The Adoption of Lean Six Sigma in the UK 'Third Sector' to Reduce and Control Waste to Promote Good Parctice in Supply to overcome Food Insecurity Amongst the Urban Poor.

Abstract

Purpose: To introduce lean six sigma to a warehousing operation of a UK 'third sector' charity to reduce and control food waste during storage and distribution.

Research Approach: This research takes an action research approach, with the principal investigator adopting a reasearcher / facilitator role in the analysis receipt, initial storage, put away, layout flows, picking, loading and pre-despatch, as well as rudimentary data communication flows. Interviews are also being undertaken to allow for the creation of narratives for consideration in juxtaposition to our DMAIC outputs.

Findings: Our ongoing research is revealing that this rapidly growing sector has by its genesis, led to the development of largely '*ad hoc'* unbalanced structures and flows. At a functional level, once organisational readiness has been established, there are a number of lean six sigma measures where potential benefits extend both up and downstream from the case organisation itself.

Practical Impact: The aim of our research has not been to arbitrarily create specifications for operational efficiencies; rather it has been to work with a third sector organisation to assess operational standards utilising a more engageable RUMBA (Reasonable, Understandable, Measurable, Believeable, Achievable) system to evaluate the operational appropriateness of current measures, alloyed with DMAIC (Define, Measure, Analyse, Implement, Control) to develop and facilitate system change to create a model appropriate to the sector and its limitations. To date we have found little evidence against gerneralisability, which also indicates that our final models may have a place in legacy phases of humanitarian logistics.

Originality: The research presented provides a unique and novel analysis of operational efficiencies in the 'third sector' and its rolein established flows and in serving an increasing demand for food banks , through the acceptance of process controls, metrics and management techniques to minimise food waste and increase efficiencies.

Introduction

The rise in food banks in the UK has been unquestionable, the Trussell Trust alone record an increase of 344,178 emergency food interventions in 2012/13 compared to available data from 2005/06 (Trussell Trust, 2013) and a rise in their model of food bank systems alone to more than 400. It is not known exactly how many food banks there are currently in the UK as food distribution also occurs as a result of other charitable organisations and their work to protect vulnerable members of society from food insecurity and food poverty. Our case organisation itself has more than 50 charities as customers.

Presently we are witnessing a considerable amount of both polemic and rhetoric as various players comment and proselytise upon the role of food banks. It is undeniable that there has been a significant growth in both the number of food banks and increases in members of the population engaging with them for a number of different factors. This rapid growth has led to the emergence of a largely '*ad hoc'* supply network of concerned actors caught in the middle of the current tumult, operating against scale, scope, interoperability issues and public misconceptions of both their roles and their clients, revealing a clear research gap in the empirical analysis of operational activities in this area of the 'third sector' in the UK, also recently confirmed as such by the Food Ethics Council's (Lambie-Mumford *et al*. 2014) for Defra. The 'noise' around the role of food banks overlooks value and efficiency in supply, disregarding other established food networks in the third sector typified by building based food provision such as 'soup kitchens', mobile provision of 'soup runs' and the provision of food to charities delivering wider rehabilitation and accommodation services as well as faith based projects. There is wider research across a macro environment of humanitarian logistics however, this generally overlooks the nuance of ongoing supply network stability beyond 'one off' events. Additionally, there is only a limited amount of research analysing the emergence of food banks during a period of relative political turmoil in Canada during the

mid-1990s, (Tarasuk & Beaton, 1999; Riches, 2002) however, these lack contextual relationships to the current situation in the UK, stopping short of analysing the potential benefits of reproducibility, to decrease variation and increase efficiencies in control and minimisation of food waste as a result of the application of lean six sigma in this sector.[1]

Warehousing is an integral part of every logistics system and plays a vital role in the ability of an organisation to provide a desired level of customer service at the lowest possible total overall cost. An optimal warehouse design and type will vary significantly based upon the type of goods, the supply chain requirements of those goods, the needs of the customer base and, the organisation's ability to access financial resources for technology uptake. It is at this point that an almost mutually exclusive dichotomy emerges between modern supply chain theory and practice in Western economies and 'third sector' activity in those economies, where it is difficult to overhead supply chain technology costs or attract people with the correct skill sets to support these organisations. Notwithstanding these considerations, good, fundamental warehousing design criteria include: colleague safety and goods integrity, safe throughput and controlling operational costs whilst maintaining a degree of layout process flexibility to adapt to requirements.

The warehousing system under research is a hybrid operation typified by distribution centre (DC) movement enterprises of: high stock cycle times, volume driven, value adding activities to support end points, with a degree of cross docking whereby some bulk is broken down and mixed in to order quantities with other products without being 'put away'. This occurs in a loose 'hub' environmental background of value adding, stock reconciliation, downstream and upstream assignments, point of inter-modality, invoicing centre etc. The literature

[1] The 'third sector' in the UK is generally accepted to be the parts of our society comprising non-governmental and non-profit-making organizations or associations, including charities, voluntary and community groups, etc.

review reveals commonly accepted measurements of warehousing performance as key performance indicators, which form the basis of the 6σ phase of our ongoing research.

Warehousing

Particular areas of focus in warehousing management are: demand management of inventory: receipt, storage, order picking, stock accuracy, and despatching as 'supply execution'. Modern warehousing efficiency does not start at receipt of goods; it starts at the point of despatch of whether that be co-located, localised or many miles away.

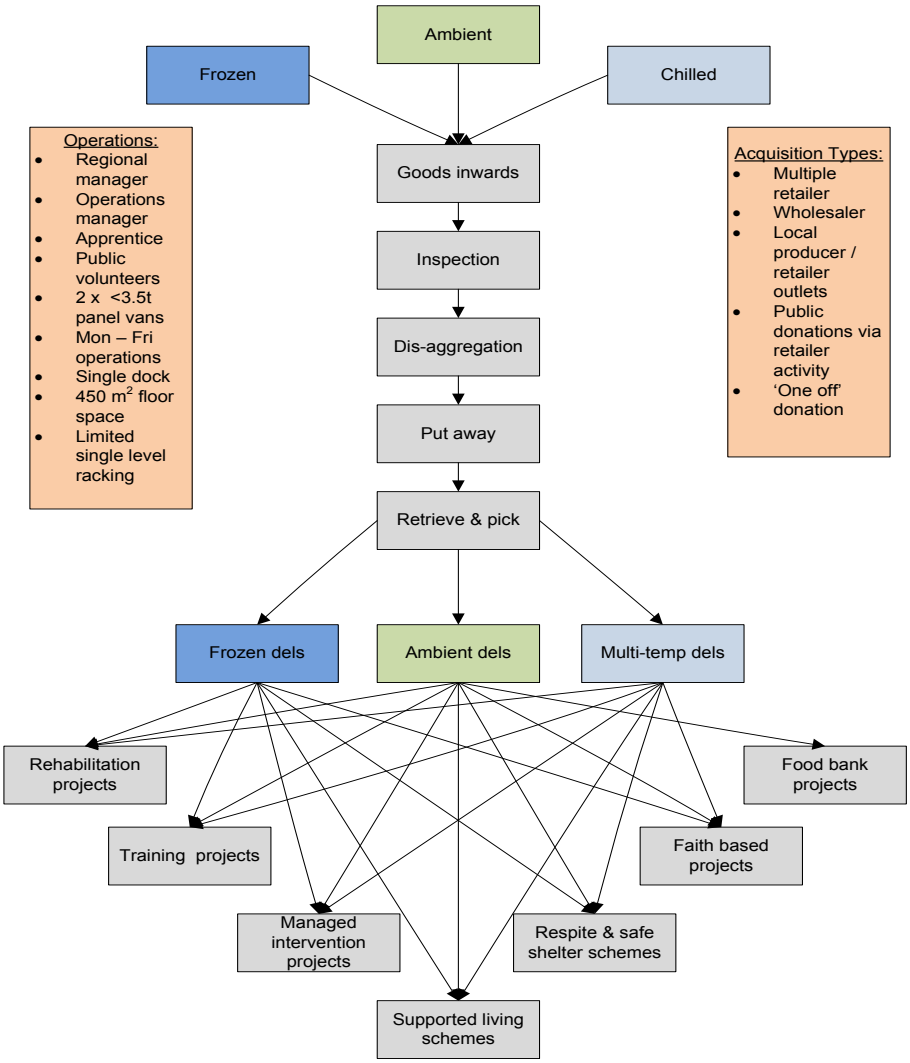

Figure 1 Operational flows at the case organisation

Establishing warehousing processes as oragnisational readiness are equally important as warehousing management systems (WMS). Further to this, IT optimisation cannot effectively be introduced without optimal design of the warehouse operation itself , indicating that physical fundamentals of layout and flow precede WMS systems (Peterson, Aase & Heiser, 2005; de Koster, Le-Duc & Roodbergen, 2007; Yu & de Koster, 2008; Theys *et al*, 2009).

Costs by warehouse function' are commonly ascribed (Richards, 2011; Grant, 2012, Palevich, 2012; Rushton *et al*, 2014) as goods in, storage, picking and goods out. Grant's EU centred research and Palevich's US centred research both reveal picking and the associated walking during picking as the largest costs in a warehousing operation.

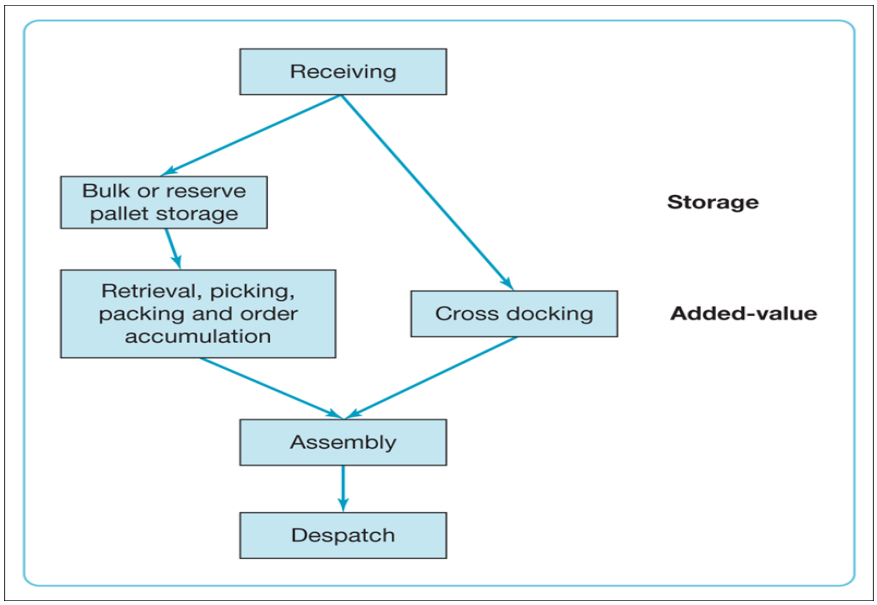

Figure 2 Modern warehousing flows (Grant, 2012)

In managing warehousing efficiencies in wider distribution networks, metrics are commonly defined as Key Performance Indicators (Harrison & van Hoek, 2011; Richards, 2011; Grant, 2012; Crocker, Jessop & Morrison, 2012; Richards & Grinstead, 2013; Rushton *et al*, 2014) The warehouse's customer usually dictates KPIs as part of the service contract between

themselves and the warehousing organisation, which is not the case in our research findings to date. The following key performance indicators (KPIs) are the most common:

KPI	Description
Order fulfilment rate	This relates to the percentage to which the order was fulfilled from stock e.g. Does the order despatched reflect 100% or the order placed or only 98% with 2% being on backorder?
Line fulfilment rate	Used to measure customer service levels by measuring the percentage of order lines that were shipped and delivered on time for a particular customer as complete in a given time period (month). Order errors associated with a line on the order being late, damaged, missing items or incorrect parts make that order line fail.
Order accuracy	The accuracy to which the order has been picked. This where technology like voice picking, picking to lights and RFID link with WMS make it more difficult to get the order pick wrong
Line accuracy	This is driven by SKU accuracy and measures whether the correct SKUs are being picked and placed and, whether the SKU data for 'on hand' stock is accurate.
Order cycle time	How long does it take for an order to be confirmed as picked from the moment it is generated
Orders picked	A measurement of individual colleague activity, team activity and shift activity which analyses how many orders have been internally fulfilled over a set period of time.
Back orders	Measures overdue deliveries being shipped in and their effect on orders being despatched. This can help in analysis of demurrage costs also.
Back order completion	Measures the total fulfilment time.
Put away rates	Records deliveries and locations.
On time deliveries	Measure both vendor compliance with agreed delivery dates and times, and delivery dates and times as outputs from the warehouse.

Table 1 Common performance indicators in modern warehousing

Lean Six Sigma

Lean Six Sigma (LSS) is a business improvement strategy to promote enhanced business performance and therefore more capability in the market. LSS has been adopted by combining two of the most popular Total Quality Management (TQM) tools for performance improvement in; Six Sigma and Lean (Assarlind et al, 2013; Lee et al, 2011; Hilton and Sohal, 2012; Delgado et al, 2010; and Naslund, 2008). Indeed, 6σ aims for discovery and immediate systematic break though in projects, whilst lean is aimed at rapid and smooth

continuous incremental improvement to relace inventory with information (Assarlind et al, 2013). Many key aspects of 6σ such as principles, methodology, benefits, training and system infra-structure are similar to LSS and consequently could be considered in any rigorous research for LSS applications (Assarlind et al, 2013).

LSS has been recognised as an organisational change and improvement method, particularly as a cost reduction mechanism (Jayaraman et al, 2012) and also as a problem solving tool and quality improvement programme in institutions that strive to become a LSS influenced organisation (Antony, 2014). The main purpose of LSS is to reduce the cost of poor quality (COPQ) and eliminate waste factors as defects through minimising the causes of the wastes and COPQ to accomplish a perfect quality, generating profitable margins and sustainable competitiveness (Prashar, 2014; and Choi et al, 2012).

As a top-down approach, LSS depends upon the collation and availability of factual and disciplined benchmarking and performance measurement, cultural transformation, training and education, management commitment and leadership (Suresh et al, 2012; Kumar et al, 2011; and Hilton and Sohal, 2012), The rewards are as developed learning capabilities within an organisation's managers and employees (Manville et al, 2012), increased customer satisfaction, reduced operation cost, increased revenue and improved processes (Kumar and Antony, 2008; Andersson et a., 2006; Miguel and Anderieta, 2009; Antony and Desai, 2009; Antony et al, 2005; Thomas et al, 2009).

The role of LSS tool in problem solving of both manufacturing and service SMEs has been in the centre of attention by many academics (Kumar et al, 2011; Antony, 2008; Kaushik et al, 2012; Laureani, 2012, Hilton and Sohal, 2012 and Manville et al, 2012). The increase of the scope of the Six Sigma literature is reflected in studies covering service sectors (Delgado et al, 2010), business functions and SMEs (McAdam and Hazlett, 2010).

There are some examples of case studies using 6σ to improve the food supply chain (Thomas and Barton, 2006, Nguyen et al, 2004; Trinekens and Zuurbier, 2008) where it is

mooted that 6σ can change food safety and quality culture from "End-of-Line" inspection to a "quality assured process" through process improvement (Trinekens and Zuurbier, 2008). However, the food logistics perspective of 6σ application is relatively limited within the literature other than a few focused studies (Shokri et al, 2010; and Nabhani and Shokri, 2009). Nevertheless, statistical thinking through statistical process control (SPC) and some other statistical tools and techniques is suggested for improving warehousing and delivery performance of food distribution and logistics systems (Morgan and Dewhurst, 2007; Stefansson and Lumsden, 2009). The LSS methodology of DMAIC (Define, Measure, Analysis, Improve, Control) is a practical tool that can be used in the logistics and distribution operation as the most common problem solving methodology (Nakhai and Neves, 2009) and also an appropriate methodology to achieve highest level of process capability (Tannock et al, 2007).

Method

In view of the disparities being revealed between theory and practice, we have adopted an action research approach, gathering and analysing both quantitative 6σ pre-DMAIC RUMBA data workplace measurement, modelling and interviews in the primary organisation, and it's customers. This allows us to build upon positivist data and integrate discourse analysis in the identification of barriers to best practice adoption and hearing the 'voice of the customer'. The nature of the research has also led to the emergence of the researcher as facilitator for change.

Findings

Our initial phase of fieldwork data gathering exercise has revealed that although some very basic distribution phase metrics are recorded as data, metrics that we would have expected to be in place relating to the previously identified KPIs do not exist. There is data gathered from a cost accounting perspective allowing invoice fulfilment, but there is no natural extension so that movements inwards and outwards can be accurately be balanced off against each other, therefore waste is neither measured or attributable in a system where cycle counting and basic perpetual physical inventory iterations would allow generation of data sets which could be used to record basic operational efficiencies and analyse demand more accurately.

Discussion

We do not regard this as a system failure, but as a current system reality in a functioning network. Notwithstanding this, we contend that this functioning data-less warehouse environment further vindicates our inquiry and initial proposition that the adoption of LSS can add resource efficiency benefits to a system where 'value' is not necessarily measured as pecuniary advantage, but systems which nevertheless would derive significant added value from a more efficient, measurable and accountable flow of materials born of basic and repeatable operational measurements. Addittionaly, we readily acknowledge that our research is at an early stage, but we contend that the development an operational model for this organisation will have a ready generalisability to other organisations in this sector. In addition to this we have already begun to ponder whether a model could also be developed to support wider humanitarian logistics which are currently dominated by contexts and frameworks of 'one off' relief strategies (Christopher & Tatham, 2011).

Conclusions

Our work to date reveals the operational realities occurring in this organisation, where concerned actors do not neccesatily comprehend the nature of muti-faceted operational problems, as their areas of specialism lie outside organisational analysis and performance excellence. This research opens a window to a sector which would benefit from the application of LSS against a current background of inceasing demand leading to more orders, picking, and mistakes which diminish the 'voice of the customer'. To address these issues we suggest that organisational readiness for the deployment of LSS is as equally important as LSS itself in accepting of responsibility to manage system change initiation. Further, we conclude that the deployment of RUMBA tools where high percentage of defect rates and low percentages of yield rates indicating a 1σ - 2σ level on the 6σ scale are more appropriate in initial application and, are more likely to achieve operational readiness, being more closely aligned to Demming's original Plan-Do-Check-Act cycle in this sector.

Ongoing Development

Data continues to be gathered on both demand and supply fulfilment by the organisation to allow simulation modelling around material flows, resource allocations, storage layouts and distribution patterns.

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