A Complexity Management Approach to Designing Viable IT Service Systems in South Africa

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Abstract

This research looks into the complexity involved in designing, implementing and managing viable Information Technology (IT) service systems for the South African economy where the fourth industrial revolution is introducing unprecedented market and technological dynamics. The research uses the viable system model to provide an iterative systematic process to service system design tackling both service delivery and service co-creation complexities. Having identified and discussed various existing service system design models available in literature and industry to date, this research identifies the residual complexities these models present. The viable system model is used for developing an approach that designs for the identified residual complexities existing in present IT service systems in South Africa. The research work is currently in progress and therefore this paper serves as a research concept.

Keywords

Complexity, Digital, Engineering, Management, Model, Science, Service, Systems, Transformation, Viable, Variety

List of terminologies

Term	Definition
Digital Transformation	A process in which an organisation is shifted to new ways of working and thinking with digital and social technologies
Digitalisation	The integration of technologies into everyday life by the digitisation of everything that can be digitised
IaaS	Infrastructure as a Service (IaaS) refers to online services that provide high-level APIs used to dereference various low-level details of underlying network infrastructure like physical computing resources, location, data partitioning, scaling, security, backup etc.
ISV	Independent solution or software vendor
ITaaS	ITaaS is an operational model where the information technology service provider delivers an information technology service to a business. The IT service provider can be an internal IT organisation or an external IT service company. The information technology is typically delivered as a managed service with a clear IT catalogue and pricing associated with each of the catalogue items.
IT services aggregation platform	This is a digital platform that allows the consolidation and dispensing of IT services and organisational competencies to customers and partners through the internet
PaaS	Platform as a Service (PaaS) is a category of cloud computing services that provides a platform allowing customers to develop, run, and manage applications without the complexity of building and maintaining the infrastructure typically associated with developing and launching an app.
Residual Variety	Variety not dealt with by the environment in which the systems operates or operational systems itself and has to be catered for in the management system managing the operational system.
SaaS	Software as a service (SaaS) is a software licensing and delivery model in which software is licensed on a subscription basis and is centrally hosted.

1. Introduction

The South Africa IT industry is undergoing a rapid transformation. This transformation is characterized by IT distributors investing in platforms, e-commerce systems, digital technologies and expertise. Chief amongst the drivers in this transformation are IT vendors mandating digital transformation downstream in the distribution channels and customers demanding digital mechanisms in consuming products and services. This paradigm shift in the distribution to products and services in the channel is rapidly reconfiguring the IT industry to a service-oriented system focusing on co-creating value with consumers rather than the traditional selling or 'box dropping' of products. Digitalisation is the integration of technologies into everyday life by the digitisation of everything that can be digitised (Khosrow-Pour, 2018). Figure 1 is a graphical presentation of the reconfiguration experienced in the industry. A service orientation promotes a re-configuration of industry resources based upon the use of service (Khosrow-Pour 2018). This affects all organizations in the industry.

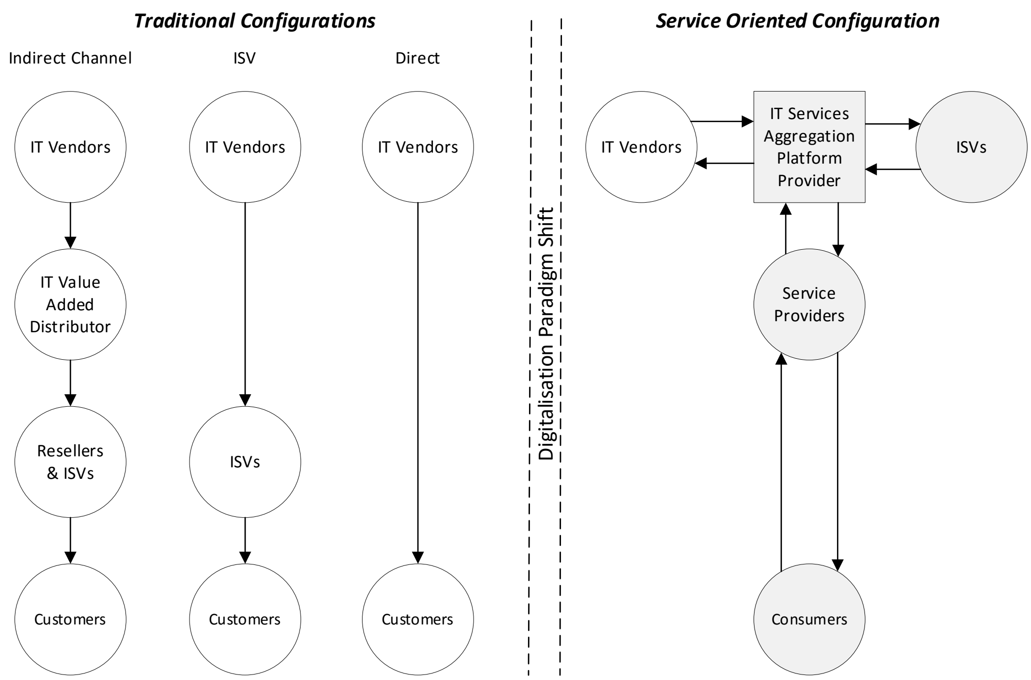

Figure 1: SA Industry Configurations (author rendered)

A Vendor is a common term used in the industry, specifically by distributors, referring to the original manufactures of software and hardware products. Many of these software vendors are global players such as Microsoft, Cisco, Oracle, IBM, Dell and HPE to name a few. The primary function of these Vendors is the designing and manufacturing of hardware and software products that are then sold directly or indirectly to end users. End users are usually made aware of a Vendor through an end-user agreement from the Vendor contained in the product packaging specifying the terms of use. A digital counterpart of this is the acknowledgment and acceptance of an end-user agreement before downloading or installing software. Nevertheless, cloud computing technology advancements over the decades have enabled vendors to package some of their software and hardware products as services namely Software as a Service (SaaS), Platform as a Service (PaaS) and Infrastructure as a service (IaaS), each attractive to a consumer profile in mind. Coupled with increased internet coverage, the vendor is enabled to sell to customer globally through e-commerce portals. A customer can buy cloud services, download the applications and receive software updates. This has allowed direct and indirect models of software and hardware distribution to customers in South Africa. Another emerging service is Information Technology as a Service (ITaaS). ITaaS is an operational model within an organisation that provides expertise, support and management of information technology in other organisations. This allows outsourcing of IT departments to other companies. The types of IT services and product consumption channel configurations that are available in the South African IT industry include, but are not limited to, indirect channel model, direct channel model, through an independent software or solution provider and through a service provider.

In an indirect channel model, vendors sell their products to value-added distributors (VAD) that resells to end customers through a reseller community. This reseller community consist of major retail stores to small privately owned stores selling specific products with tailored services to their customers. This model allows a Vendor to reduce their overheads in distributing and supporting the product while maintaining quality of product delivery to different regions in the world. A VAD is certified and promoted as a distributor of choice having attained the correct skills to support the product and enjoys discounted product volume pricing in return.

In another configuration, an independent software developer (ISV) will purchase a development platform directly from a Vendor. An ISV uses development platforms to develop software solutions for customers. An example is a private company that provides animal tracking technology to a farmer or a nature reserve. A software application is provided to the farmer developed on tools and software purchased from a Vendor directly. An ISV might look for a better option with local product support and decide to buy indirectly instead.

In a direct channel model, an end customer or consumer buys directly from a vendor. A good example is buying software online using a credit card or purchasing a laptop directly from HP. Some websites prohibit this in certain countries by recommending a reseller or distributor in your area or region. Each sales channel configuration has its own benefits and risks in the perspective of the end customer and the Vendor. All are product sales driven, meaning there is limited input from the customer, either than buying the product, to the value creation in the supply chain.

A service oriented configuration promotes the co-creation of value with the customer and other service systems creating an ecosystem. A service provider is in direct relationship to the consumer of the service also allowing co-creation of value with customers through involvement or engagement. This is done by transforming traditional product selling business models into service systems. The concept of a service system is derived from Service Science. Service Science is the study of the co-creation of value within and among service systems, which individually, are complex and adaptive in nature (Demirkan et al. 2011, p. 35). A service system is a dynamic value co-creation configuration of resources connected with other external service systems by value propositions (Demirkan et al. 2011, p. 73). Service systems improve states of other service systems by sharing resources and applying competencies collaboratively to delivering systemic value.

The service system concept provides a fitting framework for defining the new configuration presented as a service oriented configuration, depicted on the right of Figure 1. This new configuration when defined as a service system can be studied and diagnosed using approaches in service science and design. One example is a service design approach that first identifies key dimensions of a service system as in Figure 2.

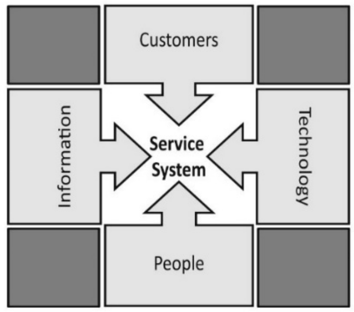

Figure 2: Key Dimension of Service Systems (Demirkan et al., 2011, p. 41)

In this case for example, a service system can be analysed in the four key dimensions of a service system, customers, technology, information and people (Demirkan et al. 2011, p. 41). What is not reflected in the image above, which is pertinent to a service system by definition, are the other service systems that co-exist with this service system. Other frameworks in the literature also reviewed (Demirkan et al., 2011b; Maglio et al., 2010) did not provide a holistic view as well. This demonstrates that although various frameworks exist for designing service systems, there is still lack of a comprehensive approach that gives the holistic, systemic understanding of a service system. This paper attempts to bridge this gap by proposing a rigorous viable systems approach that provides better understanding of an IT service system in the wider context of other service systems and the environments they operate within.

1.1 Problem statement

Traditional design methods will not suffice in designing complex IT services that are sustainable in the evolving digital economy of South Africa. A revisit to Service Science and Complexity Science is proposed to research system designs which promote co-creation of value in dynamic environments. To date, IT Services have been designed as products rather that services, thus constituting limited value co-creation from a customer or other service systems. In the digital economy, value co-creation with customers is a core competency in differentiating against competitors and reducing the risk of disruption. Traditional product oriented methods that focus largely on the internal organisational competencies assume stable market environments over product lifecycles. This might not be suitable for designing service systems in dynamic markets.

1.2 Purpose

The purpose of this paper is to provide the relevant determinants in designing viable IT service systems for the dynamic digital economy in South Africa

1.3 Objectives

The objective of this paper is to provide a conceptual design for viable IT service systems in South Africa.

2. Literature review

Beer (1985) created the viable system model (VSM) over twenty years ago and has been used extensively for conceptualizing and analysing organisations, redesigning them and supporting the management of change (Takahara and Mesarovic, 2003, p. 5). Despite the successful application within numerous private and public sector organizations, the VSM is not widely known in the professional practices (Ríos, 2012, p. 8). This is mainly because its concepts are not intuitive to grasp and secondly, organizations were predominately viewed as hierarchical institutions.

Ríos (2012, p. 11) noted that this legacy is starting to be questioned in designing organizations fit for the digital economy. The biggest contributor to this paradigm shift on organizations has been technology developments that enable flatter, networked type organizations with a wider distribution of data to all levels of the organization (Espejo and Reyes, 2011). The viable system model provides a systematic design and diagnostic tools for designing and managing these new digital age organizations taking into consideration the level of complexity in managing them (Beer, 1985; Espejo and Reyes, 2011; Ríos, 2012).

Services are designed with value propositions in mind (Demirkan et al., 2011b; Maglio et al., 2010). Although the value proposition might at first appear to fulfil clear need or requirement, it might not be viable if not well designed. On the other hand, a lot of investment goes into building a services system (Demirkan et al., 2011a). To ensure that a service system is not rendered irrelevant when a service it delivers is no longer required, a service system must be designed to deliver a multitude of services of a similar resource requirement configuration (Maglio et al., 2010). The challenges that service systems present are of great interest to researchers, thus the VSM or Viable Systems Approach is not the only approach in literature relating to the design of service system. The literature review conducted provides a number of models and framework available in literature related to service systems design.

2.1 The Service Delivery Design Framework

In summary, the Service Design Delivery Framework provides the service delivery determinants relevant to the design of a service system (Demirkan et al., 2011b, p. 225). However the Service Design Framework does not detail determinants regarding service co-creation and management of complexity from the environment in which the service system exists. It is crucial that service delivery is attuned with the dynamics presented in the market and environment in which its services are delivered. Although this could be assumed to be incorporated in infrastructural strategic design choices, this should not be a once off design choice because the operational environment and market could be dynamic thus presenting a possible risk of the delivery system being rendered irrelevant over time.

2.2 The Extended Value Co-creation Framework

The Extended Value Co-creating Framework is based on the determinants of value co-creation. These determinants include value propositions from the providers and the customers taking into consideration that these value co-creation networks could be setup statically or dynamically (Demirkan et al., 2011b, p. 188). The framework goes further to elaborating the basis of the determinants and stipulating the scenarios under consideration of service network creation. The framework was developed to only consider the Provider and Customer co-creation of value. The framework considers the determinants of co-creation between providers and customers, a valuable consideration to the determinants to service systems.

3. Research Description

3.1 Determining the State of Viability in Current IT Service System in SA

As a starting point, the research selects specific IT services in South Africa and determines their state of viability. This is done taking into consideration the differences in the delivery and the service system environment. This research will assess one of each type of IT service type namely SaaS, PaaS, IaaS and ITaaS within different channel configurations. A channel configuration can be understood as a unique binary combination or arrangement of Vendor, ISV, IT Services Platform and Consumer for the delivery of that service. One example has been created and presented in Table 1.

Table 1: SaaS Service System Configurations

IT service system configuration	Service Type	Vendor	ISV	IT Services Aggregation Platform	Consumer	Supporting from other Service Systems Resources	Service Example
SaaS Service System Configuration 1	SaaS	Yes			Yes		Microsoft Office 365
SaaS Service System Configuration 2		Yes		Yes	Yes		
SaaS Service System Configuration 3		Yes		Yes	Yes		
SaaS Service System Configuration 4		Yes	Yes	Yes	Yes		
SaaS Service System Configuration 5		Yes			Yes	Yes	
SaaS Service System Configuration 6		Yes		Yes	Yes	Yes	
SaaS Service System Configuration 7		Yes		Yes	Yes	Yes	
SaaS Service System Configuration 8		Yes	Yes	Yes	Yes	Yes	

Differentiating between a service and a service system is important because it is in the viability of both, working together, that a service system can be considered viable. Secondly, this allows the re-configuring of capabilities within service systems to delivering a different service. A service can be delivered through many service systems and a service system can deliver many services. A service system can be considered as the infrastructure on which a service is delivered. Figure 3 is a graphical system hierarchical representation demonstrating the various components to be considered when assessing the viability of a service system.

A service itself can be seen as a system because it constitutes a unique conceptual configuration of information, technology, processes, and people for delivering value to an identified market need. Taking an analogy to software and hardware, consider software loaded on a computer. The software itself is a system of classes and background services delivering a productivity tool to the user. All critical operational requirements must be met in order for the software to function. The value delivered between the user, laptop, software and the environment of operation can be viewed as a service system. A computer can run many programs. A service is a system but is not a viable system on its own. Nilo in the Clouds of Quantum Machines in (Khosrow-Pour, 2018) provides this definition of services worth noting. "*Services are cybernetic replicas of human practices, being evoked by well-established environmental motivations*."

As per the Shorter Oxford English Dictionary a system is a set of related or associate material or abstract things forming a unity or complex whole sharing a common goal. The Service System Scope of Viability Assessment in Figure 3 is a conceptual hierarchical breakdown produced when beginning to understand the various other operational elements involved in delivering a service to a market.

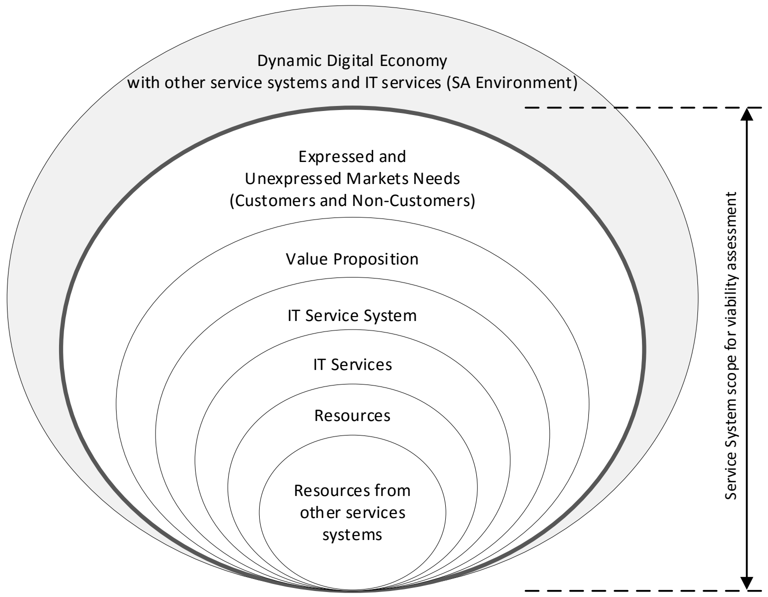

Figure 3: Service System Scope of Viability Assessment (by researcher)

Therefore, it is in the context of a purpose or an explicit need that a service system is diagnosable for viability, as demonstrated in Figure 3, thus able to maintain its own existence in a specific environment. Without the market need or defined value, a service cannot exist. Beer defines viability as the ability to maintain separate existence within a specified environment (Beer, 1985). Software cannot maintain existence without hardware. Likewise a service is not viable without a service system. Retrospectively a service system can only be viable if there is an existing need for the services it currently delivers or other existing services that have value to other service systems.

3.2 Providing a Viable Conceptual Design for IT Service Systems in SA

The Viable System Model (VSM) defines and establishes the necessary and sufficient conditions for an organization to be viable. Viability is defined as the ability to maintain existence in a specified environment (Beer, 1985). Beer (1985) argues that the primary goal of an organisation is not profits and revenues as many models suggest, but rather to maintain separate identity and existence within an environment. The VSM was born out of Management Cybernetics in the 1950s. Wierner (1985) gave the name Cybernetics to the new science and defined it as the science of communication and control in the animal and the machine. In Management Cybernetics the concepts and principles contained in Wierner's Cybernetics, are put into practice by Beer (1985) in tacking management complexities. Despite the success of the model in various disciplined most professionals are not taught the model and its approaches or apply it in practice (Ríos, 2012, p. 8). This could be because its concept are difficult to articulate into practical implementations. This research uses the VSM model to better understand service systems in the context of viability.

The VSM defines five essential functions of viability namely; policy, intelligence, integration, coordination and implementation (Ríos, 2012, p. 50). The viable systems process is a rigorous systematic process, through which is designed management mechanisms, feedbacks and controls for the five essential functions presented in the VSM. This also takes into consideration the environment in which the system in focus exists. An essential aspect of the VSM is its "recursive" nature meaning every viable system (organisation) contains systems (organisations) that are viable as well (Beer, 1985; Ríos, 2012, p. 48). This characteristic provides the VSM with enormous potential for studying a multitude of systems ranging from organizations to ecosystems, and from collaborative networks to individual service systems. It is this recursive systematic characteristic and its proven success in organisation design that it was considered by this paper. Whatever the system may be, the same operational principle applies required by the VSM, regardless of size, sector, characteristic, geography or type of activity (Beer, 1985; Espejo and Reyes, 2011; Ríos, 2012).

The VSM has been applied to designing organisations with success and is yet to be applied to diagnosing and designing service systems (Takahara and Mesarovic, 2003). A service system is viewed as a type of organisation, a virtual organisation (Maglio et al., 2010). It is an arrangement of resources within or amongst organisations, working together delivering services to either organisation-internal customers, organisation-external customers or other service systems (Demirkan et al., 2011b). The "virtual" in the definition indicates that the resources are not required to interact physically or be in the same geographical or company structure (Camarinha-Matos et al., 2001). The resources are interconnected through networking and collaboration technologies allowing co-ordination of efforts to ends of delivering value (Camarinha-Matos and Afsarmanesh, 2004, p. 17). The temporality in the existence of such as an organisation depends on the viability of the service system. The conception of viability is depicted in Figure 4.

Graphically the representation of the recursive nature of the VSM can be seen through the model shapes. As seen in Figure 4, the square in dotted lines represents the management system, the eclipse also in dotted lines presents the operations or implementation system and the amoeboid shape presents the environment in which the system exists. When looking into the big eclipse the same square circle combinations can be seen at a sub-system level. This recursive self-referenced detail in sub-systems reveals the recurring organisational fractal required in achieving a viable system. Self-reference and re-creation at all scales are required to maintain viability (Beer, 1985; Ríos, 2012, p. 48). Each viable unit is to contain the five essential functions in order for the system in focus to be viable (Beer, 1985). This recursive conception is of outmost importance when studying organisations and systems that are to survive in a given dynamic environment (Beer, 1985). An organisation's structural design is determined by the manner in which it segregates and absorbs the variety presented by its environment through its functions and recursive layers. Each function serves a specific purpose.

System 1 (Operations) is responsible for the product and delivery of the organisation's goods and services to the pertinent environment. System 1 is made up of viable operational units, each which is responsible for a line of activity, product or service. The units contained in this system "produce" (Ríos, 2012, p. 25).

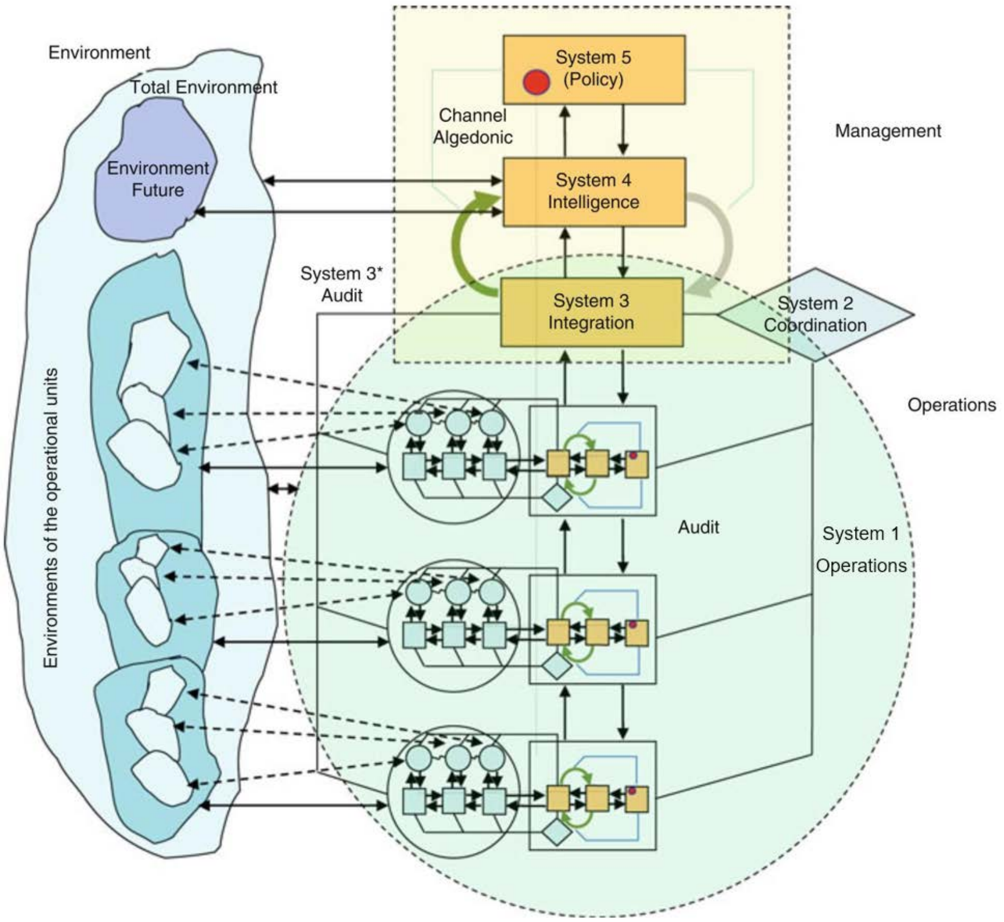

Figure 4: The Viable System Model (Ríos 2012, p. 50)

System 2 (Coordination) makes the set of organisational units which comprise System 1 function harmoniously. These units may be related by production processes, service delivery or common resource pools which might lead to counter-intuitiveness sub-optimisation or conflict as a result of each one attempting to achieve its own goals. Examples of System 2s are: Information Systems, Product Planning, Accounting Procedures etc. (Ríos, 2012, pp. 29–30).

System 3 (Integration) performs a harmonisation role exploiting possible synergies from the interactions of System 1 subsystems. System 3 may be considered the "Operational Management" of the organisation. This system is concerned with the daily operations. It is concerned with the organisation "here" and "now" (Ríos, 2012, p. 32).

System 4 (Intelligence) represents the organisation's adaption structure. In order to do this the organisation must monitor both what is currently occurring and possible future changes subject to the pertinent environment. This system contains the right tools and methods to process and analyse information, variety and complexity presented by the organisation and its environment. The translation from data, to information, to modelling and intelligence is performed here (Ríos, 2012, p. 40).

System 5 (Policy) has maximum authority in the organisation. All variety that the other subordinate functions cannot absorb is resolved by System 5. System 5's function is to balance the present and the future of the organisation, or 'the bigger system in focus.' It is responsible for establishing the identity and purpose of the organisation. Typical responsibilities of system 5 are establishing the vision, mission and strategic goals of the organisation (Ríos, 2012, p. 46).

Determining the viability of a service system will provide a base from which crucial determinates can be defined, designed for and even managed. No literature was found applying the Viable Systems Approach to analysing and designing services systems. This research will provide a contribution by reporting on the approach of a Viable Systems Approach applied to the design of service systems.

4. Research Approach

The perceived research approach is to break up the study into two phases which iteratively feedback into each other. The first phase will focus on determining the state of viability in the current IT service systems. This is done by collecting a set of perturbations and competencies in each IT service system and conducting variety engineering against the competencies or capabilities existing, 'as-is', within the service system and its current environment. This is graphically presented in Figure 5. The process involves multidisciplinary cross-functional teams that attend a workshop where information and simulation model accuracies are facilitated by the researcher. The researcher provides system dynamics simulation models to validate assumptions where there are business and market dynamics that require analyses. The researcher also provides quality function deployment templates to ensure comprehensive assessment of competencies and capabilities. Having done this, if a residual variety exists in the service system having conducted the variety engineering analysis, this then qualifies as a redesign for the service system and service.

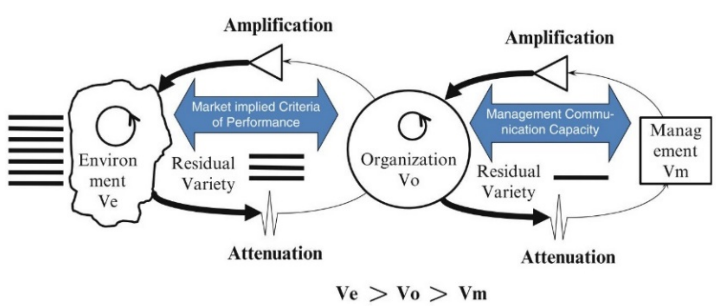

Figure 5: Residual variety in an organisational context (Espejo and Reyes, 2011, p. 69)

In the second phase the viable systems approach will be used to redesign the service system found to contain residual variety using the laws, principles, mechanisms, charts and equations first introduced by (Beer, 1985) in Diagnosing the System of Organisation. The high-level outline of the research approach is described in Figure 6, which presents how the various tools and instruments are applied in a systematic, iterative process based on complexity management to enable the design and re-design of service systems to an eventual state of viability.

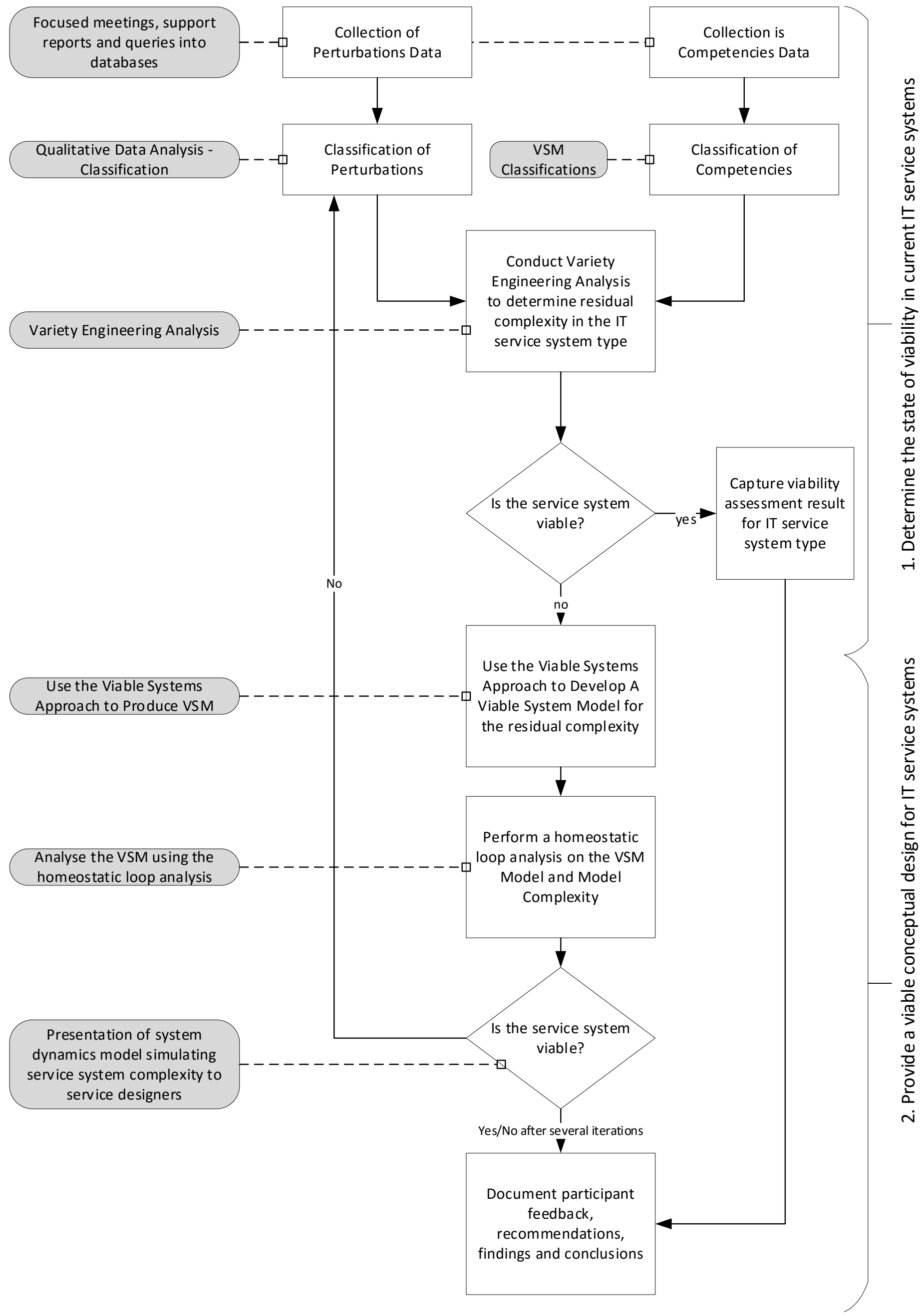

Figure 6: Research Project Logic Flow

5. Conclusion

From the literature review, it has been posited that a framework that considers co-creation complexities under dynamic markets is of great contribution to both literature and business. Having found existing models lacking a holistic solution, the research has proposed that the viable system model presents an iterative systematic process to which such service systems can be designed, diagnosed and managed. Several service systems have been successfully identified to contain residual complexity and have been re-designed in collaboration with various industry organizations. The viable systems model, due to its attenuation and amplification concepts and its recursive nature, has proven to be suitable in providing an effective approach to designing intelligent ecosystemic service systems that can proactively adapt to dynamic environments.

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