Achieving sustainability through service operations design: the role of systems thinking

Ayham A.M. Jaaron (ayham.jaaron@najah.edu)
Industrial Engineering Department, An-Najah National University, Nablus, West Bank, 97200, Palestine

Chris J. Backhouse
Wolfson School of Mechanical, Electrical and Manufacturing Engineering, Loughborough University, Loughborough, LE11 3TU, UK

Abstract

This paper investigates the impact of applying systems thinking approach to service operations design on the Triple Bottom Lines (TBL) of sustainability. A survey was conducted with 95 service organizations that have implemented the systems thinking approach into their service operations. Using the Structural Equation Modelling (SEM) technique, results confirmed that systems thinking implementation in service operations has significant impact on the environmental and social dimensions of sustainability ($p<0.05$), but has no significant effect on the economic dimension. This is the first study empirically investigating the impact of systems thinking approach on the TBL of sustainability in service departments.

Keywords: Sustainability, Service Operations, Systems Thinking

Introduction

The impact of service sector on environment is immense and growing (Zhang et al., 2012). According to Junnila (2006), the service sector consumes about the same energy and has about the same global warming potential as the manufacturing sector. With these considerations, the demand for sustainable service operations design that meet customer changing needs while considering environmental impacts is overwhelming (Roos & Agarwal, 2015). However, Williams *et al.* (2017) emphasized that successful implementation of sustainable practices requires the adoption of a multidisciplinary systemic lens to grasp the interconnectivity of ecological, social, and economic dimensions of sustainability. As a result, reductionist approach that is based on silo working of subsystems (i.e. dimensions) of sustainability will show its inability to address sustainability issues (Adetunji et al., 2003; Nguyen & Bosch, 2013; Williams et al., 2017). Further, Gray (2010) explained that a systems thinking approach of looking at dynamic interactions within and across the dimensions of sustainability is needed to achieve sustainability in the service sector (Mutingi & Mbohwa, 2014). Despite this fact, empirical studies investigating the impact of systems thinking on sustainability management, considering the three dimensions of sustainability, have been scarce. Arising from this, the current paper aims at contributing to the aforementioned gap by

mapping the influence of systems thinking approach over organizational sustainability through empirically investigating the impact of applying systems thinking approach to service operations design on the Triple Bottom Lines (TBL) of sustainability (i.e. environmental, social, and economical). Therefore, the research question sought to be answered in this paper is: RQ. What is the impact of applying systems thinking approach for service operations design on the TBL of service sustainability?

The paper uses a survey instrument to collect data from UK-based service organizations that have adopted the systems thinking approach into their service operations design. The survey was developed based on literature reviews in the sustainable operations and systems thinking research areas, and based on previous several case studies conducted by authors of this paper. This research seeks to demonstrate that the application of systems thinking approach to service operations can provide an understanding of how sustainability can be fostered in service industries. This paper is further organized as follows. The next section presents the literature review conceptualizing TBL of sustainability. Next, connecting systems thinking with the TBL of sustainability is made with articulation of the main research hypotheses. This is followed by the research methodology section outlining sampling and data collection methods. Next, data analysis and results are explained. This is followed by discussing and concluding the results.

Defining TBL of sustainability

The concept of sustainability was first formally coined at a global level in 1987 with the Brundtland report (Nations, 1987). In this report, sustainable development was defined as "development that meets the needs of the present without compromising the ability of future generations to meet their own needs". Sustainability, on the other hand, is "the integration of the environmental, social, and economic systems to improve the quality of life within earth's carrying, regenerating and assimilating capacity" (Adetunji et al., 2003). This adopted definition entails the set of actions, and inherent interrelationships, that are designed to drive the TBL around environmental protection, social responsibility, and economic growth (Arnold, 2017; Mutingi & Mbohwa, 2014). At a broader sense, service design is the application of mechanisms and tools to solve people's problems through a service response, which aims at delivering values between people involved in a value chain (Prendeville & Bocken, 2017). However, a service design can only contribute to sustainability if it can minimize resources consumption to protect the environment, fully meet human needs, and generate economic value to the organization (Martínez León & Calvo-Amodio, 2017; Zhang et al., 2012). This posit of sustainable service design concept requires making a balance between dimensions of the TBL of sustainability. Therefore, protecting environment through reducing resources consumption and waste generation does not fully capture the core idea of sustainability; it must also integrate socials networks and economic prosperity issues through an interconnected systems approach.

Systems thinking and TBL of sustainability

The concept of systems thinking suggests that a system is composed of subsystems, and belongs to a larger system where it is nested in. It is based on the process of focusing on the causal relationships between parts of the system (Fiksel 2012; Smith 2011); this makes unique properties of the systems visible and allows for easier communication and control to adjust systems performance in the face of imbalances (Adetunji et al. 2003).

This dynamic process and co-evaluation of a system view, highlighted by relational aspect of systems thinking, is consistent with the concept of complexity theory (Davis and Stroink 2016). According to complexity theory, living systems, such as organisational systems, are complex adaptive systems where parts and collective behaviour constantly evolve (Missimer et al., 2017). However, Gregory (2007) asserted that reductionist view of a system is not appropriate as it is based on silo working that limits system dynamic ability and necessary interaction between parts. Therefore, if a complex context, such as sustainable service operations, is viewed in this reductionist way, discontinuous forces of silo working would prevent achieving sustainability (Nguyen and Bosch 2013; Smith 2011). This is brought out by the work of Seddon (2003) of implementing an innovative systems thinking approach into service organizations' operations design. A detailed account of this approach is reported in the work of Seddon (2003), Seddon (2008), and also in the work of Jackson et al. (2008), this is also explained below.

Seddon's systems thinking approach articulate a structured process where service operations are built around customer demands, and not around functional hierarchies of the organization (Jackson et al. 2008). According to Seddon (2003), the systems thinking approach instils a culture characterised by the formulation of a self-managing teams in order to deliver what the customer wants. For this purpose, front-line employees from the workplace itself are chosen to formulate these self-managing teams; as they are most knowledgeable about how a service can be delivered based on customer needs (Jackson et al. 2008). Taking a systems view, self-managing teams are encouraged to understand the nature of customer demands (Jaaron and Backhouse 2017). To achieve this, the flow of customer demands, at all points of contacts, are studied over a considerable amount of time. As the team pursue this logic, they learn about the main purpose of the service system from the customer point of view, and about different frequencies of demands that the service system has to respond to (Jackson et al. 2008). This will also allow categorization of customer demand into two types: 'value' and 'failure' demands. Value demands are defined as those demands that the service department has been established to serve and are of value to customers (Marshall 2010). Failure demands, on the other hand, are defined as those demands caused by a failure to do something right for the customer (Seddon 2008). However, as soon as the purpose of the service system, from a customer perspective, is defined, the interconnections between service organization's parts become the focus to deliver that purpose (Jackson et al. 2008). To fully illustrate how this systems thinking approach is applied in practice, the following paragraph presents three main steps for the implementation of the systems thinking approach in service departments:

1) 'Check' stage: The purpose of this stage is to study customer demand to understand what matters to customers, and to find out what is the purpose of the service system from the customer's point of view? This stage is usually terminated by mapping flow of all current processes in the system to identify waste and systems conditions that stop the flow (Jaaron and Backhouse 2017; Seddon 2008). The importance of this stage is the ability to examine, through demand analysis, how capable the current system is in achieving the (real) purpose.

(2) 'Plan' stage: it involves exploring all possible improvements to the current flow of operations to better achieve the (real) purpose of the service system and

minimize failure demands. This is achieved by minimizing waste, from a customer's point of view, during the process of mapping out the new service design.

(3) 'Do' stage: this stage involves gradually implementing the new service design in the service department. Front-line employees are also gradually rolled-in to experiment new operations. It is significantly important here that customers' feedback and employees' comments about the newly designed operations are carefully studied to find out whether the service is providing the (real) purpose of the system with least failure demands or not (Jaaron and Backhouse 2017).

Systems thinking and environmental dimension of TBL

According to Williams *et al.* (2017), organisations adopting systems thinking approach into business operations design, including service operations, can improve organization's sustainability indicators through feedback loops with other actors in the external environment. In response to external feedback, the organisation can adapt or transform its internal systems and operations to mitigate environmental impacts (Folke et al. 2010). Moreover, complex adaptive systems using systems thinking lens are able to restructure itself or, in other words, self-organize (Ashton 2009). Self-organization is enabled when the environmental system is out of equilibrium, thus, an internal shift in organizational processes is required. Manring (2014) has positively associated this ability of a system with achieving sustainability. The constant adaptation to complex feedback loops, warranted by interconnectedness of subsystems, facilitate the emergence of environmental problems solving through better information flows and improved decision making processes (Dougherty and Dunne 2011). One example of systems thinking in creating internal shift in service processes is the development of strategies for reducing resources consumption through redesigning service operations in the most effective way (Jaaron et al., 2014). The above presented relationships have, therefore, allowed for the articulation of the following hypothesis:

H1. The adoption of systems thinking approach in service operations design is positively related to the environmental dimension of TBL of sustainability.

Systems thinking and social dimension of TBL

According to Chou et al. (2012), systems thinking approach has the capability of connecting social networks to enhance the remaining two dimensions of sustainability (i.e. environmental and economic), and to simultaneously improve human well-being through sets of behavioural changes (Smith 2011). In this sense, behavioural changes are seen as a necessary ingredient for sustainability because individual behaviour aggregates to drive systems dynamics in business and society (Marcus et al., 2010). As a consequence, systems thinking has been found to increase individual's confidence in problem-solving ability due to direct individuals' engagement with emergent events, individuals connections with each other, and increased individuals' awareness of the connected parts of the system they operate (Seddon 2003; Smith 2011). Subsequently, systems thinking has the potential to create a working place that is largely driven by shared interests, information, identity, processes, and, thus, competencies (Jaaron and Backhouse 2017). These virtues of the systems approach establish systems, especially loosely coupled ones such as services, around shared values and meaning at the level of employees, as well as other stakeholders involved (Morgan 2005). Based on this, the following hypothesis has been formulated:

H2. The adoption of systems thinking approach in service operations design is positively related to the social dimension of TBL of sustainability.

Systems thinking and economic dimension of TBL

An inquiry into previous studies reveals that systems thinking can mainly contribute to economic growth through reduced resources consumption. For example, Fiksel (2012), in his discussion of strategies for reducing resources consumption from a systems thinking perspective, explain that increasing resources efficiency in operations of a facility is closely linked with reduced costs. Similarly, Jaaron et al. (2014) identify that interconnectedness of service system parts, warranted by systems thinking approach, can provide clarity for the system as whole by analysing demand arriving into the system. This was found to significantly improve service demand predictability and, thus, better organizational preparedness for required resources will save organisational financial resources. Furthermore, Smith (2011) found that systems thinking allows for operational skills and personnel experience development. These benefits of systems thinking are relevant to the achievement of reduced operational errors and reduced resources wastage, thus, providing economic benefits for the business (Jaaron et al. 2014). According to Bicheno and Holweg (2016), resources depletion of a service organization is caused by several types of wastes such as lack of preparedness that cause the inability to provide what a customer wants, duplication of processes, unclear communication, human errors, and delivery delays. These causes of resources depletion are also asserted by Seddon (2008) and Marshall (2010) as a result of flawed design of service operations. These relationships are articulated more formally as:

H3. The adoption of systems thinking approach in service operations design is positively related to the economical dimension of TBL of sustainability.

Based on these research hypotheses a research model is presented in Figure 1.

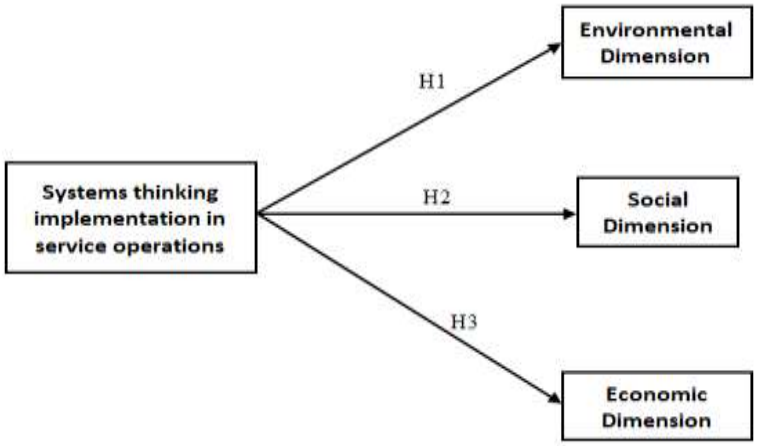

Figure 1 – Research Model

Research methodology

The study applies a quantitative method in which data was collected from a survey instrument. However, to pinpoint, and then only target service organisations implementing Seddon's (2003) systems thinking approach into their service operations, a leading consulting firm in England, specializing in providing consultancy services

around the systems thinking implementation in service organizations was contacted. An earlier research work of authors with the help of this consulting firm ensured easy access to available list of their clients. The survey was designed based on a literature review in systems thinking, service operations management, and sustainability management research areas. To enhance content validity of the survey, it was pre-tested with three academics with extensive background in sustainability and operations management issues. A web-based survey has been sent to 250 service organizations through e-mail (i.e. available list of service organizations fully implementing the systems thinking approach); after organizations were first contacted by e-mail to explain the research project. In total, 95 surveys (responding to all survey items) were returned from UK-based service organizations that are operating in four different sectors (i.e. logistics of house repair and maintenance, financial, insurance, and IT support services); and all have fully implemented the systems thinking approach into their service operations. The survey was completed by general directors, operation managers, systems thinking team leader, or the person responsible for the sustainability development in the organization. Respondents were requested to rate each item in the survey on a Likert scale (1-not at all, 2-slightly, 3-moderately, 4-very, 5-extremely). The Structural Equation Modelling (SEM) technique was used to analyse the data. Statistical analysis of the data was conducted with the help of the SPSS software (Statistical Package for Social Sciences) Version 23, as well as to the viability of SEM methods was performed using IBM SPSS Amos 23. Table 1 provides details of participating service organizations in terms of size, type of respondent, and number of years since the systems thinking adoption in service operations.

Table 1 – Demographics of the sample

Characteristic	**Alternatives**	**Percentage (%)**
Job title	General Director	8.4
	Operations manager	60.2
	Systems thinking team leader	11.2
	Responsible for sustainability development	20.2
Number of employees (Size)	10-49	10.1
	50-249	42.1
	More than 250	47.8
Number of years of systems thinking redesign	Less than 3 years	1.7
	3- less than 5	29.5
	5—less than 7	32.2
	7 years and above	36.6

Data analysis and results

In accordance with the aim of this research, the practices of the systems thinking approach for service operations are used as the exogenous (independent) latent variable, whereas the TBL of sustainability (i.e. environmental, social, and economical dimensions) were used as the endogenous (dependant) latent variables. To ensure validity and reliability of the data, different techniques were used for this purpose. First, content validity, as mentioned earlier, was addressed in the survey development process through pre-testing with academics, for consistency of survey items with available literature, and through sharing with systems thinking practitioners. To validate factors

structure in the model, convergent validity was tested with the help of Confirmatory Factor Analysis (CFA) technique. The model fit was assessed with the help of three different indices widely used in CFA; the Tucker-Lewis Index (TLI), Comparative Fit Index (CFI), and the Root-Mean-Square Error of Approximation (RMSEA). The results of the CFA technique indicated that TLI and CFI values are 0.952 and 0.957, respectively, and that the RMSEA value is 0.061. According to Hu and Bentler (1999), cut-off values close to 0.06 for RMSEA, and a cut-off values above 0.90 for TLI and CFI indicate a good fit between the hypothesized model and the observed data. Following these validity and reliability measures, the results for testing the three hypotheses presented in structural model in Figure 1 are described. The results achieved through the SEM technique have shown that there is a statistically positive and significant relationship between applying systems thinking principles in service operations and the environmental and social dimensions of sustainability. However, systems thinking principles were found not to have a direct impact on the economic dimension of sustainability. The results of the analysis are shown in Table 2, and summarized in Figure 2. The structural model fit indices show an adequate model fit, with CFI=0.923 and TLI=0.913, which are well above the minimum threshold of 0.9 required in SEM (Kline, 2015). In addition, the RMSEA=0.065, which is very close to 0.060 as recommended by Hu and Bentler (1999). Furthermore, the path coefficients for hypotheses H1, H2, and H3 are significant at ($p < 0.05$) level.

Table 2 – Results for testing hypotheses of the research

Hypothesis	Description	Estimate	S.E.	C.R.	P	Result
H1	*The adoption of systems thinking in service operations is positively related to the environmental dimension of TBL of sustainability.*	0.977	0.109	8.982	0.000*	Supported
H2	*The adoption of systems thinking in service operations is positively related to the social dimension of TBL of sustainability.*	0.834	0.210	3.963	0.000*	Supported
H3	*The adoption of systems thinking in service operations is positively related to the economical dimension of TBL of sustainability.*	-0.430	0.421	-1.020	0.308	Rejected

*significant at $p < 0.05$

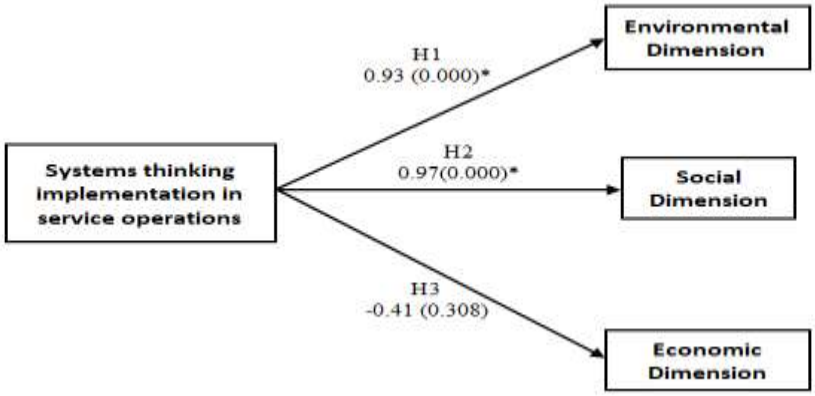

Figure 3- Results of the SEM with standardized regression weights.

Discussion and Conclusion

The overall hypotheses testing results achieved through the SEM technique have proven that there is a statistically positive and significant relationship between applying systems thinking principles in service operations and the environmental and social dimensions of sustainability. However, contrary to what was predicted, systems thinking approach was found not to have a direct impact on the economic dimension of sustainability. As for the result of the first hypothesis (i.e. H1), as it was explained in literature reviews, the value of systems thinking to environmental dimension is explained through the ability of building an operational system that can respond to feedback from different stakeholders on its environmental performance (Lezak and Thibodeau 2016). This adaptive capacity of systems thinking design allows transformation of internal operations to reduce resources depletion and, thus, improve environmental protection. In specific, continuous adaptation to customer demand patterns, made possible by interconnectedness of subsystems of a service, facilitate information flows and decision making processes required for the development of environmental problems solving (Dougherty and Dunne 2011). In line with these virtues, systems thinking application has the potential of not only absorbing various customer demands, but also increasing material efficiency in operations; delivering a service with least repeated contacts and paperwork, thus reducing energy utilization. In addition, the results suggest that working principles of systems thinking such as matching and predicting customer demand, and less failure demands are significantly important for waste management. As for positive impact of systems thinking on the social dimension (i.e. H2), the findings suggest that systems thinking provide a rewarding experience for all stakeholders in the service. It was found that systems thinking application has the capability of improving human well-being through changing behaviour at work (Smith 2011). Behavioural changes include relocating employees to work within teams, thus, creating a working place where employees share values, interests, information, and eventually, they get the chance to improve their competencies through learning from each other. Customers also become the focus in this context, thus, increasing their satisfaction with the service organization (Jaaron and Backhouse 2017). In fact, sustainability depends on shared values of all stakeholders in a service system to create changes in the consumption pattern of organizational resources. This can only be warranted by the creation of new forms of interaction between individuals, inside and outside the boundaries of the organization, which may result in improved sustainable practices. However, the missing direct link between systems thinking application and economic dimension of sustainability (i.e. H3) can also be explained through the potential positive impact of environmental dimension on the economic dimension. The most important offering of systems thinking is the reductions of failure demands. This minimization of failures is associated with severe reduction in resources waste. According to Seddon (2008), failure demands can produce many types of wastes that can affect operational costs, such as duplication due to repeated customer contacts, significant delays, more back office paperwork, and more time wastage; thus, causing reduced productivity and less profits. It can also be discerned from results that the second most offerings of systems thinking is customer focus. As mentioned earlier, employees, in this context, are well-prepared to provide a high-quality service, thus, providing economic benefits through more satisfied customers.

To conclude, this research study has several contributions for practitioners and researchers. First, most research in the field of service operations design investigates

sustainable development based on the product-based domain; where the focus is on economic value as it is relatively more tangible than in service setting. This paper is the first study of its kind that sets to empirically investigate the impact of systems thinking design approach on the TBL of sustainability in the context of service departments. Second, while previous research has showed limited capability in designing sustainable services (Arnold 2017), that can remain financially stable while simultaneously contributing to social benefits and clean production of services, this current research provides an evidence that systems thinking approach, in a service setting, ensures the service system design is directly linked with enhanced environmental and social dimensions while indirectly contributing to the economic dimension of sustainability, thus, providing a nuanced view to re-conceptualizing sustainability in services.

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