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Is Sustainability in Operations Just a Question of Adopting Standards?

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Abstract

The overwhelming issue of sustainability in business activities has over the last few years transformed organisational goals to cover far broader areas compared to narrow result areas looked upon as business drivers in the past. It has also led to a proliferation of generic and organisational sustainability standards applied across all disciplines of business activities. The intention behind such standardisation of activities is primarily to restrict or avoid wastage of resources – in whatever form or substance, which also in a way homogenises the environment. In Operations Management, it assumes significance and this brings to the fore the concept of life cycle management (LCM) for sustainable business. In the context, even though LCM per se is not novel it is proposed to evaluate product and process life cycle management methodologies within a broad perspective provided in part by the generic standards for sustainable businesses. Further the digital revolution has advanced to such a stage that it is rather a "data revolution" that is happening through embedded computing intelligence developed through the inventive methods of information management and computing. An opportunity for organisations to dovetail operations management into sustainable practices has been opened up through the availability of such information management methodologies and computational intelligence. A brief ontological substrate for building sustainable business processes in the life cycle management perspective provides possible ways of furthering sustainable operations management. A short summary of the sustainable OM efforts in manufacturing being pursued all over the world gives a perspective on the imperative change in operations management.

Keywords: Sustainablility, Operations, Computing, Life Cycle

Introduction

Over the last decade rapid strides in technology centred around computing and communication has seen a number of traditional business models undergoing substantial modifications. Innovations in communication methodologies built around networked entities with computational power has led to new and powerful management support systems. On the other hand, in question is the very existence of business organisations on the traditional mould for long; accepting and assimilating the strengths of the new economic and technological changes is a necessity (Hopkins, Townend, Khayat, Balagopal, Reeves, & Berns, 2009). In this context, it should also be noted that a major shift in economic activities is underway - sustainability in all its forms is now being built into business practices. In this environment operations management (OM) cannot remain an insulated area of business processes, more so since organisations are seeking to embed connectivity in all aspects of processes to support flexible decision making (Sharma, 2013).

Role of Standards in Sustainable Business

Even while acknowledging the necessity of incorporating sustainable business practices in organisational management it is seen that many do so through adoption of management system standards like ISO 140001 for environmental management or SA 8000 for social accountability (BSI, 2009). It is a moot question whether mere certification to such standards can transform organisational practices into sustainable ones. Standards like the ISO 14001 have been developed to render help for any kind of business organisation to recognise and address the need for reviewing use of resources while reducing impacts on the environment through multiple measures involving intelligent process selection and responsible management of it including the reduction of

waste generated subsequent to activities. The most recent revision of this standard has brought forward holistic planning to achieve sustainability in business activities rather than merely preventing pollution as was stressed in the previous version. It is clear that the revised standard will lead to organisational changes including operations management (OM). Another standard contributing to the sustainability aspect from a human resource point of view which is again of utmost importance in OM is the SA 8000 social accountability standard. Recognition of labour as one of the driving forces for organisational sustainability lies at the basis of this standard. Understanding energy sustainability to be a key to modern life, the ISO 50001 standard sets out guidance for organisations to identify, enumerate and develop methods for reducing energy use in organisations, especially in the operations portfolio covering manufacturing, supply chain and auxiliary utility functions. Recently the GRI initiative has been gaining momentum as a voluntary reporting methodology for different organisations and indicates how global engagement with sustainability is taken as seriously as basic business processes. Other standards include the ISO 14064 one providing the guidance for greenhouse gas use and reporting, the ISO 201121 on event sustainability etc. Figure 1 shows some of the standards and the areas of application.

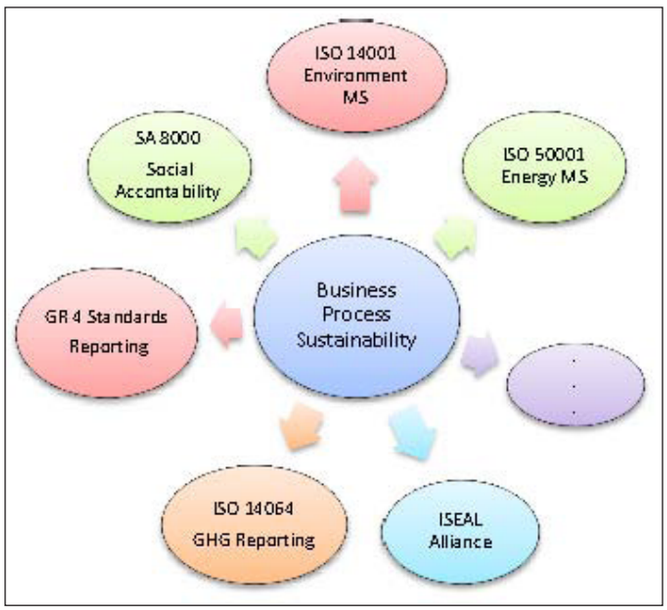

Fig. 1: A Few Global Standards and Standardisation Methodologies for Sustainability

Sustainability in Operations Management

The insularity of OM to much of the changes happening in management practices in organisations has stemmed from the perception that it is based more on engineering principles with the control function exercised to cover the interfaces with other functional units in the organisation through sound management principles developed within behavioural frameworks. Even so the relevance of new ideas derived from the information and computing resources which have fundamentally changed the macro-environment of business has started penetrating operations management as a practised discipline since many of the stakeholders have access to most of organisational data in one form or the other, rendering lengthy, hierarchy-driven procedures of earlier OM models is quite inadequate in satisfying the stakeholder needs (Kumar, 2012). Alongside, people and governments have been looking at resourceful ways to reduce the impact of human activities as sustainability has taken centre stage.

It cannot be said that there were no efforts made earlier for curtailing waste generation from activities or for optimising resource use. In fact, much of the early OM techniques were targeted at optimisation of resource use and reduction of wastage. The question then is why sustainability is being reviewed as a comparatively new area. The answer lies in the three pillars of sustainability as recognised now – environment, economy and society. Early OM methods didn't focus on the environment and society to a major extent but only as an incidental impacted area. Methods and techniques developed for optimal management including quality management, optimal production planning and project management in the early stages looked to focus on the immediate optimisation problems and not global optimisation, wherein the impacting areas were considered on the basis of immediacy with long term impacts being taken into account for the initially important areas of concern like production or project completion. Hence the present stress on sustainability and standardisation for sustainability is in its detail different from the earlier efforts. The standards in use too have begun to stress holistic sustainability wherein business processes and organisational motivation are formulated within a life cycle model (LCM) so that activities derived from the organisational goals and objectives are linked to sustainability in the long term.

Many OM interventions which have brought timely shifts in the management perspectives like TQM, JIT and BPR have in specific ways given due place to issues of sustainability (Kleindorfer, Singhal, & Wassenhove, 2005; Shekhawat, 2015). It is in the translation and 'transference' of these management frameworks that dilution has occurred leading to a false perception of lack of effective sustainability focus in these. For example the 5S standardisation of workplace in organisations imply at the highest level – *Shitsuke*, imbuing the idea of sustainability through assimilation and standardisation but in implementation this is translated to mean rule based discipline in a majority of cases. An examination of TQM framework components show that dovetail fits between the components are made possible through the underlying unity in the principle of sustainability. This aspect requires further refinement, in which case adoption and certification to standards need not be the sole channel for organisations to proceed on the sustainability trajectory even if the legal compliance requirements may allow some amount of laxity (for example Singh, 2013).

Extending Operations Management beyond Sustainability Standards

As a strong intervention methodology, certifiable standards are conceptualised with business process models in use superimposing the structure of management objectives within the scope of the relevant architecture of each standard. Both Hopkins *et al*. (2009) and BSI (2009) provide evidence of the appropriateness of such standards for organisational effectiveness in pursuing sustainability. But an important and counterintuitive finding is that in many firms there is a lack of organised vision on what is sustainability beyond mere reporting and standards. In the BSI report 25 % of the respondents were still not clear on exactly how sustainability could be part of the business activities. In Hopkins *et al*. (2009) mention is made about how "More than half of those surveyed stated a need for better frameworks for understanding sustainability". This shows how a strategic intervention into sustainable organisational practices can be localised to each firm if the functional interactions leading to innovative initiatives are driven in a bottom-up mode hand-in-hand with committed leadership from the top management. Understanding the needs and peculiarities of each organisation is not necessarily a prime concern in certifiable standard adoption method unless the standard is first reinterpreted through the organisational perspective by the management which need not always happen. In many instances, the certification standards are simplistically applied to derive a framework of easy compliance which defeats the purpose behind such an initiative.

A proactive and difficult path involving deep commitment across management and functional levels as well as understanding the philosophy behind sustainability standards is to empower the stakeholders to rework organisational processes to trace sustainable trajectories that become inherently in consonance with its sustainability vision. To answer whether organisations can develop competitive advantage through sustainability within OM, the importance of value chain as central process driver should be first acknowledged as it enables continual improvement even when functioning in an environment that involves business risks stemming from regulations and legal compliance as well as customer driven perceptive needs (Fig. 2). The continuous but filtered interactional matrix of customer perception of organisational outcomes in tandem with the regulatory compliance requirements acts as driver for incorporating sustainability in operations for any business firm.

Life Cycle Management as an Integrative Frame of Reference

The transition from cost centred operations management to sustainable operations management through multiple means like production optimisation and supply chain optimisation puts forward asset building – whether it is tangible or intangible, as a prime motive even while following the 3Ps of sustainability as in the triple bottom line strategies of business organisations. Enhancing this is the life cycle management (LCM) methodology of integrative product, process and service value chains in which business organisations are operational entities. Product life cycle management (PLM) has taken up green manufacturing for apportioning the responsibilities of sustainable product design, development and manufacturing strategy where the organisational vision of sustainable PLM from design to market unified through information paths leads to a mission centred on the minimisation of product lifecycle impacts realised through operational management (Vila, Abellán-Nebot, Albiñana, & Hernández, 2015). In their analysis starting with the eco-design approach, environmental factors are seen as impacting four major areas: society, energy, environment, and economics which require green competencies across design-manufacturing-service (DMS) covering all of OM in addition to other functional domains. An ontological structure is attempted by proposing a framework oriented to develop appropriate methods and tools for each stage in DMS and tying them through the knowledge base accumulated over previous cycles.

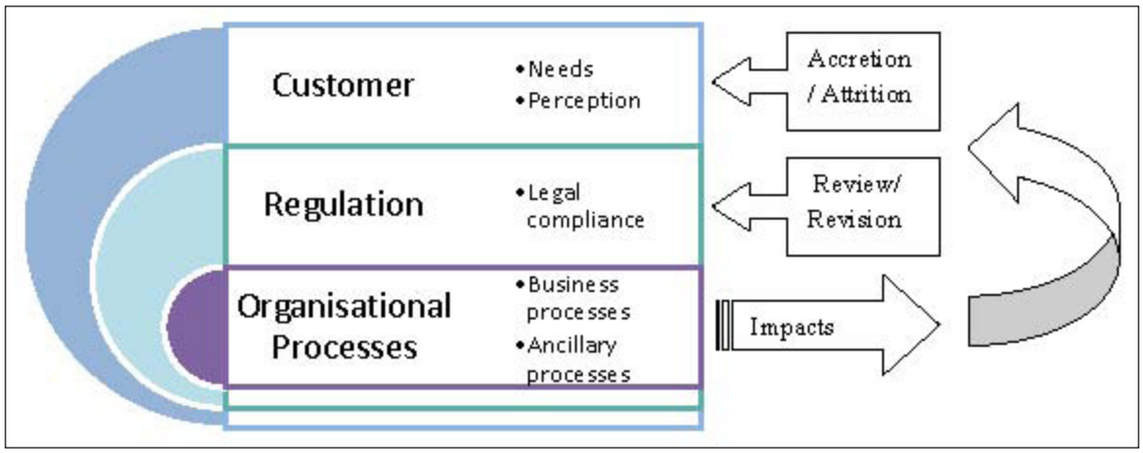

Fig. 2: Locating Sustainable Operational Processes in the Customer Space

3.2 An Intuitive Extension: Product and Service Lifecycle Management

It becomes important for firms to look for integrated strategies incorporating sustainability in the full value chain (Tonape & Owk, 2013). Customer focus brings back the question of how to achieve real time responsive product-service bundling (Wiesner, Freitag, Westphal, & Thoben, 2015). Primarily service lifecycle management (SLM) and product lifecycle management (PLM) should be combined to deliver the real time response. It can be seen that the gap between service delivery and beginning of life phase for products in the PLM has been identified and many efforts have followed even before formal structures for PLM were thought of; for example, TQM stresses the importance of customer driven quality management of products. The limitation of such efforts stemmed from two factor; one is the divergence of customer service delivery mechanisms from functioning manufacturing/operations mechanisms in organisations, the other factor is the dissonance in service management information interchange on real time basis. The information revolution has since led to very strong data analytical and information extraction methods which had prevented earlier attempts in real time information interchange throughout the organisational operational functions. Interoperability is a formal requisite for knowledge interchange in the operational domain. In fact, the factory of future (IEC, 2015) envisioned is primarily an information driven cyber-physical layer connecting the knowledge content and the physical operational process of manufacturing. In the report there is again clear mention of how entire value chains will have to be organised into computationally intelligent network. The resulting self-organisation of networked manufacturing equipment will take into account the entire value added chain, with the manufacturing sequence being determined on a flexible basis, depending on the current situation, and with the human being remaining essential as the creative planner, supervisor and decision maker of the process. The decision making intended here is hierarchically uppermost decisions which go beyond the immediate operational decisions in a manufacturing environment which will be dealt with through machine intelligence and high level artificial intelligence built into production systems. Sustainability can be a prime reason to continue with the human interference at this decision level. With this background the operational interactional model of SLM and PLM suggested in (Wiesner, 2012) which proposes a three stage SLM in the sequence "service creation – service engineering – service operations" closely paralleling the "beginning of life – middle of life- end of life" PLM. In this the ideation, requirement analysis, design, implementation and service testing are precursors to the service delivery. An analysis of attempts in integration of SLM and PLM is (Wiesner, Guglielmina, Gusmeroli, & Doumeingts, 2014) which mentions the following four types of interactions:

1. SLM follows PLM (we will call it 'Follower model')
2. PLM follows SLM ('Leader model')
3. SLM aligned with PLM ('Tandem model')
4. SLM and PLM integrated ('Assimilation model').

Although other models are followed by many organisations, those following the assimilation model of SLM/PLM are not there since mature data analytical methods and information interchange standards enabling computationally intelligent operational management of organisations has come about very recently. Such powerful technologies in the software and hardware

domains have seen to it that enterprise resource planning (ERP) has now started employing artificial intelligence along with advanced communication architectures to tool up for the emerging challenges of operations management. In these developments, sustainability gets threaded in through the methods employed rather than subsequent standardisation through certifications-though for new organisations employing these tools it is quite easy for both certification to standards as well as follow globally accepted sustainability reporting.

New Perspectives of Operations Management

Having established the role of computational intelligence and communication in future ready operations management it is the turn of organisational approaches to production and service delivery that requires adaptation. Such an approach is elaborated next in the context of sustainable business processes.

Service 'as Product' and Service 'with Product'

The LCM view of operations management cannot be an outlying method for manufacturing organisations alone if 'servitisation' of products which began by the end of 1990s taking root in software related organisations is taken into consideration. The development towards a growing importance of services and the related transition from a mere physical product to a combination of physical product and associated services and sometimes even to a service that is provided instead of physical product is called servitisation (Wiesner *et al*., 2014). The software as a service (SaaS) has already become established and if new business models like mobile application derived service solution to transportation, which provides a service instead of ownership of a product meeting the functional need, get extended to more areas of human lives servitisation would be truly revolutionizing organisational interactions with customers since the possibilities of resource sustainability gets enlarged multiple times. An examination of the changing scenario with reference to service businesses carried out by Schmenner (1986) mentioned the shift to a 'diagonal' where the service factory moves to a professional service firm for better control. Servitisation is in effect the shift of manufacturing firms to service firm mode and sustainability too gets due space in this move.

In such paradigm shifting trends how will sustainability be measured and indicated in management? Sustainability as defined by Brundtland commission is "development that meets the needs of the present without compromising the ability of future generations to meet their own needs". As seen from triple bottom line reporting, societal impacts should be measured for establishing control and how effective these indicators are will decide how the progress is documented for traceability and continuity. Continuing on the path of the indicators of sustainable development put forth by the UN (United Nations, 2001) a study relating to manufacturing shows how sustainability in business processes can be measured relating these to sustainable project and technology life cycle management (Brent & Labuschagne, 2006) by calculating the social impact indicator (SII) related to the dominant life cycle phases and environmental resource impact indicators (RII). Methods of deriving equivalence units for the indicators provides the necessary normalising across multiple bases and parameters. Establishing such SIIs/ RIIs will provide organisations measurable parameters for tracking sustainability even without the need for certification standards. The multiple perspectives of sustainability in business processes have to be conjoined through an ontological structure since the logical architecture for sustainable OM should be clear for the practitioners and assessors. It is from this ontological model that the interlinks and information flows can be examined and realised by the organisations. For example, Bruno (2014) mentions how a set of classes, relations among classes and properties of classes provide the ontological model to help integrate computational intelligence in sustainable OM. Such a model builds standardised terminology by incorporating the three aspects of innovation perspective, a production perspective and a materials perspective into business process modelling notation and associated metadata to allow the field in utilizing a schema for the information and knowledge on sustainability in OM (Borsato, 2014). The categorisation of activities in sustainability driven OM into 'class artifacts' and 'related object' properties will allow extraction of data from databases including those involving ERP and PLM which need not be directly part of software for life cycle assessment of product/service in the organisational context as multiple addressing becomes possible. This requires an analysis of integrated PLM/SLM processes from real world to follow the channels and modes of information interchange with identified terminology and can form part of a major research effort.

Some Examples of Sustainability in Operations Management

In the following examples a brief glimpse (IEC, 2015) of the changing patterns of sustainability practices is seen

with the increasing need for information connectivity and a radical departure from the human-centred organisational methods in operations management.

1. Industrial Internet Consortium for Advanced Manufacturing: Applying the concepts of connected intelligent automation which reduce the human exposure, technologies like Internet of Things (IoT) are now being pioneered for use in industrial operations to give an unmatched level of connectedness. Many of the concepts being readied fall under the advanced manufacturing partnership.

2. e-Factory: Data analytics and management control under the visible production processes with industrial internet is shaping the e-Factory. Further the data from the supply chains and collaborative technology inputs from smart sensors, smart robotics in a cloud environment.

3. Industries 4.0: Distinct from local automation this German experiment visualises the integration of core functions, like production, material planning and supply chain. In a holistic view, the machines and IT entities are trying to optimise the existing business operations while new business models on usage and metering are supported.

4. Indian Experience in Sustainable Manufacturing: Green production methods have been innovated in India also and a number of manufacturing firms have taken up lifecycle management principles. The case of India Glycols which has gone for a green petrochemical route for two of its products is an example (FICCI, 2015) where lifecycle management is applied for a real time operation.

The manufacturing and operations activities in traditional organisations are undergoing major realignment in the wake of heightened sustainability issues (Walker, Seuring, Sarkis, & Klassen, 2015). This is occurring against the background of rapid strides in machine to machine communication, cloud computing resources and intelligent manufacturing which suggests that seamless integration of business processes into this evolving world will have to be through a well-planned sustainable architecture.

Conclusion

The field of operations management is being transformed through the emergence of computational intelligence and intelligent connectivity enabling flexible and collaborative workflows while redefining the work environment itself through machine to machine communication with intelligent decision support systems. Some of the efforts being undertaken the world over in modern OM shows how essential it is for organisations to migrate to a communication driven, distributed decision systems which work on the analytical abilities of the new information management systems. The increasing trend of integrating communication technology, computing resources and supply chain management into sustainable practices for organisations has been highlighted through this discussion. A few brief case examples of the changing conceptualisation of operations management wherein these drivers are harnessed to show the power of processes built on sustainability beyond regulatory means alone is shown to be a valid model for organisations to adapt.

The present study of the underlying trends of sustainability in operations management can be extended through an analytical approach showing the linkages between adoption of appropriate sustainability processes in organisations and the derived competitive advantage which will strengthen the argument for business processes going beyond sustainability regulations to achieve consistent and continual growth. The scope of this study is however limited to highlight the possible directions "green thinking" is having on the field of OM and SCM. In all this the sustainability of business processes in the wider perspective measured through impact indicators provide the framework for organisations to move over to an operations management approach built up on the life cycle management basis. An integrative methodology of incorporating product life cycle and service lifecycle management will prove sustainable for firms in the manufacturing and service space.

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