henle (1942) argues that "*where there is an emergent there is unpredictability* and that *we have emergence where a new form appears and where the causes of the appearance are unable to explain the form"*. P488

This does not mean that everything that is unpredictable is emergent for it may mean we have not as yet developed the model that explains the underlying relationships. The argument here is that given a known starting position and knowledge of the components of the system we may not know what the outcome of the system could be.

Emergence is clearly a deeply challenging concept and one that is at the heart of studying wholes not parts. We can provide three insights that might help.

1. What we are observing in complex systems is circular causal chains (Buckley 1980) where the effect of one element on a second element returns to influence the original effect perhaps directly or through some in-

termediate effect. In organisational life, it is often difficult to point to one-way causality.

2. Secondly: emergence is very hard to predict because of the number of elements that interact to produce the property. Seen from one perspective this is a combinatorial problem: identifying all the potential outcomes with many millions of interacting elements (all the potential states of the system) is incredibly challenging and if we take into consideration the non-linear relationships and multiple potential feedback loops, then the results are impossible to predict.
3. Thirdly, there is coupling between the elements so that something is produced in the interaction of the two elements which is a product of the interaction. An analogy might be a win-win game where both parties gain and therefore and the new relationship produces an outcome that is greater than the parts.

Core Systems Ideas. Building on the notion of a system this section will consider some of the main features of systems thinking that can contribute to the development and embedding of service science as a new discipline.

1. Systems characteristics.

One of the advantages provided by systems thinking is that there is an established language of systems characteristics. As a meta discipline systems thinking has over the past 50 years developed, across many disciplines, an established set of terms that can provide insights into any discipline. Some authors e.g. Kast and Rosensweig (1972) have applied these terms into identifying some basic characteristics of a management system which include; boundaries, interfaces, hierarchy, feedback and adaptation to which most systems writers would add emergence, input, output and transformation (Kast and Rosenzweig 1972). These terms may be used as a basis for a research agenda for the consideration of a service system.

2. Law of requisite Variety

How a system behaves is a key question for those systems researchers working within the general field of cybernetics. One of the most important ideas for service systems research is Ashby's law of requisite variety. The law states that at a minimum there needs to be as much variety in the responses available to the regulator (manager) as in the disturbances that emerge from the environment. If there is not then the manager cannot guarantee acceptable outcomes and therefore keep the system viable. Ashby summarises the law as *only variety can destroy variety.*

3. Viable Systems Model

Beer (1984) applied Ashby's law of requisite variety in his Viable Systems Model (VSM) where the term viable is used to assess whether an organisation is able to survive in its environment. The paramount viable system in an organisation (VSM has 5 sub-systems) is its *producer system,* which is the system which gen-

erates the income on which the organisation depends for its survival (Beer 1984). Producer systems are threatened with overwhelming variety from the environment and have two potential options which Beer terms variety engineering.

1. Attenuation; limiting the amount of variety on offer e.g. a fast food restaurant like MacDonald's has a very limited range of offerings on its menu. If what customers want is something outside the fixed menu then the attenuator (the systems designer) has reduced operations response below the threshold and the producer system does not have sufficient variety to respond.
2. Amplification; for example in a producer systems that only offers one choice of colour, for example black, we could amplify variety by offering the customer price promotions that emphasise the value in buying black or we could develop an advertising strategy that promotes black as "cool".

4. Socio-Technical Systems

A major part of the systems movement that was based around the view of an organisation as an open system was the socio-technical systems school developed during the 1960s at London's Tavistock Institute. Emery and Trist (1960) in their famous work on socio-technical systems were interested in the open systems notions of input-throughput-output and how a system maintained a quasi-stationary equilibrium despite changes in the environment (Emery and Trist 1960).

The Socio-Technical school drew a general conclusion that the social and psychological aspects of work needed to be understood in the context of the task and the way in which "the technological system as a whole behaves". The technology system here is taken to include not only the hardware, machines etc but the methods and procedures of work and how that work is organised in a process. Thus the Tavistock research identified the technology component of the system as playing an important part in the organisation of the system and that it was no longer possible to talk of purely social systems composed of people and their relationships but to consider the enterprise as a combination of human and technology in a socio-technical system.

5. Open and Closed systems

The notion of an open system is associated with the early work of the Biologist and General Systems Thinker Von Bertalanffy. He describes open systems as a system which has an *exchange of matter with the environment*, (Bertalanffy 1972). Closed systems, on the other hand, are systems where *no material enters of leaves it* and are typically found in the realm of physics and physical chemistry.

The discussion on whether a system is open or closed has particular application in the management of service systems. Consider the implications of taking a closed or relatively closed system view of an organisation or department in an organisation. Such a system would be deterministic and optimizable. However, tak-

ing an open systems view would suggest a complex and dynamic interaction of the organisation and its environment with undeterminable results. The consequences of closing the system in a technical core are considered by Mills and Moberg (Mills and Moberg 1982).

Revisiting Reductionism

A systems view does not, however, conflict with the reductionist views, it should be considered as complementary.. The traditional thinking behind the reductionist view is if we can get the right simpflications, we will then understand all. If this is true, by logical extension, the right simplification has to be particle physics, since that is what all matter consists of. Clearly, knowledge of particle physics would not be particularly helpful in understanding sociology, economics or psychology. Such a notion as Dennett (1995) puts it, is "greedy reductionism". Also, as Anderson (1972) points out, reductionism does not mean constructionism i.e. just because we could reduce it, does not mean we could construct the system (Anderson 1972). The key question is what the system should be reduced to and for what purpose. The important consideration for a reductionist approach is to weigh the potential to generate insights against the cost of being less exact. Being less exact might be acceptable, but being inappropriate could warp what needs to be understood. Thus, service science has to embrace the notion that whatever the reductionist approach taken, what is lost in reduction is merely resolution, and not the understanding of the whole.

One example of reductionism from a systems perspective is research in computational modelling of agent-based complex systems and developing work in the science of complexity (Wolfram 2002; Epstein 1999). Agent-based objects could be people, organisms, and such objects are capable of change, interacting, thinking and are intelligent but not brilliant in their deliberations. Using agent-based objects in modelling provides a more flexible, dynamic and networked approach that is process oriented and allows for adaptive and emergent properties (Miller and Page 2007). Research in this area has provided insights into why some systems are stable while others are constantly in a flux (Tiebout 1956) by modelling elements, their interactions and analysing feedback into the system. Thus, from the reductionist view of a complex service systems, a system could be reduced but only if all interactions are modelled as well. Miller and Page (2007) proposed that when reducing systems to agent-based objects, there are eight interconnections to model so as to ensure the representation of the system is appropriate; the agents' information and connections, goals, communication among the agents, action (interaction), payoffs, strategies and actions, cognition and the model focus and heterogeneity. Yet, even as all eight are modelled within one or more agent, the resultant system could result in unpredictable emergent properties – both of the stable and unstable variety. This is because even if we completely specify all interactions and components of the system and its probabilities of occurrence, it is acknowledged amongst researchers in the field that there is still no simple way to understand the

macro-level outcomes. This emphasizes the crucial aspect of reductionism in service systems, which is to create models that could go beyond our own understanding, and to build in framework for emergence within the model, and to explore the notion of *organized complexity* (Weaver 1948, Weinberg 1975) that could be invaluable when designing future service systems.

We recognise that the division of approaches to science into reductionism and systems is to some extent artificial. It would be better, perhaps, to recognise them as different positions on a continuum. For problems of relatively low complexity with low randomness, termed *organised simplicity* by Weinberg (1975) then deterministic closed systems models are appropriate i.e. we can understand how the factors inter-relate and we can predict the end result with accuracy. These are the problems that are suitable for reduction into components. For those problems that have greater complexity and that exhibit higher levels of randomness in their behaviour (emergence) then this is the domain of systems thinking. Here the problems are of large numbers of variables with many combinations that are not amenable to varying one factor at a time. This makes the problems too difficult for the traditional reductionist method. Weinberg (1975) and Weaver (1948) term these problems *organised complexity*. Any reductionism would have to incorporate interactions and would be a reduction of the whole system into a prototypical or representative equivalence.

Systems thinking provides an important platform for the development of a 'how' research agenda. The division of academia into subject silos contributes to the challenges in engaging in businesses where problems tend to be complex and deeply integrative. One simple example serves to illustrate the point, in what we term the potato case. In this example a company was making French fries from potatoes. However its purchasing department was having problems buying potatoes that fitted their size requirement (they had a minimum and maximum specification). The types of potato that fitted the specification had high demand and were being sold at a premium price. The purchasing department was regularly exceeding its price target and consequently received lots of pressure from their senior managers to improve their performance. Without consulting anyone, the purchasing department removed the maximum size specification of the potato thereby allowing them to buy larger potatoes and at a cheaper price. However, the potatoes were now too big for the chipping machines and at Christmas the company were unable to fill their order from a major retailer. A minor modification to one part ie changing the maximum size specification had huge implications across the business. This is often termed the law of unintended consequences.

This simple and true story illustrates the interactive effect of change in business. If academia reduces problems to, for example, the level of a pricing strategy or performance measurement it then it risks providing sub-optimal solutions at the level of the whole. Research in service systems needs to include models that show

the interactive effects at the level of large 'wholes' be they individual companies or across supply networks.

The above presentation has highlighted the approaches towards research in service science. Following on, we propose a research agenda for service science and key issues in producing new knowledge in service.

SERVICE SCIENCE RESEARCH AGENDA: ISSUES FOR KNOWLEDGE PRODUCTION

1. **The need for more appropriate simplification in service.**

There is a pressing need for service to be understood across sectors. *Abstraction* is necessary to discern the tacit knowledge in service for the purpose of *transferability* of knowledge across industry sectors and academic disciplines as well. Abstraction is also needed for *replicability* so that future service design could be systemic, structured and deliberate to ensure sustainable service excellence. Finally, abstraction is needed for the *scalability* of service for growth. Service needs to find a set of simplifications that is able to preserve the essence of the whole while being able to achieve transferability, replicability and scalability. Service science could provide not merely fundamental understanding, but also better tools and mechanisms for discovery and abstraction. Even at the very least, service needs better measurement, analytics and identification of what is performance success. For most of the past three decades, social scientists have tried to find ways to classify and disassemble service in a meaningful manner that would aid practice and provide understanding. This has been without any noticeable success in part due to the analysis being not sufficiently fundamental (the periodic table would be a good analogy of achieving a framework for fundamental understanding so as to classify, systematize and compare all the many different forms of chemical behaviour). In addition, we argue that existing research of this nature has been conducted through narrow disciplinary lenses. Hence, much of service research to abstract service typologies use words such as "complex", "system" and "relationships" (see (Liu et al. 2008) for a historical account of service typologies), an indication of a knowledge gap. Just as science provided ways forward for Physics and Chemistry from 'Alchemy and Occult', service science research is challenged to find its abstraction and properties that would subsume all sectors. Service, like color in the early days, is currently alchemistic[2].

2. **The need to look forward.**

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[2] As Newton wrote, "A Naturalist would scearce [sic] expect to see ye science of [colours] become mathematicall, and yet I dare affirm that there is a much certainty in it as in any part of Opticks" (The correspondence of Isaac Newton ed. HW Turnbull, JP Scott, A Rupert Hall, Laura Tilling, 7 volumes, Cambridge: Cambridge University Press, 1959-177 1:96)

The Janus face of science suggests that science has two faces where one looks back at the current state and evidence (ready-made science) while the other looks for the way forward (Latour and Biezunski 1988). For the sake of publications, service research in the past has had to be conducted through the lenses of one or another existing discipline. The current state of service research could then be a reflection of the way it has been influenced by whichever disciplinary regime in which it currently sits, which may not be the best way to look forward. There is a need to take the lessons from the other disciplines, but without the hegemony. When disciplines come together to understand value co-creation with the customer, there would be new impetus for service innovation and service excellence. Yet, while service science is tasked to be able to both look back for the best technologies and look forward to progress knowledge, it must acknowledge the strength and weaknesses of current disciplinary-based knowledge and methodologies. In researching service systems, the technology to capture the range of data (particularly behavioral data) may be beyond the current conventional collection methods and possible observations are far more expansive than what current methodologies can capture. When Copernicus first thought about the possibility of the Earth revolving around the sun, it was not based on measurements or data (although he was clearly motivated to find a theory that could simplify measurement since the Ptolemaic system was very cumbersome empirically). Instead, Copernicus indulged in what is termed as ‘thought experiments’ (Brown 1993; Cohen 2005), breakthrough ways of seeing the world, instead of merely looking at new methods or tools to ‘measure’ what is existing. Indeed, as contemporary philosopher Cohen puts it, "much of modern physics is built not upon measurement but on thought experimentation". Hence, current knowledge and methodologies may be inadequate for service systems. Rather than apply legacy knowledge towards service systems, researchers must also open their minds to opportunities to produce new knowledge, new methodologies and new ways of seeing the world, brought upon by intrinsic characteristics of the service system. The act of focusing on what exists now should not draw attention away from 'what can be' (Alvesson and Skoldberg 2000). Work by Vargo and Lusch (2004, 2008), although incorporating themes of what has been iterated for the past 30 years, is a start towards viewing the service domain through a different logic but service researchers the world over need to feel much more empowered to challenge conventional thinking and legacy knowledge (Vargo and Lusch 2004; Vargo and Lusch 2008). Finally, the interactions and the interplay between processes and outcomes within a service system which are non-linear and multi-directional in nature, suggests that the instrument of analysis may not yet be scientifically reproducible in any meaningful manner by conventional methods. Indeed, techniques traditionally used could be, as Miller and Page (2007) puts it, “understand running water by catching it in a bucket”. Future techniques and tools for service system would also need to emphasize dynamic processes and states of equilibrium; much of these ignored by current researchers that research within a static environment.

3. **The role of technology changes the service system and vice versa.**

Real/virtual interaction is playing an increasingly prominent role in the service economy and there is a need to better understand virtual worlds as a medium, virtual companies, brick-and-click delivery, multiple-channels, and web 2.0 in value co-creation of service systems. In the field of management, technology is beginning to gain traction in changing business models, for example, in the field of management 2.0® (Breen and Hamel 2007). Leaps in computing power have resulted in newer technologies with greater capability, from the ability to sense facial expressions and stress levels to a fully liberated cyberspace where autonomous and intelligent entities or virtual objects can act in full inter-operability and auto-organize themselves to deliver services, based on the concept of the *internet of things* attributed to the original Auto-ID Center, based at MIT (with continuing research with Cambridge, UK). The service system and the notion of value co-creation are starting to change research in technology as well. More studies are being conducted in the technological sphere that includes customer behaviors and processes, informing research in service-oriented architectures (Papazoglou and Heuvel 2007), User Centred Design (UCD) and Human-Computer Interaction (HCI) which views design for and from the customer, termed as user in the literature. A socio-technical systems view of service could challenge the assumptions surrounding customer types in software modularity and mechanistic designs, compelling research in this area to bring the customer into design issues for greater innovation in value co-creation. This is clearly evident in healthcare, where the digitisation of medical records is not merely leading to a convergence of biology and engineering, resulting in the health care service systems and clinical practice becoming much more an information industry, but also allowing customers access and control into their own information and letting them take responsibility for their health through intelligent sharing network of records (The Economist, April 16, 2009).

4. **The need to integrate social sciences (and business), engineering and technology *for customer value co-creation*.**

It would be a mistake to think that basic research in service science is disciplinary specific and the applied research of service is where interdisciplinarity and integration sits just as it would be a mistake to think that the practice of service is where integration occurs. Precisely because the unit of analysis is the whole service system, basic research is needed into understanding what patterns and orders exist at a systemic level whilst *at the same time* at the analytical level research is needed into how elemental parts of the service system behave, all within an interdisciplinary context. However, interdisciplinarity is one of the biggest challenges in research. As an analogy, one does not leave sodium and chlorine in a beaker and expect them to naturally react and deliver salt. More often in the real world context, the sodiums would have retired to their rooms while the chlorines would have gone down to the pub. Integration of disciplines requires *a common purpose* and the development of a common language, platforms, units of analysis and re-

search philosophies towards that purpose (Wild et al. 2009). Thus, our emphasis on value co-creation with the customer explicitly identifies the purpose towards inter-disciplinary collaborations. The focus on value co-creation, much like the focus on *healing* for medicine as a discipline, should therefore be the central theme of service science and is also the unifying focus towards which knowledge from various disciplines can contribute. By explicitly bringing in the value co-creation, we believe service science can achieve a constructive collaboration for the betterment of knowledge to deliver and innovate on service in the modern economy. In addition, the focus on value co-creation conceptually differentiates service science from service research within other disciplines which would still thrive, particularly in light of the dominance of the service economy. The theme of customer value co-creation is echoed in several papers and presentations on service science (Spohrer 2009; Spohrer and Maglio 2005):

> *Service science is emerging as the study of value co-creation phenomena in a globally integrated and connected world, which has the potential to become significantly smarter and more sustainable. In a service world, diverse entities create, abandon, utilize, ignore, configure, reconfigure, specialize, integrate, protect, and share resources and relationships to co-create benefits with and for each other, both as individuals and collectives, both for the short-term and the long-term.*

5. **Service Science could be a Disruptive Science.**

We have previously presented how the introduction of a customer system within a service system is a requirement in the study of service. It would therefore not be surprising to find that traditional disciplines that are strongly goods-based may find service technologies rather disruptive (Bower and Christensen 1995) although the disruption might provide opportunities for innovation. In the service context, the move towards a service orientation could lead to the ability to define new "spaces" for doing business that were previously non-existent but of which the profitability is uncertain (e.g. youtube or google). With value less 'contained' within the vessel of a tangible product, value co-creation could happen everywhere within a service system, often between employees, customers, tangible products and technology (Ng and Yip 2009a). Traditional manufacturing and engineering technologies that proposes the optimization of a system that does not include the customer system is now challenged. Similarly, the notion that costs could be minimized and efficiency gains could be attained within a service system without controlling for the loss of value co-created with the customer suggests that many tangible product-based technologies need to be seriously re-evaluated and service science technologies could possibly be disruptive to existing ways of thinking (Ng and Yip 2009b). The industrial era has accumulated more than a hundred years of knowledge in the managing, manufacturing, and engineering of

tangible products, often within silo-ed disciplinary domains. Thus, the advancement towards a technologically fast-paced globalized world where the service system is a constellation of amorphous value co-creation with the customer, integrating several disciplinary approaches is bound to create severe discomfort, not least amongst the knowledge producers of the old. As the world moves towards a service era, serious questions need to be posed about the legacy knowledge and while the best technologies to advance knowledge in the service era will eventually be adopted, adapted and improved, the initial task of embedding the discipline of service science will encounter political difficulties.

Those with the most to gain from a trans-disciplinary approach would be expected to be most enthusiastic. These include researchers who recognize knowledge transfer through a plurality of mechanisms rather than merely through publications; those who are marginalized by their own disciplines or who labored under the patronizing attitudes of the 'purer' or more 'basic' disciplines, as well as policy makers who are motivated to create better links between science and innovation. Those who are most threatened by a trans-disciplinary approach would predictably be most skeptical; they would argue that the quality of research would be eroded through trans-disciplinarity or feel that their autonomy might be jeopardized. Most alarming to such researchers is the possibility that those who subscribe to product-based technologies may find themselves obsolete in a service system-dominated world. For these researchers, a natural reaction is to reject and refuse to participate. This would be disappointing as the reality is usually far less threatening. What is required of researchers is the willingness to share and adapt existing knowledge, particularly in light of increasing complexity of research problems, and recognizing interdependencies in the production of new knowledge, a fact that has been widely acknowledged (Gibbons et al. 1994; Nilsson 2001; Nowotny et al. 2003). Ziman (2000) describes the transformation of knowledge production processes in what is commonly known as 'post academic' as:

"*…marked by an increasing degree of collectivization as a response to the growing complexity of research problems, [and] the increasing costs of scientific equipment, but also the growing potential for research collaboration that is offered by information technology.*" (Ziman 2000)

What is needed for service science is for knowledge from all relevant disciplines to be presented to inform customer value co-creation. In doing so, we believe that the gains from the interactions would inform and contribute in return to the production of their own disciplinary knowledge, which is still much desired.

In our endeavour to embed the discipline of service science, our chapter has presented system and reductionist approaches to research as well as the research agenda for the discipline. We now put forward an argument for why service science is an emerging discipline.

Service Science as an Emerging Discipline

As a result of disciplinary inter-dependency, we propose that service science is not a logical development within any existing discipline. As long as it sits within a discipline, it shall remain a subset of that discipline and more drastically, oppressed by the discipline's agenda, whether intentionally or otherwise. High level mainstream journals are disciplinary-focused, and these gatekeepers will often not allow their power bases to be diluted by a trans-disciplinary approach. The current climate of service research therefore behaves as though most of the answers are there to be applied, albeit it depends on whether it is a technology, marketing, operations, organization behavior, strategy or engineering perspective of service. As such, we argue that service research is currently studying service very much in context. A research article in a service sector often does not address how relevant it is towards other service sectors and as long as service is relegated to 'sectors' and does not sit as a 'discipline', it would be impossible to progress the learning. Hence, we contend that service needs to *emerge* into a discipline of its own; an integrative discipline of the business, engineering and social sciences for value co-creation with the customer, much like medicine is an integrative discipline of physical and biological sciences for healing.

Our thesis is incomplete unless we conceptually locate where disciplinary knowledge of service, what we define as serviceX (e.g. service marketing, service engineering, service operations, etc.), sits vis-à-vis service science. Disciplinary knowledge in service is still very much desired due to the depth of analysis within that domain. To achieve that depth, many disciplines such as engineering, operations and ICT, while striving to be customer focused, have had to assume customer characteristics to be exogenous to study problems in service design, architecture, engineering and delivery. This is necessary for research questions to be defined and solutions to be tractable. The knowledge produced within such disciplinary domains would still be valuable to service science. Marketing, which brings the customer endogenously into its discipline (in terms of understanding customer choices and needs) is conversely less inclined to evaluate design and delivery issues in service for the obvious reason that design and delivery requires exogenous customer characteristics to design and deliver around. Yet, marketing research in service would also contribute to service science, for example in the understanding of value-in-use and customer needs. Consequently, to use again the analogy of medicine, research in genomics should still continue even while the discipline of medicine continues to seek the best technologies for healing.

Those who currently conduct service research would recount two major movements to push the service agenda – once in the seventies and another in the late eighties/early nineties and both led by Americans (Fisk et al. 1993). Concurrently in Europe, there was also a movement in support of service research. The most notable were by the Nordic Schools (Gronroos and Gummesson 1985) and among its proponents include works by Gronroos and Gummesson. Unfortunately, these movements lacked traction and a tenure-track system of rewarding academics only if they publish in top-tier (disciplinary-focused) journals led to the quiet with-

drawal of many service researchers back to their parent disciplines. The creation of the new *Journal of Service Research* in the early 2000 by Roland Rust, who subsequently became the editor of *Journal of Marketing*, was the start of a new initiative in customer-focused service research in this millennium which has finally begun to gain momentum.

Our proposal for service science as an emerging discipline is facilitated by two further major events in 2004. First, the publication of Vargo and Lusch's Service-Dominant Logic in the *Journal of Marketing* (Vargo and Lusch 2004) and its follow-up article in Vargo and Lusch 2008 served to propel service into the forefront and has had a big influence on at least one other discipline, operations management; and second, the growing service science movement initiated by IBM. Led by these two events, service researchers have become more empowered to challenge the status quo and to push journal editors for more interdisciplinary special issues in service. While the current state of empowerment is laudable, it falls short of true liberation. Hence, service science, as a catalyst for change (Davis and Berdow 2008) and as an emerging discipline, would complete the task necessary to push the frontiers of service research.

Large manufacturing, telecommunication and engineering organizations such as Kone, Rolls Royce, BAE Systems, BT and HP have started to take a greater interest in service, bringing along researchers from engineering and manufacturing and increasing the credibility of conducting service research. However, it also poses new research challenges for service researchers who have been based in business schools often researching in traditional service industries such as hospitality, healthcare, transportation, leisure and banking. The arrival of engineering and technology researchers threatens to create a schism in service research, polarizing it into the IPS[2] (Industrial Product-Service-System[3]) and service support engineering research that caters to the engineering-types; the IT-based research on service oriented architecture, HCI, cloud computing or 'Everything as a Service' (EaaS)[4] that cater to the technology-types; and the traditional service research of the social science and business variety. We argue that the timing is therefore right for service science to emerge as its own integrative discipline.

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[3] IPS[2] comprises the integrated and mutually determined planning, development, provision and use including the option of partial substitution of products and services over the lifecycle. IPS[2] working group was founded by the International Academy for Production Engineering and is a community of 550 members from 41 countries with a strict limitation of membership. See http://www.lps.rub.de/schwerpunkt/cirp/

[4] Cloud computing is the development and usage of Internet-based (hence, "*cloud"*) computer technology (hence "computing"). Cloud computing signifies IT-related capabilities that are provided "as a service", allowing users to access technology-enabled services from the Internet with little knowledge of, expertise with, or control over the technology infrastructure that supports them.

Conclusion

This chapter has presented a conceptual discourse for embedding and advancing knowledge production in the new discipline of service science. Agendas have been presented throughout service science literature addressing the 'why' and the 'what' of research into service science, the aim of this chapter is to build on conceptual discussion of the 'how'. Through the perspective of systems thinking insights are offered into integration that will complement the traditional reductionist position and that together will provide a sound foundation for the development and embedding of the new discipline of service science. The paper also considers five salient issues for knowledge production as part of the wider research agenda for service science - (1) the need for more appropriate simplification in service; (2) The need to look forward; (3) the role of technology changes the service system and vice versa; (4) The need to integrate social sciences (and business), engineering and technology for value co-creation; and (5) service science could be a disruptive science. The chapter locates the argument for service science knowledge production alongside disciplinary knowledge of service and in so doing, suggests that service science is not a logical development within any discipline and proposes that the time is right for it to emerge into a discipline of its own. Thus, developing conceptual thought through future directions into how researchers should approach knowledge advancement in the discipline of service science.

Implications for Research and Practice

As Chesbrough & Spohrer (2006) noted, productivity gains arise from research and development and at the heart of this R&D system is the academic university, and the academic community of scholars, students, and alumni that comprise the greater academic community. Whilst there is a growing initiative to understand and advance the roots of the service economy, organizations are still left without a solid theoretical framework. Without such theory, service providers are left with legacy tools and the challenge of providing effective, scalable delivery of service offerings. In today's economy, service means employment and growth, but the companies who have been leading the charge lack a strong theoretical foundation for their practices and are now reaching out to academics (Chesbrough & Spohrer, 2006).

The research agenda presented in this chapter has a number of implications for generating abstracted theory of service which can be understood and implemented across sectors. The five salient issues for knowledge production which are presented call for abstraction for the purpose of transferability, replicability and scalability. To do this, rather than apply legacy knowledge towards service systems, researchers must also open their minds to opportunities to produce new knowledge, new methodologies and new ways of seeing the world, brought upon by intrinsic characteristics of the service system. The research community needs to embrace the challenges of knowledge production in service and the disruption it

will inevitably bring if we are to improve the basis for understanding service systems. In order that theory is generalisable to all service providers in order that they can apply that understanding for advancing our ability to design, develop, improve and scale service systems for practical business and societal purposes.

In terms of practice, managers are increasingly called to develop solutions in service that can be de-contextualized, so that firms could be more efficient in rolling out new services and employ better management practices, rather than re-inventing the wheel for each context. Too often, service practices fall easily into the trap that service is 'common sense' and the notion of 'merely coping' seem sufficient. Such tacit practices do not lend itself well to the scalability of the service and service management, even though may seem intuitive, is in need of sound engineering design that must also incorporate behavioural issues. The capability to deliver service excellence, like the capability to deliver a new technology, should not be lost in the fact that many others have a similar tacit capability to deliver mediocrity.

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Index words & Phrases:
Systems theory
Ashby's law of requisite variety
Viable systems model
Value-in-use,
Value co-creation,
Complex service systems,
Service-dominant logic,
Trandisciplinary,
Reductionism

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