THE FEASIBILITY OF ADOPTING CLOTHING MASS CUSTOMISATION IN SOUTH AFRICA

ABSTRACT

Mass Customisation (MC) is increasingly seen as a strategy to survive in the competitive clothing fashion markets. This importance to retail sales necessitates its consideration in the South African context. There is a paucity of literature on adopting MC so exploring the feasibility of MC for South African clothing manufacturers was a step in understanding what is required from manufacturers. Three corporate clothing manufacturers were selected for qualitative interviews to determine whether they currently exhibit identified competencies from literature considered essential to undertake MC. Two manufacturers exhibited key competencies of communication, human capital, flexibility and technology needed for MC success.

Keywords: Technology, innovation, manufacturing, mass customisation

INTRODUCTION

The aim of the research was to explore the feasibility of adopting mass customisation (MC) by South African clothing manufacturers. Four key competencies to support MC in clothing were identified from a review of academic literature for this study – communication, human capital, flexibility and, technology: Tseng and Jiao (1996: 153) define MC as the development of 'products and services that best meet individual customer needs with near mass production efficiencies'. MC is increasingly being explored in the global clothing industry as a key strategy for sustainability (Pine, 1993a; Pan & Holland, 2006; Brunø, Nielsen, Taps, & Jørgensen, 2013). The main MC competencies as posited in current literature were used as a benchmark to assess South African manufacturing readiness to adopt customer production of individualised clothing for a mass market. The research question posed was - what competencies do South African clothing manufacturers need prior to engaging in MC?

PROBLEM INVESTIGATED – BACKGROUND TO THE RESEARCH

According to Keller, Magnus, Hedrich, Nava and Tochtermann (2014) few industries require companies to stay nimble in meeting customer demands as the global fashion industry. This is because continuous market change is inherent in fashion both because of the trend-driven nature of fashion consumption as well as its seasonality (Nenni, Giustiniano, & Pirolo, 2013; Keller et al., 2014). Mass manufacturing is typically characterised by both accurate forecasting and designer-led pushes (Pan, 2012). According to Yi, Ngai and Moon (2011) and Nenni et al. (2013) because ranges in the clothing industry are constantly being renewed and, the brevity of seasonal selling periods, there are often forecasting errors leading to stock-outs (no stock) or, high levels of unsold inventory the latter creating a need to discount goods in order to sell them. Yet mass-manufactured clothing items are still traditionally assembled in anticipation of customer demand not in response to demand (Claycomb, Dröge & Germain, 2005; Pan, 2012). As early as 1970 Alvin Toffler in his book titled 'Future Shock' (1970:264) foresaw society moving towards making the greatest ever demands from manufacturers for unstandardised goods. Stan Davis (1989: 20) named this consumption phenomenon as the 'market of one' – that of the individual customer. The concept was that as customers became increasingly focused on their own personalisations, they would be less likely to accept current mass-market offerings (Bellemare, Carriere & Baptiste, 2014). Customised clothing already serves a real functional need in terms of sizing as mass manufactured clothing only fits 30-40% of customers (De Raeve, Cools, De Smedt & Bossaer,

2012). Tian, Bearden and Hunter (2001: 50) note that 'consumers acquire and display material possessions for the purpose of feeling differentiated from other people'. Bellemare et al. (2014) claim this need for uniqueness is especially prevalent in clothing purchasing decisions. By 2013, one third of all Nike™ shoes sold online were individually customer personalised (Probst, Monfardini, Frideres, Demetri, Kauffmann & Clarke, 2013) and the requests by customers for personalisation is a widely felt trend in the fashion industry with luxury fashion retailers such as Burberry™ (Burberry, 2015) allowing customers to choose scarves in unique combinations of colours, fabric weights and patterns of their choosing, together with the option of monogramming their initials (Abnett, 2015). There is nothing new about making clothing targeting the individual customer as fashion was a customised experience for many until the early twentieth century when mass produced ready-to-wear clothing was first adopted on a large scale (Business of Fashion, 2011). What is new is the notion that the individual customer of a mass market can be targeted by the manufacturer in an efficient and profitable way. MC aims to create advantage from the fact that customers want to be different (Bardacki & Whitelock, 2003; Walcher & Piller, 2012; Weiss & Schweiggert, 2013) making market heterogeneity a core premise of successful MC. In an MC paradigm, each customer is a separate market (Holbrook & Hulbert, 2002). Technological advances, particularly in Information and Communications Technology (ICT) are claimed to have enabled the application of mass manufacturing efficiencies to be applied to the traditional world of custom-made clothing (Piller, 2010; Lyons, Coronado Mondragon, Piller & Poler, 2012; Probst et al., 2013; Walczak, 2014). The implication of this is that customised goods can now be produced at near mass production prices (Tseng & Hu, 2014).

THE SOUTH AFRICAN CONTEXT

The last known study on MC in South Africa was published in 2000 by Radder and Louw (2000). Radder and Louw (2000) broadly explored MC as a manufacturing strategy for a number of different types of manufacturers, none of whom were specifically referred to as being clothing manufacturers. The South African clothing manufacturing industry has shed 120,000 jobs since 1980 (Nattrass & Seekings, 2012; Moorad & Thomas, 2015; Moorad, 2015) and currently, local clothing production serves approximately only 60% of domestic demand (Morris & Barnes, 2014). Nattrass and Seekings (2012) attribute this production to lowered trade barriers with other outside country producers, the relative cheapness of these products because they use cheaper, offshore labour and, a current local lack of commitment to invest in the country's clothing-manufacturing

sector (Nattrass & Seekings, 2012) because it is compressing not expanding. Since clothing manufacturers mostly employ unskilled workers, those unemployed by a diminishing clothing manufacturing industry can not readily be absorbed into other job streams – a concern in a developing country (Morris & Barnes, 2014). Yang, Zang and Shan (2007) emphasise that ICT advances and close, local proximity to the local target markets should be key advantages for promoting domestic individualised customer products. However, shifting production systems to the market-of-one requires a radical rethink of existing business processes (Yi et al., 2011; Lee & Moon, 2015) as it brings the customer in at the early stages of product development. This requires an inversion of the traditional mass manufacturing supply chains which was designer to customer, to where the customer is a designer (Holbrook & Hulbert, 2002; Weiss & Schweiggert, 2013; Sommer, 2014). Pan and Holland (2006), Probst et al. (2013), Skjelstad and Thomassen (2014) and Tseng and Hu (2014) all agree that the required structural changes to a manufacturer's supply and production systems are one of the most significant implications of adopting MC.

PROBLEM STATEMENT

The feasibility of adopting the manufacturing requirements of MC for South African clothing manufacturers needs to be better understood if it is to be considered as a viable option for future clothing manufacture. The research problem addressed was that there is currently no definitive literature on the competencies of South African clothing manufacturers to engage in MC so this research sought to understand if South Africa do indeed have the competencies already that would offer the opportunity to pursue MC.

LITERATURE REVIEW

To establish the key systems underpinning MC manufacturing, a review of relevant literature was undertaken. The complication of one-off customisation as in MC production is that it depends on meeting the exact needs of each customer (Senayake & Little, 2010). In fashion, MC manufacturing would need to rapidly respond to designer market information whilst allowing for a high variety of customer styling of the former (Naylor, Naim & Berry, 1999; Brown & Bessant, 2003). Made-to-measure apparel such as anticipated in individualised MC is a form of fit and design online customisation which requires extensive input from the customer (Senayake & Little, 2010). MC manufacturing is demand-led being first demanded and then supplied as opposed to traditional supply driving demand (Pan, 2012). To realise MC, businesses have to supply products that are individually customised but with minimal loss of manufacturing efficiency (Salvador,

Rungustanatham & Forza Liu, 2004; Deitz, 2011). Bruce, Daly and Towers (2004) suggest that a manufacturer's ability to deal with variety in demand as associated with MC, would be a clear indication of its agility and ability to survive. Serving this customer demand is supported in MC by continuous re-organisation of manufacturing processes using technology to help manage the resulting systems' complexities of communication, human capital management, flexibility of processes and, technology (Bruce et al., 2004). How re-organisation optimises MC is the first component to consider in assessing the feasibility of adopting MC. Salvador, de Holan and Piller (2009) undertook an extensive study of MC organisations and found that the ability to reuse or recombine existing organisational resources into different, robust process designs and manage these processes with technology, was one of the key determinants of successful MC implementation. Walcher and Piller (2012: 5) define this adaptability as the 'capability to reuse or recombine existing organisational and value chain resources to fulfil differentiated customer needs'. Piller, Lindgens and Steiner (2012) claim this type of process redesigning can ensure that the increased variability of MC can be met with near mass-production efficiency and reliability if planned carefully. Technologies, such as laser cutters, 3D printers and digital patterning software such as computer aided design (CAD) technology is often used in clothing manufacture from the conceptual design stage into product development and all the way through to the production process (Dabolina & Vilumsone, 2012; Zang, Bilberg & Hadar, 2014). CAD software is able to calculate the amount of fabric that will be necessary, how to best lay out the pattern pieces and to calculate the level of intricacy with regards to the production of the garment significantly decreasing time to produce and, waste in terms of resources (Anderson-Connel, Ulrich & Brannon, 2002). Additionally, the development of online configurator software has enabled customers to digitally and remotely construct their desired customisation of products (Anderson-Connel et al., 2002). The ICT interaction between the customer and the clothing manufacturer is suggested to consist of three principal components (Peterson, Larsson, Mujanovic & Mattila, 2013). Firstly, a core software configuration component is needed which guides the customer through the process of designing the product using prompts; secondly, there needs to be a realistic computer simulation of the configuration enabling the customer to visualise their designed product; finally, computerised analytical software needs to translate individual orders into lists of materials with information required for production. This type of customer-driven planning is possibly the most challenging aspect of applying MC, as it defies conventional supply chain management processes

that to-date have a designer-led mass product development approach (Tseng & Hu, 2014). It is during the production phase that the majority of costs are incurred and the quality and lead-time of a garment are determined (Zangiacomi, Zhijian, Sacco & Boër, 2004; Senayake & Little, 2010; Daaboul, Da Cunha, Bernard. & Laroche, 2012). Consequently, Pan and Holland (2006), Probst et al. (2013), Skjelstad and Thomassen (2014) and Sommer (2014) indicate that MC usually results in a need for structural changes to other, interrelated manufacturing systems. One major change needed for MC manufacture is recognition by the manufacturer of the point on production of each individualised category of garment. This is the point at which the manufacturer decides to hand over the finalisation of a product to the customer defined specifications. This is known as a decoupling point that manufacturers need to understand and plan for calculating for the gap between parts of the garment made-for-stock (traditional mass manufacturing design-led push) and parts that with MC, become made-to-individualised-order (customisation by individual demand-led pull) (Lui, Choi, Yen & Ng, 2012). Senayake and Little (2010: 287) note that there will be a distinct 'customer order decoupling point' which will vary dependent on the type of garment. Understanding the placement of the decoupling point in a process redesign is considered key to MC type manufacturing (Lui et al., 2012). The practice of deciding on the decoupling point in MC manufacture is closely related to the concept of postponement based on delaying actual manufacture until full knowledge of the customer's requirements is known (Su & Chuang, 2011). In an MC process this would mean that the entire physical production cycle is postponed until placement by the customer of their confirmed order (Su & Chuang, 2011). Postponement eliminates virtually all resource waste (time, materials and human capital) thanks to having perfect information about the customer's needs (Su & Chuang, 2011) but impacts on the ability to utilise mass manufacturing efficiencies such as buying in bulk for discounts on volume (Piller, 2010; Liu et al., 2012). Adopting MC requires manufacturers to assent to planning for flexibility as a management characteristic constantly assembling and reassembling their production processes (Pine, 1993b; Claycomb et al., 2005; Labarthe, Espinasse, Ferrarini & Montreuil, 2006; Pan & Holland, 2006; Senayake & Little, 2010; Xiaosong, Gensheng, Liu & Heim, 2011; Yi et al., 2011; Stump & Badurdeen, 2012; Probst et al., 2012; Brossog, Merhof & Franke, 2014; Roh, Hong & Min, 2014; Walczak, 2014). Flexibility is the second component considered in determining the feasibility of a manufacturer adopting MC. Hu (2013:3) defines MC flexibility as creating reconfigurable systems to 'create high variety in the final assembly through combinational

assembly'. This flexibility leads to considerable competitive advantage as every customer's needs can be fulfilled (Claycomb et al., 2005). According to Manivelmuralidaran (2015) aspects of lean manufacturing must not be forgotten in achieving MC manufacturing capabilities. Lean means being prepared to manufacture with agility, by minimising wasted resources using highly optimised, uninterrupted processes that espouse flexibility, quality production, and managed production cost simultaneously addressing fast responses to customer demand (Taj & Morosan, 2012). Modular production can answer these requirements for MC accommodating lean manufacturing principles while producing customer driven garment variety (Mehrsai, Karimi & Thoben, 2013; Zang, 2014). Various components of a garment are independently designed and manufactured (modularisation) then assembled uniquely to satisfy customers' heterogeneous needs (Kalaoglu & Saricam, 2007; Daaboul, Bernard & Laroche, 2012; Mehrsaia, Henriksena, Røstadb, Hribernika & Thoben, 2014; Tseng & Hu, 2014). Flexible manufacturing through modularity depends heavily on the organisation also having adaptive human capital, the third component to be considered in adopting MC manufacturing (Bhattacharya, Gibson & Doty, 2005). Adaptive human capital means employees will be required to deal with novel and sometimes ambiguous tasks prescribed by designing customers (Piller, 2010). Additionally, employees need to be able to competently move their skills and knowledge within the modularised production systems (as the systems are redesigned to meet production demands) often working with new people in cross-functional teams created once-off for specific garment runs (Stump & Badurdeen, 2012). This concept of modularised, mobile teams is sometimes referred to as designing teamwork sewing systems (Lin, Moore, Kincade & Avery, 2002). With both human capital deployment and manufacturing processes constantly changing, a management style with the ability to design flexible systems while ensuring employee skills development to meet changing customer demands, become imperative in support of MC (Kincade, Kim & Kanakadurda, 2013). To make the best managerial decisions for each MC scenario, managers need accurate and timeous information so communication for information sharing is the fourth and final component to be considered in this paper in adopting MC. Numerous authors mention the necessity of information sharing within and without the manufacturing organisation to achieve this integration of human skills, lean manufacturing principles and modularisation that bring flexibility to the MC production systems (Mikkola & Skjøtt-Larsen, 2004; Potter, Breite, Naim & Vanharanta, 2004; Zangiacomi et al., 2004; Chaudry & Hodge, 2012; Pan, 2012; Probst et al., 2013; Roh et al., 2014; Walczak, 2014).

For instance, Chaudry and Hodge (2012) after studying the clothing industry in relation to decoupling points and postponement highlight that it was successful information sharing practices with suppliers that enable accurate integration of these concepts into manufacturing processes. Orchestrating the flow of MC goods facilitated by constantly changing modularised production systems involving multiple stakeholders, requires managers to undertake complex analyses prior to decision-making with the tractability for continuous adjustment as new information becomes available (Labarthe et al., 2006). The variety and volume of data that needs to be shared in the MC systems requires information flows that are planned and effectively configured if they are to deliver value (Mikkola & Skjøtt-Larsen, 2004; Pan, 2012). To facilitate optimised communication, Mikkola and Skjøtt-Larsen (2004), Xiaosong et al. (2011), Liu and Deitz (2011) and Pan (2012) firstly recommend managerial focus on collaboration to be able to make joint decisions with the help of external supply partners. Secondly, communication must take place at multiple levels of management both operational and strategic; there needs to be a strategic exchange of long-term ideas at the top-level, a tactical exchange on how to deliver on a seasonal level, and an ongoing, daily exchange through forecasts if lean manufacturing principles are to be attained. To ensure the integrity in the information shared between internal managers and suppliers, Zangiacomi et al. (2004) note that suppliers have to be able to load their own production and supply status onto the MC organisation's ITC system so that there is always an up-to-date, two-way flow of information across the entire organisation and strategic partners. Liu and Deitz (2011) maintain that these practices result in production lead-time reduction and products that better meet customer demands. The most important tool for this information sharing is technology in the form of product data management systems (Pan, 2012; Roh et al., 2014). To ensure alignment in the MC processes, ICT measurement tools can then be utilised such as joint performance measures, joint performance monitoring and collaborative forecasting (Min, Roath, Daugherty, Genchev, Chen, Arndt & Richey, 2005). All four discussed concepts have importance when adopting MC and literature highlights how integrated they need to become to support lean manufacturing (Dabolina & Vilumsone, 2012). Bellemare et al. (2014) note however that the clothing industry has to-date displayed relatively non-integrated technological systems. Pan (2012) also states that not only do clothing manufacturers resist technology advances but even if they do adopt ICT for MC, they are prone to hiring practices that do not attract the best technically competent talent needed to realise ITC related MC strategies. A strategy for improving technological literacy is adequately training

operators and managers in order to improve not only employee morale as they become competent but also to boost process performance in the MC business specific functions of the as firm communication, human capital, flexibility and, technology (Bellemare et al., 2014).

RESEARCH METHODOLOGY

The paradigm that was adopted for this study was pragmatic in nature. The pragmatic paradigm is concerned with understanding the 'what' and 'how' in terms of what is required for South African manufacturers to adopt MC as to how will it be possible to deliver to the four competencies highlighted (Wilson, 2014). Since there was very little known about the feasibility of adopting MC by South African clothing manufacturers, this study assumed an explorative, case study approach typically used when the subject of study is relatively new and the researcher seeks to gain an overall insight and comprehension (Babbie & Mouton, 2011). Yin (2009: 18) defines a case study as an 'empirical enquiry that investigates a contemporary phenomenon in depth and within its real-life context' as with this research with assessing MC for South Africa. The case study approach also enabled a holistic, rich understanding to be gained of selected South African manufacturing processes that could lend knowledge to how MC might be adopted by others (Saunders, Lewis & Thornhill, 2009). According to MacCarthy (2013: 7337), MC is especially viable for 'niche clothing manufacturers such as corporate clothing' to consider because of their existing manufacturing resources. Corporate clothing manufacturers deal with great variety and individualisation in styles and order quantities, and it was important that the participants of this study were chosen from the managers of three South African corporate clothing manufacturers. A decision to interview three participants, one from each of the three corporate clothing manufacturers was useful in providing a measure of triangulation in what each said, against the background of previous academic findings. The exploratory nature of this study called for the collection of rich, descriptive data which implied that the study's methodology was qualitative in nature (Babbie & Mouton, 2011) making use of semi-structured, open-ended, one-on-one interviews. The participant selection method utilised was purposive ensuring participants who are knowledgeable about individualised, customised production, were interviewed (Babbie & Mouton, 2011). Qualitative interviews are flexible so suited to this exploratory research providing for the possibility of the researcher probing participant comments to better understand their situation (Saunders et al., 2009; Yin, 2009). The ethics of this study adhered to those required by the University under which this research was undertaken. These ethics adhered to maintaining

anonymity, confidentiality and the right to withdraw at any time of all participants. A profile of the participants all based in Johannesburg follows highlighting their ability to answer knowledgeably in the context of their respective companies:

- *Manufacturer 1* - Employees: 300; Participant position: the managing director (time in this position 3 years; industry experience 22 years); His responsibilities included sales, range development, raw materials purchasing, patterns, garment engineering, operational logistics.
- *Manufacturer 2* - Employees: 400; Participant position: the technical manager (time in this position 6 years; Industry experience 43 years). His responsibilities included raw materials purchasing, garment engineering, production.
- *Manufacturer 3* - Employees: 600; Participant position: Production manager (Time in this position 15 years; Industry experience 20 years). His responsibilities included range development, raw materials purchasing, patterns, production.

Interviews followed an interview guide to ensure that specific topics were covered with regards to the roles of the reviewed MC competencies of technology, flexibility, human capital and communication (Bryman & Bell, 2011). Each participant interview was conducted face-to-face lasting two hours, and verbatim transcripts were made from each interview. Interviews were analysed using content coding seeking evidence of the four competencies. The limitation of this study is that it focused only on corporate manufacturers not a wide variety of unspecialised mass production clothing manufacturers.

FINDINGS

Technology

Anderson-Connel et al. (2002) and Probst et al. (2012) indicate that constantly emerging computer technologies have driven the potential for all manufacturers to attain the competencies required to support MC. Manufacturer 1 felt technology had limited use for his factory noting, ‘everything in our business is essentially manual - not run by software’. Yet surprisingly it was only Manufacturer 1 who had tried accepting one-off orders via a website as would be considered a prerequisite in MC. ‘We created a website where you could create your own garment. You could pick just a shell [garment] shape, click to change the colour. We loaded 3,000 shell styles for pockets, bodies etc. Following the submission online of the final coloured drawing by the customer, the factory would send a professional drawing back to the client with all the little bits like draw-cords and tassels.

However the website was used only twenty times in five years despite being advertised through over two thousand promotional agencies'. Manufacturer 1 had tried to decouple customer preferred design from his organisation's control using the website input from the customer as the decoupling point. He was not certain why the website failed to attract customers but partly attributed it to the clients' need to have their imagined design drawn for them and with them by factory staff. They did not have the confidence to do the design themselves. This statement echoed Bellemare et al. (2014: 95) findings that customers 'lack of experience and knowledge may limit their ability to determine what it is that they want in terms of individualised mass customisation'. A factor to consider is that in corporate clothing manufacturing, the customer is actually spending her company's money not her own which may make them fearful of making a wrong choice. This draws attention to the fact that this research only on corporate manufacturers does not establish if the independent shopper feels differently about ordering and paying entirely online. Production flexibility for facilitating MC was inferred in reviewed academic studies to require the ability to assess where to place decoupling points and how long to make production postponement in reconfigured internal production systems such as these (Tomastik, Luh & Liu, 1996; Tseng & Hu, 2014). Bellemare et al. (2014) also indicated that the manufacturer can be to blame in resisting advances in technology that support MC and indeed Manufacturer 3 was not enthusiastic about customers creating one-off garment designs online, 'garments are about touch-and-feel… it might look beautiful online but you can't touch and feel what the final item is like. It could lead to under-delivering on customer expectations'. Manufacturer 1 had concerns over the technical production difficulties that could be associated with MC online design, 'you can't just have anybody put what they like on the online design because not everything they put works when producing the garment'. Manufacturers 2 and 3 displayed a lack of understanding of how new ICT solutions could overcome these hurdles and in doing so both manufacturers removed the opportunity to decouple customer design from their own hands and place it wholly in their customers hands. All three manufacturers did however exhibit enthusiasm for specific technologies. Fogliatto, da Silveira and Borenstein (2012) suggested that CAD is the most frequently used form of advanced clothing manufacturing technology and it is required for MC. Indeed all three manufacturers use the French Lectra (2018) system for CAD. Lectra (2018) is one of the largest global suppliers of software to the textile and apparel industries (Anderson, 2005). Manufacturer 3 noted that having technology however often leads to a 'need for expertise from outside their company with sometimes a week's

delay in getting Lectra support as IT support is from France'. This makes reliance on buying more MC suitable ICT software solutions debatable as to its value for manufacturing in a South African context as most of these technologies will be bought from and often supported from overseas companies. Manufacturer 2 indicated that he had a very good ICT technician in-house but worried because the technician, vastly experienced with many CAD software problems, is 'past retirement age already'. Manufacturer 2 had found that recently 'Lectra can sometimes do repairs [to software] remotely from France'. Manufacturer 2 noted 'going fully automated has disadvantages as we do not have the technical skills in South Africa to maintain all this new technology'. It seems that the skills of specialised software support staff is lacking. Manufacturer 3 had invested in enterprise resource planning (ERP) software a technological enhancement for management (Pan, 2012) to aid the communication of critical information between internal and external business systems when making decisions. Manufacturer 3 noted that the ERP had improved their resource management for instance the visibility on their stock levels, which used to be manually counted but with ERP, stock levels are instantly known saving money on reordering by giving 'information now' and a kind of postponement point to deciding when raw material stock is needed. Ziangcomi et al. (2004), Pan (2012) and Roh et al. (2014) all mention that ERP systems enable MC specifically assisting communication in so doing supporting the principles of lean manufacturing. However, Jitpaaiboon and Sharma (2012) and, Moutzis and Doukas (2014) both warn of the set-up and maintenance costs associated with CAD and ERP systems.

Flexibility

Corporate clothing production works best where the clothing item is only manufactured on a customer's order (Kalaoglu & Saricam, 2007). All participants from the three manufacturers believed they are demand-led manufacturers and that serving their corporate customer necessitates that they demonstrate daily flexibility in their production processes. Hu (2013) stated that achieving a wide variety in types of production items is encouraged with an assembly process that allows for flexibility in the combination of its design elements but Hu also notes that this is technically challenging for the managers of production systems. Each of these manufacturers believed their systems demonstrated flexible production by being able to constantly change their construction processes varying colours, styles and order quantities as required by the customer. This flexibility, also a prerequisite for successful MC, was considered by each to be key to their own success with their customer markets. Manufacturer 2 stated, 'every corporate wants their own

identity so you've got to be flexible in production'. Flexibility is needed according to Manufacturer 3 because 'every garment we manufacture for corporate wear is specifically designed for an individual person'. Manufacturer 1 agreed with Hu (2013) as to the complexity of attaining flexible systems, noting 'the corporate market is however very difficult to manage technically in the factory because of this inherent flexibility required of every element of the production processes'. Manufacturer 2 indicated that he regularly changed machinery to different positions on the factory floor, 'so we have smooth flows'. Moving machinery into different configurations had proved very successful for this manufacturer. Manufacturer 1 had tried moving machinery but found it unproductive due to his physically large factory size, 'by the time you've moved everything around you've lost half a day'. He instead relied on creating smooth production flows by moving his staff changing staff roles on the production line. Lin, Moore, Kincade and Avery (2002) and Stump and Badurdeen (2012) indicate this as a very successful option to vary production demands. Another way to gain varied production was through modularisation of tasks. Baldwin and Clarke (2003), Sudarsham and Rao (2013) and, Tseng and Hu (2014) indicated that modularised production processes lend themselves to technically complex work as required for MC. Manufacturers 2 and 3 both implement a degree of modular production. Manufacturer 2 noted that due to the complexity in managing and integrating stand-alone modules 'the only modules that we do implement very successfully are things standard on every garment in this case embroidered pockets individualised by embroidery of corporate logo but standardised in shape'. Manufacturer 2 noted that even with this limited degree of modularisation it gained a competitive advantage. Separating the pocket manufacturing into a stand-alone module that later integrated to attachment on the entire shirt was very effective in producing small runs of shirts very quickly, and dealing with frequent style change requests from the customer such as would be experienced in MC production. Manufacturer 3 had modularised by what he termed, 'mini factories within his factory' consisting of 'small little teams of about 20-25 people' forming 'little cells that each function independently'. As regards keeping costs down in support of lean manufacturing principles, Walczak (2014) has noted that flexible manufacturing systems should make it possible to create single garment orders without a significant increase in costs. Yet, Manufacturers 2 and 3 indicated there was an extra cost on individualised garment creation as they had to travel to the client's site to measure the staff member. Manufacturer 2 explained going to the customer site to measure was part of retaining their customers (a competitive advantage in their eyes) who seek 'quicker and quicker turnarounds'

and appreciate this effort to speed up their order delivery. Neither Manufacturer 2 nor 3 had considered using technology (laser scanning) to help do the fit online. The South African customer sees the service of the manufacturer's personal attendance at their own business as part of the individualised service offering and value. To further improve response times Manufacturers 2 and 3 also hold fabric stocks as recommended by Cheng and Choi, (2010:55) but this comes at a cost and can lead to overstocking which does not facilitate lean systems of manufacturing (Taj & Morosan, 2012). Manufacturer 3 stated though that holding fabric rather than made-up garments was another competitive advantage. He considered cost was actually reduced by holding, 'raw material rather than inventories of completed products because we can still convert it quickly in numerous ways'. This draws attention to a different concept of postponement displayed by this manufacturer in that waiting for a customer to place a confirmed order before getting the production process started (including getting materials) could be speeded up by the postponement of raw material ordering (the materials are already in stock). Postponement of raw material stock ordering until the order has been placed are posited by several authors (Cheng & Choi, 2010; Piller, 2010; Su & Chuang, 2011; Chaudry & Hodge, 2012) as a benefit of MC in terms of not having funds tied up in stock, but this activity has not proved valuable for this South African manufacturers. Manufacturer 2 and 3 noted that this was because materials lead-time on ordering slows down supplying the customer.

Human capital

According to Bhattacharya et al. (2005) flexible manufacturing through modularity requires adaptive human capital. Adaptability in staff would be evidenced in both their ability to work in teams and in their individual wide range of skills (Lin et al., 2002). Modular production is the most interactive of all production forms requiring employees to have strong relationship-building skills to facilitate teamwork (Piller, 2010). Both manufacturers 2 and 3 make use of one-off team compilation in order to achieve modular production. Manufacturer 2 noted however that his teams are always managed by team leaders who each could complete a garment from start to finish to show the team how and what to do. Kincade et al. (2013) indicate that individual employee training is essential when in modular production and both Manufacturers 2 and 3 have internal training schools. Manufacturer 1 does not have a training school and so only hires staff with experience on his machines. Bearing in mind this manufacturer avoids all types of technology in his factory except for CAD, Manufacturer 1 does not need staff to have ICT expertise to work on his

production systems. One of the chief factors affecting productivity for Manufacturer 2 is employee absenteeism, but here modularisation proves very useful. The presence of modular production as needed in MC reduces the impact of absenteeism (Sudarsham & Rao, 2013) and Manufacturer 2 has trained a pool of extra operators available to combat absenteeism creating a type of adaptive human capital.

Communication

When asked what their key criterion was for choosing one supplier over another, the three participants unanimously chose stability attained through superb communication with their supplier. Manufacturers 1 and 2 pointed out that the level of communication in the relationship leads to consistency in behaviour and reliability in support. Manufacturer 3 stated 'we choose to deal with suppliers that support us'. Roh et al. (2014) indicate that to be successful with MC the manufacturer must actively implement socio-relational integration with its strategic suppliers. Manufacturer 1 communicates with suppliers on an ad-hoc basis 'it's sort of supply and demand communication'. Manufacturer 2 encouraged suppliers to 'come and see us, discuss, sit down, bring new products' and 'our suppliers come in at least once a week'. Manufacturer 2 believed that personal contact is very 'important because you get to know your supplier and your supplier gets to know you and this saves you time and money'. Manufacturer 3 stated that his company communicates with suppliers 'probably on a daily basis to find out what they can supply, what they have heard about the market'. Manufacturer 3 was concerned about the negative impacts of maintaining relationships over an entirely electronic interface instead of having face-to-face meetings, 'I think you will lose the personal interaction that give measurable value to the production'. While all three manufacturers agree their success is in large part all about their supplier relationships, manufacturers 2 and 3 demonstrate here that they encourage a more performance-orientated way of managing their supplier relationships. Manufacturers 2 and 3 underscore the empirical literature that constant flows of updated information about market dynamics and demand patterns are necessary for the MC supply chain to succeed (Probst et al., 2013; Roh et al., 2014). However, none of the manufacturers had their suppliers linked to an ERP system to electronically update information as suggested by Pan (2012) and Roh et al. (2014).

MANAGERIAL RECOMMENDATIONS

The presence of competencies such as technology adoption, flexibility in production, communication with suppliers and, human capital development are considered key management

features in empirical literature from outside of Africa on MC preparedness. The research has shown that in a South African context, two of the three manufacturers are already surprisingly well adapted to deliver to some extent on the four MC production concepts. This suggests that mass customisation on a larger scale has potential for clothing manufacturers. The findings that all three manufacturers have invested in CAD technologies, that one (although unsuccessful) had tried online bespoke customer product design, and one had invested considerable money in an ERP system contradicts global research (Bellemare et al., 2014) and South African (Morris & Barnes, 2014) on MC clothing manufacturers' general reluctance to improve systems and unwillingness to invest in generally supportive technologies. South Africa's manufacturing management embraces the use of technology and have been shown in this research to be ready to innovate to facilitate MC activities.

CONCLUSION

A limitation of the study is that the perspectives of potential customers for mass customised goods have not been investigated by this research. This is recommended for consideration in future research as to why mass customisation to-date has not become a South African customer service. The research question has been addressed as to what competencies South African clothing manufacturers need prior to engaging in MC proving evidence that existing manufacture strategies being adopted for MC do encompass creativity and application in technology adoption, flexibility in production, communication with suppliers and, human capital development. This research highlights that what is construed as reluctance may in some cases be because ICT systems cannot be supported locally. Adoption of MC by South African clothing manufacturers is possible especially since it is supported by expertise in modularisation, employee team systems and communication networks in-country through locally based corporate clothing manufacturers.

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