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Service Systems and Requisite Variety

Purpose

This conceptual paper will explore the application of an aspect of systems theory, the Law of Requisite Variety, (LRV), to service organisations.

Design / methodology / approach

The notion of a system has a strong history through the works of, inter alia, Forrester, Checkland, and Beer; in searching for theory to provide substance to service systems research each can provide valuable insights. Systems theory is the study of complex adaptive wholes; the focus is on the whole rather than the parts and Systems can be studied in at least two ways: their state – what are their properties and their dynamics - how they behave. The LRV, introduced by Ashby and developed by Beer in his examination of viable systems, concerns the behaviour of systems. The LRV states that the organisation must be able to deal with, by matching, the variety introduced by the external environment, in the case of service organisations this is the customer, in order to remain viable. Understanding the nature of customer variety and how to deal with it is important for service organisations since variety provides both a challenge and an opportunity. This paper seeks to explore and operationalise variety in a service context.

Findings

Some examples of how customer and supplier variety could be operationalised are shown; a new service systems model is proposed building on the LRV, systems concepts and on current developments in service classification.

Originality / value

To further the use of systems thinking in service science and to explore how the LRV could be applied.

Keywords

Variety, Law of Requisite Variety, Viable Systems, Systems Thinking, Service,

1. Introduction

There is a growing acceptance that a different, more holistic approach to value creation and management is becoming necessary for a wide variety of reasons, not least the rapid growth in interconnected technologies and increasing complexity and choice and change in relationships that this will entail. Systems thinking is one approach that could contribute to understanding and providing frameworks for these challenges.

This paper sets out to describe the potential application of Ashby's Law of Requisite Variety and its implications. Generally stated and understood as 'only variety can destroy variety" (Ashby, 1969), it uses systems concepts to look at the impact of external disturbances on the viability of an organisation. I start with a brief discussion of the debate on the nature of service and suggest that there is an emerging consensus that definitions should be centred around firstly, process rather than product, and secondly the customer – producer interaction and relationships.

A short overview of some of the concepts of systems thinking (the study of complex and adaptive wholes) is given and the way that it has been applied to the study of management and operations based on the work of Forrester and Beer. From this follows an examination of variety and the Law of Requisite Variety. An argument is made that variety is not, as is traditionally assumed within operations management literature, simply the inverse of volume, and hence already understood, and that the traditional manufacturing approach of keeping the customer removed from the operation is neither possible nor appropriate for service organisations. The law of Requisite Variety is used, along with recent Unified Services Theory, (Sampson and Froehle, 2006) and Service Dominant Logic (Vargo and Lusch, 2004) developments to develop a descriptive model of a service system, based on variety and the interaction of the customer and the producer. I conclude with comments on the potential direction research in this area might take.

2. Services

"Services" is a complex subject with growing diversity in the definition of the subject under study. Recently, this has been further compounded by the development of a 'science' for services. Any review of extant literature will identify a wide range of frameworks, classification schemes and conceptual models and perspectives.

Initial exploratory research into these frameworks suggests that the major paradigm in the services literature is one of customer-centricity with an emphasis on customer presence, predominantly concerned with customer-contact environments, customer-facing operations, or customer-processing activities. . To provide a context for our argument, I set out briefly three distinct perspectives of services.

Firstly services can be thought of as an entire industry. This can be described as the SIC classification where services are everything that is not extraction, farming, and manufacturing. Such classification schema do not inform the management of different service operations or service processes (Silvestro et al., 1992) since they overlook the necessity that service operations characteristics often vary considerably within industries and organisations. In addition this "everything else" definition is hardly useful in that it leaves us little to say about the nature of service other than it accounts for the majority of economic activity.

Secondly a service can be considered an outcome. It has been argued that service outcomes share four specific attributes, often referred to as IHIP, making them different to manufactured goods: intangibility, heterogeneity (variability), inseparability of production and consumption, and perishability; (Zeithaml et al., 1985). These attributes and their combination are often regarded as the core paradigm in services marketing (Lovelock and Gummeson, 2004). Other attempts to differentiate between services and goods include the ownership distinction. (Judd, 1964) proposes that services do not transfer ownership of a tangible item. Lovelock and Gummesson significantly extended this basic criterion to include such things as place and space rental, physical facility and network access..

Thirdly, a service can be described as a process. Shostack suggests that services are processes, "a series of interactions between participants, processes, and physical elements" (Shostack, 1982); service processes generally involve customer contact, (Chase, 1981); and / or customer participation (Shostack, 1982) in the process of production. In the Unified Service Theory Sampson and Froehle (Sampson and Froehle, 2006) define a service process as one where the customer provides significant inputs to the production process which can be the customer herself, her tangible belongings, or her provided information.

Vargo and Lusch have changed the nature of the debate.(Vargo and Lusch, 2004). Using the twin concepts of operand (material) and operant (skills and knowledge) resources to distinguish between what they term a goods-dominant logic (G-D logic) and a service-dominant logic (S-D logic), they suggest that operand resources underpin G-D logic and operant resources S-D logic. They define service as 'the application of competences by one entity for the benefit of another' (Vargo and Lusch 2008). Thus all organisations are engaged in service, goods are simply an appliance for the delivery of a service, and everything in exchange is a service.

Definitions of "service" now seem to range from the "SIC" classification to "SDL" and hence fall between being either "everything" or everything else". (Godsiff et al., 2009) but in systems thinking terms the most useful type of definition would be ones which concentrate on the role of the customer, processes and relationships.

3. Systems

A long tradition of systems thinking conceptualizes systems as having a number of attributes.

Katz and Kahn established two basic criteria for an examining open social system: "the pattern of energy exchange or activity as it results in some output …and… how the output is translated into energy which reactivates the pattern" (p90) and went on to name the following characteristics of open systems: importation of energy, throughput, output, systems as cycles of events, negative entropy, information input, negative feedback, coding processes, steady state, dynamic homeostasis, differentiation and equifinality. (Katz and Kahn, 1969)

Churchman (Churchman, 1971) identified the following 9 conditions for a thing to be considered a system: goal seeking or purposeful, a measure of performance, a client (customer), teleology, an environment which co-produces the performance, a decision maker, a designer, the designers intention (to manage the system to the benefit of the client),and stability.

Jackson (Jackson, 2003) says using the metaphors of machine organism and brain has given rise to a "vast range of systems: black box, feedback, control, communication, variety, hierarchy, recursion, viability, autonomy, environment, autopoiesis, self-regulation, self organisation, learning."

One application of systems thinking to operations is systems dynamics. This uses flows, causal links, feedback loops, (positive and negative), accumulation of stocks, and delays to describe, model and simulate operational and social systems. The Forrester (bullwhip) effect in which small changes in one part of the end to end supply chain, time delays and poor information can cause major and unpredicted changes elsewhere in the chain. Forrester's observation: "the relationships between the elements are just as, if not more, important than the elements themselves. The interconnections, the compatibility, the effect of one upon the other must receive more attention than the parts" (p6)(Forrester, 1958), shows the rooting of system dynamics in systems thinking.

The need for a systems approach is increasingly and everywhere apparent, and its use implicit or explicit can be seen everywhere in the literature. A single example will suffice. Gummesson points out that within Service Dominant Logic value is co-created. "The supplier contribution is a value proposition…the customer contribution is value actualization" (Gummesson, 2008). As an example in the purchase and use of a car, "the customer interacts with the car and service is created in that process". This is a perfect example of an emergent quality, firstly in that it is of a different nature to the inputs and processes, and is uniquely personal and unpredictable: "each customer will use the car in individual ways and experience its value differently" and "The supplier chain is based on mass manufacturing, whereas the customer value chain is individual and changeable" (ibid, p17) Gummesson calls for a research

agenda which is more pragmatic and holistic, based on nodes, relationships and interactions.

In a review of more than 50 accounts of systems thinking, the common points factors among these definitional sets of systems attributes have been identified by Atkinson and Checkland (Atkinson and Checkland, 1988). These are often summarised as the twin concepts of emergence/hierarchy and information / control. These represent the twin concepts of systems thinking: what are the properties of systems, and how do they behave. One of the authors who developed systems thinking using information/control is Ashby, who developed the law of requisite variety.

4. Variety

Ashbys simple law is based on an equally simple model, (itself based on a simple electrical circuit described as a "lash up" consisting of just 4 elements, disturbance, a transformation (that may be thought of as a set of laws) a regulator and an outcome. (See Figure 1). The role of the regulator R, is to control the range of disturbance or variety D, that is reaching T to ensure that the outcome E remains within an acceptable range, which does not threaten the survival of the system. The law states that the variety of response must match the variety of the disturbance. "only variety can destroy variety" (Ashby, 1969)

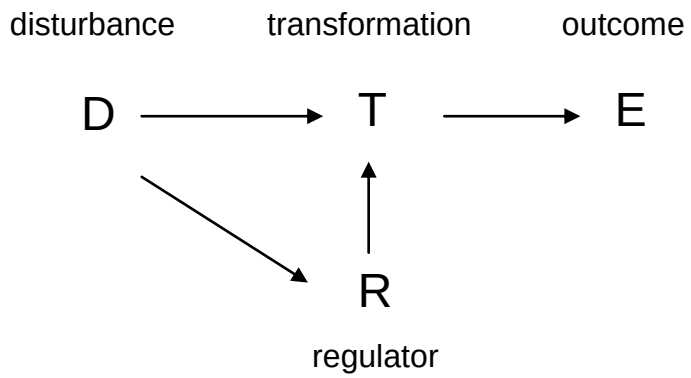

Figure 1

Stafford Beer extended Ashby's work into the notion of the Viable Systems Model. (Beer, 1984). He developed variety engineering focusing on two aspects of requisite variety - attenuation and amplification - he defines viability as the ability to survive in a specific environment. As Pickering points out Beer considered that "the success or failure of organisations was a function of their adequacy in coping with their environment, the outside world of suppliers and consumers" (Pickering, 2002).

A producer may not want to offer fully bespoke reasons and thus we design operational systems with limited variety. The challenge is to either make that attractive to customers through marketing, or cause the customer to attenuate her

variety or to amplify the producer response. Consider a company that makes (as its value proposition) only black cars. Customer's indifference to this proposition could threaten the company's viability. Variety could be attenuated by offering price promotions or redesignating "black" as somehow "cool". This could cause the customer to attenuate her variety. Or the company could amplify variety by redesigning the production system to create cars of different colours, according to anticipated customer demand, or later perhaps, individual specification, and thus amplify variety.

These are examples of variety engineering and show that for the outcome for both systems to be viable variety must be matched by both the customer and the producer Beer also said that different parts of the organisation as a system needed to treat variety differently and may need to amplify their range of responses rather than attenuate them.

What is viability? Berton et al. have suggested that it is a measure of effectiveness, and that an effective organisation is one in which the internal structural variety is matching the variety in its environment. (Berthon et al., 2008). An interesting example of the application of LRV is given in by Berthon in relation to the structure of the organisation and how it reacts to variety through either a "machine" approach or a "holographic" reaction. "requisite variety in machine design corresponds to increasing differentiation of parts and functions (the part becomes more and more unique and less and less like the whole)." (ibid p216). This is contrasted with the holographic design where dealing with "requisite variety corresponds to increasing the flexibility, richness and potentiality of the parts. Simply the part is enriched in that it develops the abilities of the whole: the whole is more accurately reflected in the parts." - hence the holographic metaphor. The example given is the need for improved and different relationships between marketing and the technical parts of the organisation: defined as R&D, production, operations, manufacturing, R&D, and information systems. (Berthon et al., 2008). Perhaps this could be seen as a call for the "productive core" to be opened up by and to marketing in the same way as it is to the customer in a service organisation.

How is variety represented in the management literature? It would seem to be depicted as either the linear inverse of volume, or as a" problem" to be dealt with. As an example of the former approach, Silvestro suggests that there is a natural inverse relationship for services along a volume - variety diagonal. (Silvestro, 1999). To be cost effective service organisations should place themselves on this diagonal. Not all service industries will conform to this manufacturing development based model, and the cost focus is very internal. However the idea that being off the diagonal is in some way less viable is a recurring theme.

The standard operational response to variety is that it is a feature to be eliminated as much as possible, by designing operations in such a way to be simple or by attempting to seal off the productive technical core from disturbances.

An example of variety reduction is self service restaurants providing extremely limited menu choice, and clear instructions, a smoothed service demand, through waiting. This allows the substitution of technology for people in the service provision, which will lead to customers requiring new skills and increasing their variety. Chase suggests that the service systems be reorganized to isolate the technical core from the front office so that the benefits of manufacturing technology can be achieved (Chase, 1978).

Thompson suggests attempting to seal off the technical core and operate this as a closed system. (Thompson, 1967). This may be appropriate for manufacturing and make to stock / make to forecast producers but for service industries where the customer has a significant presence it is not appropriate as the system is open and cannot be closed. In a service system it may not be possible to isolate the technical core and buffers may need to be introduced. These have been framed as rationing, client selection and socialization, (training), and routinisation and simplification of processes. (Mills and Moberg, 1982).

A key feature of service systems is the presence of the customer, what Frei calls "throwing a customer into the works". (Frei, 2006). The presence of the customer suggests the core has been breached, and that the customer is now in the producer system. The challenge of understanding and matching variety starts when there is significant customer input and isolation is not possible.

A word on another key systems concept that may help demonstrate this: boundaries. Weinberg suggests the term interface, since a key thing about a boundary is that it connects, rather than separates. (Weinberg, 2001). Using "interface" focuses attention on the connection between the environment and the system. This has implications for variety and service. "The market is a boundary or part of a boundary. [It] is the condensation of all the transactions across the boundary into a single visible arena." (p166). This Weinberg says is an example of a port – a localized place on the boundary/interface which allows input and output; across the rest of the boundary no contact is allowed.

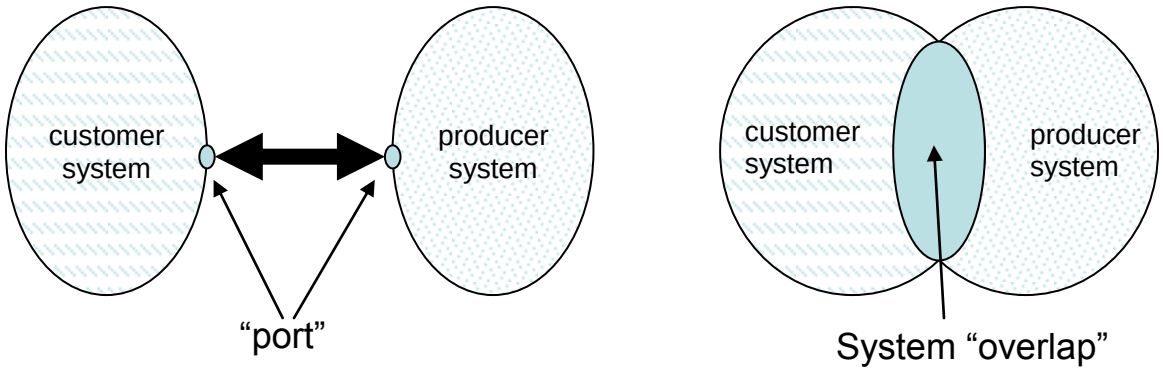

Figure 2.

"Within the port special mechanisms can be brought to bear on the special problems of input to output" (ibid. p166). A market and a port become a way of matching and controlling variety. A port is contrasted with a membrane, the distributed interface: "an obvious example is the cell wall that may be penetrated *at almost every point on its surface, but not by everything and* not at all times" (ibid. 166 italics in original). There are more and more unpredictable flows across a membrane and control of the associated variety becomes more complex. The notion of a port and permeable boundary can be applied to distinguish goods based transactions and service based transactions. This is shown graphically in figure 2. It could be considered that goods type transactions most closely the port analogy, and service transactions, with the presence of the customer and significant customer inputs, and a longer contact time most closely resemble the membrane model.

Service can be seen as the interaction of two open systems through a membrane type interface. The variety implications of this are shown in figure 3. Instead of a traditional volume variety diagonal based on the producer, this shows that there is an interaction of two systems, the customer and the producer, each of which introduce and manage variety.

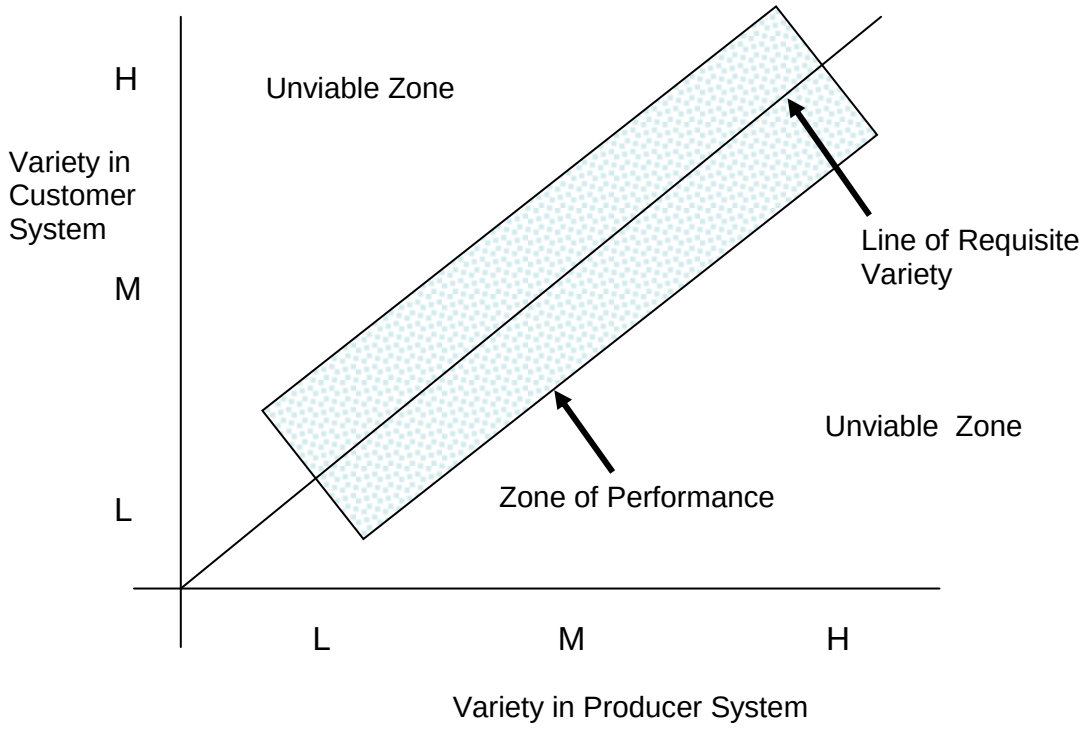

Figure 3

The law of requisite variety says that for each system to remain viable variety must be matched, and this is represented by the diagonal and the performance zone around it. If the producer has more variety in his system than the customer introduces during the service encounter, or offers less variety than the customer demands or introduces, these positions will be unviable, represented by the two unviable zones.

As an example consider two types of haircutting services – the boutique salon contrasted with a military barber. The former offers high producer variety against a varied customer demand, the latter a "one size fits all approach". Both remain viable because, by whatever method, variety is matched. For either to operate off the diagonal would be to reduce viability. What types of variety might exist in such a service system are considered in the next section.

5. Service Systems

We are now in a position to combine the elements covered and describe a service system model based on Ashby's model, the Law of Requisite Variety and Service Dominant Logic. See figure 4. The value proposition created by the producer and "sent" to the customer contains variety and represents a disturbance to the customer system. The customer needs to match the variety in the Value Proposition with her internal variety. This is the first disturbance; an acceptable outcome to both would be the decision to purchase a service from the producer, during which a form of service system would be created due to the necessary overlap of two systems across a wide interface; this is as a result of the second disturbance. This service system is where co-production and initial co-creation of value can take place. Although the transformation "T" is common the customer and producer, both use their own individual regulator "R" to control variety to achieve an outcome "O" acceptable to each of them to remain viable. Co-creation of value continues after the service system is closed, and thus viability management of the individual systems continues to be necessary.

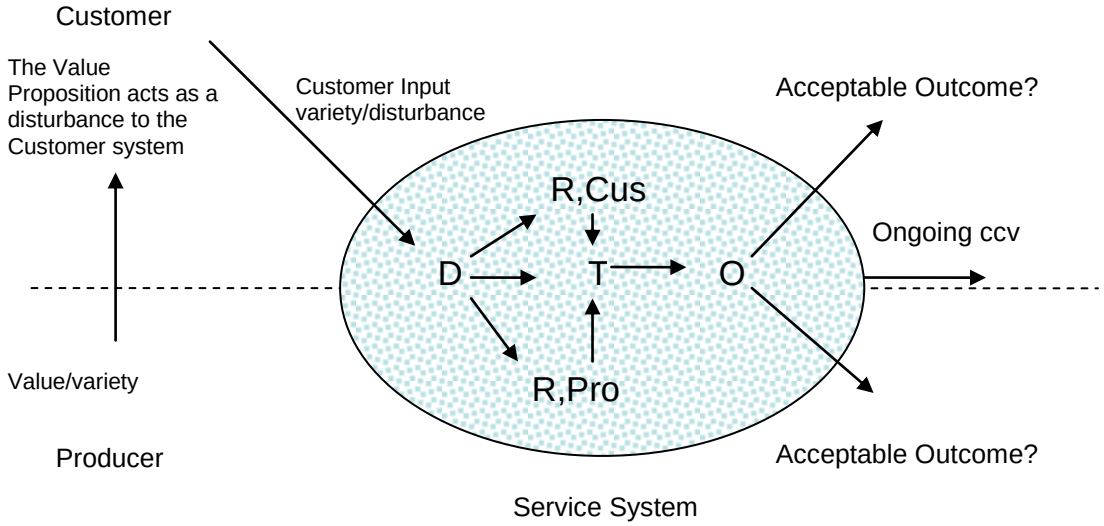

Figure 4.

The model suggests a number of sources of variety which need to be examined: the value proposition, the customer reaction, the customer input to the service system, the producer input to the service system, and the customer and producer outcomes.

Ashby himself was not concerned with a clear definition or operationalisation of variety. In many respects this has hampered a wider use of his law. Two examples of methods of conceptualizing and operationalising variety are given which could be used in the service system model.

Frei typifies customer input variety in 5 categories: Arrival variability (peaks and troughs in service demand); Request variability (different requirements for each customer); Capability variability (customers have differing skill levels); Effort variability (some services require customer input/ participation and customers will have differing willingness to make effort); Subjective preference variability (different and contradictory views of what constitutes good service). (Frei, 2006).

A potential way of operationalising production variety is suggested by Parnaby and his distinction of work types into runners, repeaters and strangers. (Parnaby, 1988) Parnably actually refers to them as regular runners, irregular runners and strangers and although he is talking about conditions suitable for JIT scheduling – (that runners are able to be pulled, strangers have to be pushed through in a more traditional jobbing style approach), it does provide a potential nonclemature to describe and operationalise production variety and design approaches. A fourth category of "unknowns" would need to be added: those which might be considered to be just outside the value proposition but feasible.

6. Conclusions and Future Research

The proposed models of the Line of Requisite Variety and the combined service system are examples of how systems thinking can be used to conceptualise and describe. Both models need further development and empirical data gathered to prove or disprove them. (Although, Ashby would surely be sufficiently confident in the nature of his law to think that data would only provide examples, rather than contradiction).

Systems thinking in all its breadth and depth could be used to provide a theoretical and philosophical underpinning for the emerging service science, and help for example Service Dominant Logic in establishing itself as a paradigm, and that systems thinking provides insights that are not being provided in the management or marketing literature.

I have taken the step of bringing the customer into the discussion of the interaction of two systems, rather than one system with an environment. We should not necessarily see the development of service science as a way of redefining marketing or relationships with customer, but instead consider it as way of understanding the network and relationships within the organisation and between all parts of the organization, and the customer. Those, like Buhman et al (2005), who propose a research focus treating the organisation as a system and part of a network could be limiting their scope too tightly: the customer needs to be included as part of the system as well; in addition, restricting the input from systems thinking to service science to network analysis could mean losing valuable additional insights.

In terms of future research programmes there are areas for exploration based on the findings of this paper, and also in the wider arena of the application of the wide range of concepts and methodologies in systems thinking to the study of service systems within service science.

In respect of the findings of this paper certain topics suggest themselves:

A better conceptualization, operationalisation and test of viability is required. What does it mean to be on or off the diagonal line of requisite variety? What is the size and nature of the effect? What are the timescales involved? What is the contingent effect if any, of the environment and the industry?

The inclusion of the customer into the variety equation as a participant, rather than as a nameless part of the environment, results in a number of relevant issues arising, among which are: How can the customer's system and network be conceptualized? What influences her ability to engineer and match variety? and how is it achieved?

Variety amplification, rather than reduction or accommodation techniques need to be properly understood, as do their relationships with co-production and co-creation of value. The ways described of measuring variety, and the techniques involved in creating barriers between the customer and the technical productive core, have as their aim the reduction or accommodation of variety, as if it were a quality to be removed at all costs, if only to reduce costs. Ashby contributed to this view of variety with his use of the word "destroy". A better approach may be to understand the potential benefits of amplifying variety, especially within the context of service organisations.

Work needs to done on how to conceptualize the ongoing co-creation of value as part of the system, and how the law of requisite variety affects this, once the transaction within the overlapping and combined new service system has been completed and the customer and producer go their separate ways.

I have demonstrated how one element of systems thinking, the Law of Requisite Variety can be applied to an understanding of how a service operates. There are

potentially many more applications of systems thinking that could be applied in an attempt to more theoretically underpin service science.

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