**The Flexibility Paradox – Achieving Ambidexterity in High-Variety, Low-Volume Manufacturing**

**Abstract**

The ability to simultaneously increase operational efficiency and undertake organisational innovation has become a cornerstone for the long-term prosperity of organisations. For manufacturing small-to-medium sized enterprises (SME’s) that produce a high variety of customised products at low volumes (HVLV), achieving this so-called organisational ambidexterity poses significant challenges. HVLV manufacturers are designed to facilitate maximum flexibility in the manufacturing system, however, it is this same flexibility that can hinder the ability of a HVLV manufacturer to achieve organisational ambidexterity – bringing to light an apparent trade-off between two seemingly contradictory objectives. Hence, in this paper we investigate the relationship between flexibility and ambidexterity in the context of HVLV manufacturing as well as the use of different management practices to manage this relationship. We construct a conceptual model by adopting a paradox-based view of tensions using insights from an extensive literature review. Building off the contributions of paradox and organisation theory, this conceptual model demonstrates the multi-dimensional and dynamic nature of tensions between flexibility and ambidexterity as they manifest as much from salient factors (regarding social phenomena and individual cognition) as they are from latent factors (through the complex interactions of organisational elements). By moving beyond the dominant paradigm of efficiency-driven research in HVLV manufacturing we provide managers with unique insights into the role flexibility plays in achieving ambidexterity to help facilitate better informed decisions taken by them. Further theoretical and practical implications are discussed as well as potential areas for further research.

**Key words:**  Ambidexterity, Flexibility, High-Variety, Low-Volume Manufacturing, Paradox Thinking.

# Introduction

High-Variety, Low-Volume (HVLV) manufacturing is built on the notion of providing manufacturing services tailored towards the production of a wide variety of customised products (Amaro et al. 1999, Adrodegari et al. 2015). The nature of adopting such a manufacturing strategy carries significant challenges in achieving lead-time and budget goals (Land and Gaalman 2009). It comes as no surprise, then, that a significant portion of HVLV literature has focussed on the improvement of operational efficiency. Literature in this space has typically been associated with production planning and control (Hendry et al. 2013; Adrodegari et al. 2015; Cransberg et al. 2016) and (more recently) the adoption of mass-customisation principles to HVLV manufacturing environments (Thomassen and Alfnes 2017). There is a proliferation of research focused on increasing certainty, reducing variation (in product customisation) and increasing productivity – the hallmarks of an organisational strategy centred on what some authors label as “exploitation” (He and Wong 2004).

Indeed, there is substantial evidence supporting the fact that adopting such efficiency-driven management practices increase profitability (Silva et al. 2015), customer-satisfaction (Zhang et al., 2003) as well as competitive advantage (Amaro et al. 1999). However, a heavy reliance on exploitation can cause a firm to “stagnate” in the face of increased competition as well as create path dependencies that generate an inertia proving difficult to overcome (March 1991, Gupta et al. 2006, ). Some authors have gone so far as to suggest adopting such an approach to performance improvement will ultimately result in the demise of the organisation (March 2003). In this case, a set of competencies focused towards “exploration” must also exist (March 1991). Management practices based on exploration aim to facilitate the creation of new products, processes, and organisational capabilities necessary to ensure an organisation does not become obsolete in the face of market changes (O’Reilly and Tushman 2008; Birkinshaw and Gupta 2013). Thus, the HVLV manufacturer also needs to be able to embrace variation in customisation, break the mould with existing business practices and develop innovative ways of capturing and delivering value for their customers. However, the ability to create something new is also nested on the organisational practices and routines that enable the manufacturer to compete in the first place (Andriopoulos and Lewis 2009) – thus an apparent trade-off ensues.

Given this backdrop, such a trade-off carries significant consequences for HVLV manufacturers. For example, in order to undertake both exploration and exploitation activities, managers in these organisations are required to commit (split) resources between the two (Gupta et al. 2006) – something particularly difficult to do given HVLV manufacturers can also act as manufacturing service providers where they are, in effect, selling their resources and capabilities. Consequently, undertaking both exploitation and exploration activities means risking short term profits for long-term gains that may or may not eventuate. It is for this reason authors including Keegan and Turner (2002) have concluded that organisations with similar management and organisational structures (project-based organisations) prioritise efficiencies in operations and project management and only deploy resources for longer term initiatives (for instance innovation projects) when it is absolutely essential. By this logic, it is quite often too late to balance the act of exploitation and exploration for firms’ enhanced performance.

Recent advances in the field of organisational ambidexterity have attempted to synthesise the knowledge gained within multiple theoretical lenses including operations management, organisational behaviour, innovation management and organisational theory (Raisch and Birkinshaw 2008; O'Reilly and Tushman 2013). Ambidexterity has also been studied at the organisational (Lubatkin et al. 2006), business unit (Jansen et al. 2012), project (Turner et al. 2015) and individual (Mom et al. 2009) level within a plethora of industrial contexts (Junni et al. 2013). The fact that it holds considerable merit in organisational contexts with high levels of environmental dynamism (Tamayo-Torres et al. 2017) as well as its applicability to effective mass-customisation (Kortmann et al. 2014; Wang et al. 2016) make it an appealing avenue for further investigation in the context of HVLV manufacturing. However, there is a catch – recent literature has shown that flexibility helps facilitate organisational ambidexterity (Tamayo-Torres et al. 2017) and vice versa (Patel et al. 2012), though in the case where the firm is designed to facilitate maximum flexibility from its inception (HVLV manufacturers) the same flexibility then becomes the very reason why ambidexterity is so hard to achieve (Keegan and Turner 2002). This “flexibility paradox” leads us to our research questions for this paper – what is the relationship between flexibility and ambidexterity in the context of HVLV manufacturing and how can this be managed?

This paper addresses the research questions based on the following structure. Firstly, a literature review of HVLV manufacturer characteristics, flexibility and organisational ambidexterity is conducted in order to identify the organisational and managerial practices which facilitate synergy between flexibility and ambidexterity in the context of HVLV manufacturing. Secondly, drawing on paradox theory and the notion of better management practices, a conceptual model is generated which highlights the relationships between the two concepts based on key elements uncovered during the literature review. Finally, a conclusion is provided which highlights the theoretical and managerial implications of this research as well as potential avenues for further research.

# HVLV Manufacturer Characteristics

HVLV Manufacturers are typically characterised as SME’s that produce a wide variety of customised products (Amaro et al. 1999). The level of product (and service) customisation offered by HVLV manufacturers can vary significantly – ranging from standard products to pure customisation where the customer order infiltrates the entire manufacturing value-chain (Amaro et al. 1999; Hendry 2010; Katic et al. 2017). Figure 1 depicts these characteristics using the Customer Order Decoupling Point (see Wikner and Rudberg 2005).

Figure 1 Characterisation of a HVLV manufacturer using the Customer Order Decoupling Point (adapted from Rudberg and Wikner 2004 and Portioli-Staudacher and Tantardini 2012)

Typically, manufacturing systems can be categorised as Engineer to Order (ETO), Make-to-Order (MTO), Assemble to Order (ATO) and Make-to-Stock (MTS) according to where the customer order infiltrates the manufacturing value-chain (Wikner and Rudberg 2005). HVLV manufacturers can exhibit both Engineer-to-Order and Make-to-Order characteristics depending on the degree of customisation offered and the types of activities the manufacturer is willing to do (design, fabrication, assembly and so on) (Amaro et al. 1999). For instance, HVLV manufacturers that offer fully customised solutions requiring comprehensive design activities can be characterised as ETO (manufacturers including Marand Precision Engineering and Ferra Engineering fit into this category). Other HVLV organisations may only offer fabrication services with limited customisation capabilities. In this case they can be classified as MTO (an example can be a typical job-shop where the product is mainly “produced to print” i.e. the customer would provide a drawing to manufacture from and the HVLV manufacturer may provide limited design solutions to increase the manufacturability of the product – more often to accommodate their own machine requirements).

There is still not a clear consensus in extant literature as to the actual characteristics that constitute a HVLV manufacturer (Portioli-Staudacher and Tantardini 2012; Willner et al. 2016) with many possible combinations in existence (see Amaro et al. 1999 for a detailed analysis of HVLV characteristics). For this reason, we take into consideration SME manufacturers that exhibit both MTO and ETO characteristics (sometimes also referred to as Non-Make-To-Stock or Non-Repetitive manufacturers) (Portioli-Staudacher and Tantardini 2012).

Indeed, adopting such an approach to manufacturing bears many uncertainties (both within the boundaries of the firm and externally) affecting strategic decision making (from the high-variabilities in demand and customer base) right through to operational decisions (work routing, job set-up, and general production planning and control). The job-shop style of production, flexible-multipurpose machinery, cross-trained and highly skilled employees as well as project-based organisational structure are examples of organisational practices implemented in order to facilitate (or “deal with”) the inherent uncertainties mentioned earlier (White and Prybutok 2001; Muda and Hendry 2002; Adrodegari et al. 2015). Intuitively, this would suggest a particular organisational focus on being able to adapt (quickly) to changing circumstances both within and outside the organisation.

The idea of “bending without breaking” (De Haan et al. 2011) and responding to changing market conditions is a central tenet of the field of organisational flexibility. However, so far, we have only discussed what is known as “manufacturing flexibility” – the ability for the manufacturing system to adapt to changing circumstances (Koste et al. 2004; D'Souza and Williams 2000). As was mentioned, the HVLV manufacturer must not only be flexible to the point that the manufacturing system can effectively and efficiently produce a wide-variety of products – the uncertainty in adopting this strategy permeates throughout the organisation (from strategy to operations). In this case, certain management practices are adopted to achieve flexibility from the strategic perspective which can have follow-on effects on flexibility at the operational level (Brozovic 2016), thus demonstrating the seemingly multi-level and ambiguous nature of flexibility as an organisational construct. In light of this, we begin the proceeding section by conceptualising flexibility (as it pertains to the study of organisation) followed by an analysis of how HVLV manufacturers make use of flexibility in different competitive environments.

# HVLV Manufacturing and Flexibility

Flexibility, though a pervasive concept appearing in many different fields of enquiry, does not have a generally accepted conceptualisation (Brozovic 2016). Motivated by this lack of understanding, Golden and Powell (2000) went in search of this “holy-grail” of definitions and describe flexibility as what is essentially “a capacity to adapt”. Much like the recent reviews of flexibility by Roberts and Stockport (2009), De Haan et al. (2011) and Brozovic (2016), Golden and Powell (2000) concluded that flexibility cannot be understood as a singular phenomenon – rather it consists of varying dimensions which affects the capacity of an organisation to adapt to changing circumstances. Such dimensions are typically in relation to (as in Golden and Powell 2000) time, range, intention and focus[[1]](#footnote-1). Even still, delineating the dimensions of flexibility relevant to a particular context is only half the battle – arranging them in such an order to facilitate a cohesive analysis and then effectively operationalising each still proves to be an arduous task (Jain et al. 2013; Pérez Pérez et al., 2016)

Because there is such ambiguity with the term flexibility and the varying conceptualisations of its constituent dimensions, we begin by understanding what needs to be flexible in the first place. Given “change” is a central tenet of flexibility (Brozovic 2016), to understand the role flexibility currently plays in HVLV manufacturing we first ask the questions what needs to change and why?

## Flexibility and HVLV Manufacturing Strategy

A core competence of HVLV manufacturing is the ability to design, engineer, assemble and manage manufacturing projects (Adrodegari et al. 2015). Intuitively, it would then seem that the ability to provide customised solutions is a key factor to the success of these firms. However, from a strategic perspective, this is not necessarily a key competitive criterion. According to the literature on HVLV manufacturers and competitive advantage, their strategic orientation is typically centred on the access to and retention of repeat business (Hendry 2010). However, the degree to which this holds true is dependent on their perception of their competition, the types of customers the firm is servicing, their respective industries and the degree of customisation being offered (Hendry 2010). This suggests their competitive priorities are largely influenced by their competitors as well as their (potential) customers. In a study of customisation, repeat business and competitive advantage on high customisation manufacturers Hendry (2010), building off the research by Amaro et al. (1999), found 4 major classifications depending on their competitive orientation in relation to the type of work they do. For the sake of comparison (in line with Amaro et al. 1999), we group these into two forms of HVLV organisation – Versatile Manufacturing Companies (VMC) and Repeat Business Customisers (RBC).

### 3.1.1 Versatile Manufacturing Companies (VMC)

Starting with the latter, HVLV manufacturers that primarily operate in a market characterised by the competitive bidding for single “one-off” projects on a consistent basis are known as versatile manufacturing companies (Kingsman and de Souza, 1997; Amaro et al., 1999). From the customer’s point of view this means each buying decision is made on a project-by-project basis i.e. every project is put out for tender regardless of which organisation has done the job before. As one would expect in such environments, HVLV manufacturers operating under these conditions would have to cope with constantly varying product types with different amounts of processing as well as work flow requirements. In this instance, the changes occurring in the organisational context are centred on the product being produced with flexibility required to facilitate as much range in the product as possible. The time focus is very much in the operational space as the manufacturer must “adapt” to each new project won on a relatively short-term basis. Here, inter-functional collaboration between sales, engineering and production is key to ensure seamless integration of projects into the production system accompanied by a formal method of production planning and control under periods of high-workload and resource utilisation (Hendry et al. 2013; Stevenson and Vanharanta 2015). Flexibility is achieved by (for example) the use of highly-trained cross functional staff, overtime, shift-work and (most commonly) the allocation and constant reshuffling of resources (Zorzini et al. 2008). During peak periods flexibility is also achieved by outsourcing, hiring temp workers and similar external means (Zorzini et al. 2008; Kingsman et al. 1993). It becomes evident that resource availability and capacity to facilitate major differences in project requirements is key here.

### 3.1.2 Repeat Business Customisers (RBC)

As the name suggests, Repeat Business Customisers focus the majority of their efforts to stabilise demand and increase efficiencies through repeat business (Amaro et al. 1999). The first customer order will typically present itself as a one-off highly customised solution though the contract will include subsequent orders of the same (or similar) product. Here, they are still competing based on lead-time and cost against other HVLV manufacturers, however it is not uncommon for the organisation to intentionally lose money on the first order knowing it will make up for it on subsequent orders so long as the project is delivered on time (Kingsman et al. 1996). Flexibility here is more centred on the type of customer, with the time focus being tactical (seasonal) rather than operational. Increased predictability and reduced uncertainty from the type of products being produced means greater opportunity to plan and less integration required between sales and production – essentially freeing the manufacturer up to focus on more longer-term objectives. Even if the manufacturer does not precisely know when they will be receiving orders for more products, they can still “plan” with relative certainty (Hendry 2010). Flexibility can thus be achieved, for instance, by hiring seasonal workers as well as facilitating effective customer and supplier relationships.

So far, there has only been a discussion on the need for flexibility and the manner in which flexibility is achieved according to two different competitive environments in a generalised, more abstract, sense. However, what it does tend to demonstrate is that as the demand for customised products becomes more predictable, the focus of efforts in flexibility tends to change from short-term production related flexibility to longer-term customer focused flexibility. This would also seem to suggest the existence of some cumulative capabilities (Flynn and Flynn 2004) and a higher level of organisational maturity that some authors recommend HVLV manufacturers should achieve (Muda and Hendry 2003; Hendry et al., 2013; Petroni et al. 2017). Of course, this is not possible for all HVLV manufacturers given some operate in competitive environments where a reliance on repeat business is simply not feasible (Hendry 2010). However, the goal remains the same – to improve the ability of the organisation to nullify the effects of uncertainties in relation to external demand for customised products. This is achieved through building operational capabilities (see Helfat and Winter 2011): whether the manufacturer makes a strategic decision to buy capabilities through capital or business investments, increasing focus on supplier/customer relationships or increasing inter-functional collaboration, the aim is still on stabilising the organisational performance and incrementally improving efficiency.

Whilst extremely beneficial to HVLV manufacturers in the short-term, some authors claim too much focus on building operational efficiencies poses significant dangers to the sustainability of the organisation in the long term (March 1991). Indeed, better relationships with customers, decreased uncertainty in production developed through improving or “exploiting” existing resources are examples of best-practice for HVLV manufacturing (Hendry 1998; Petroni et al., 2017). However, recent studies of organisational performance in the long-term suggest this is not sufficient (O’Reilly and Tushman 2008; Eisenhardt et al. 2010,). The organisation must be able to build new competencies and “explore” different strategies. In flexibility literature this is either referred to as the development of type two flexibility (Carlsson 1989) or proactive flexibility (Johnson et al. 2003; Sushil 2015).

This implies flexibility isn’t necessarily just an adaptive capability - it doesn’t always need to be triggered by an external event (Johnson et al. 2003). However, in order to build proactive flexibility capability, the organisation should exhibit substantially different characteristics. Exploration requires organic structures, autonomy and chaos as opposed to the control, stability and routinization discussed earlier (He and Wong 2004). For HVLV manufacturers that essentially adopt such a unique strategy that has been characterised as defying some fundamental rules of business (Hendry 2010), developing proactive flexibility is considerably more complicated.

## Proactive Flexibility in HVLV Manufacturing

Being proactive means taking action – not in response to change but in the anticipation of the change itself. For HVLV manufacturing (taking into consideration the literature analysis done earlier) this has two distinct meanings namely 1) being proactive in the management of uncertainty with customisation projects and 2) being proactive in finding new ways of creating and capturing value for the customer.

HVLV manufacturing projects are saturated in uncertainty – from the quotation phase right through to the production and delivery, the manufacturer needs to be able to “look ahead” and make assumptions that could make or break the firm (Kingsman et al. 1996). Project management is critical in HVLV manufacturing though its effective use in reality is quite limited (Adrodegari et al. 2015 ; Vaagen et al., 2017). In an environment where machine breakdowns, absenteeism, intentional counterproductive behaviour and even lost tools can cause a project to run over-budget or over-time it is not surprising why such firms do not have the time to exploit when they are too preoccupied with stabilising operations.

HVLV manufacturers (through the proxy of Engineer to Order and Make to Order classifications in literature as discussed earlier) are commonly characterised as undertaking project-based work (Caron and Fiore 1995; Yang, 2013; Mello et al. 2017). Fortunately, literature on organisations that are centred on projects (project-based organisations) have also recognised the importance of innovation activities to the success of the firm (Gann and Salter 2000; Blindenbach-Driessen and Van Den Ende 2006). Though still quite scarce, this research stream emphasises informal structures, experimentation; chaos over order and self-management as enablers for harnessing the uncertainty associated with undertaking projects (Keegan and Turner 2002).

Being proactive also relates to acting with uncertainty and doing away with the traditional “risk management” attitude towards doing project work (Perminova et al., 2008; Böhle et al., 2016). This is dependent on the individual attitudes towards uncertainty, the degree of information being readily available, the complexity of the project and turbulence in the environment as well as other institutional factors (Saunders et al. 2015). That is not to say that uncertainty cannot be managed in this context. Rather, in a review of uncertainty management practices in project management literature Saunders et al. (2015) found that different schools of thought had different ideas on how best to address uncertainty.

In the optimisation school, the focus is on optimising the execution of projects where improved project planning and quotation are examples in the HVLV context (Kingsman and de Souza 1997; Stevenson et al. 2005; Corti et al. 2006 ). The factor school of thought looks at success factors, which can be leveraged to deal with uncertainty (see best practices in HVLV manufacturing by Petroni et al. 2017). The contingency school aims to identify suitable organisational designs according to different types of projects - Clegg and Fitter (1981) are one of very few that looks into this in the context of HVLV as well as Wan and Sanders (2017) in their study of vertical integration and high product variety. This follows closely the behavioural school of thought looking into organisational behaviour. Here, individual sense making, judgement and decision making as well multi-stakeholder relationships are investigated (Saunders et al. 2015). Project governance structures and contract styles are part of the governance school of thought. Merrow (2011), from the customers’ point of view, describes various contract styles in the building of mega-projects and their effects on contractor performance. They outline how small contractors can often leverage contracts to address uncertainty in projects. Winch (2014) and Turner and Müller (2017) also investigate the role of governance in project-based work as well as emphasising the role of networks and business ecosystems in proactively managing projects towards organisation-wide success – leading into the last school of thought where relationships between parties involved in project execution are sources of uncertainty. In the relationship school of thought, there is emphasis on the pre-production processes where stakeholder relationships are key to working with uncertainty (Land and Gaalman 2009). Indeed, when it comes to being proactive in managing the uncertainty related to producing highly customised products, HVLV manufacturers can adopt a wide variety of “coping” mechanisms.

Being creative in developing novel value propositions for customers is certainly not a new concept. Though, making the customer feel like they’re getting $30 worth of value from a $5 purchase is not an easy task in mature industries like HVLV manufacturing. This perspective of flexibility came from the strategic importance of repeat business mentioned earlier – though customer retention is becoming more and more difficult given recent mega trends in the increased focus on niches, hypercompetitive environments and the increased availability of technology which enables customisation (AMGC 2016). So, if being proactive in finding new ways to enhance the “value” customers experience is so crucial to HVLV manufacturing, how can they do it?

Literature would suggest two propositions 1) leveraging networks in the form of open innovation and 2) developing service-based innovations – both of which seem promising in mature industries, high customisation environments and SME’s in general (Van de Vrande et al. 2009; Chiaroni et al. 2010) Open innovation can help facilitate value co-creation (critical for customisation) (Chesbrough and Appleyard 2007) which in turn can also help improve service offerings (Agarwal and Selen 2009, 2011). There are many combinations of open innovation (Chesbrough 2007), customer-focused (Loïc et al. 2010) and service-driven (Karpen et al. 2012) business models/strategies that can potentially be beneficial in the HVLV context. The bottom line is, however, when chasing proactive flexibility in the domain of value creation the HVLV manufacturer should be able to fundamentally change the way it does business. That is to say, it must be capable of sensing, seizing and appropriating value through Business Model Innovation (BMI) (Chesbrough 2010). Thus, relating closely to the development of dynamic capabilities (Teece et al. 1997; Teece, 2010).

 There are a myriad of organisational and social phenomena at play when an organisation undergoes the process of BMI (see Foss and Saebi 2015). For example, when moving towards service-based business models, organisations require a different culture, perception and understanding of value as well as customer relationships (Kindström and Kowalkowski 2014). As it involves changing the money-making logic of an organisation, it would also involve careful balances in exploration and exploitation to ensure the firm remains sustainable in the long run (Kindström and Kowalkowski 2014). Thus, the process of achieving proactive flexibility in the sense of discovering and leveraging the latent needs of customers involves critical changes to the way the firm operates.

## Summary – Flexibility in HVLV Manufacturing

Figure 2 provides a high-level summary of the dualities involved in the activities undertaken to achieve both reactive and proactive flexibility in HVLV manufacturing. Though discussed in a rather unitary fashion in the literature review, these apparent dualisms are not entirely mutually exclusive. Effective management of HVLV manufacturing projects requires both strict control mechanisms to ensure effective utilisation of resources whilst remaining open to the prospects of changing customer (as well as strategic) requirements and the early identification of opportunities for organisational improvement. Operational capabilities help to maintain the status-quo through organisational activities conducive to reactive flexibility (optimising processes based on identifiable constraints). As mentioned previously, this is not sufficient in todays’ HVLV manufacturing competitive environment – in the longer term the HVLV manufacturer is required to innovate and discover new opportunities for growth if it is to remain relevant. Proactive flexibility requires a different set of organisational capabilities based on the orchestration of resources to change the way an organisation “does business” based on the perceived needs of customers. These (dynamic) capabilities build off the operational capabilities (through combining, changing or developing new ones) in order to enable the HVLV manufacturer to “identify and exploit new opportunities, synchronise business processes and models with business environment and/or shape the business environment in its favour” (Leih et al. 2015). This also implies the capability to create changes in demand also rests on the ability to routinely adapt to such changes. Indeed, each of these activities required to achieve reactive flexibility and proactive flexibility use the same resource pool and tensions in the simultaneous pursuit of both is intuitively quite easy to perceive. It is in the “management” of these seemingly contradictory forms of flexibility (one based on stability and maintaining the status quo whilst the other based on instability, uncertainty and changing the status quo) that holds one of the significant keys to HVLV manufacturing excellence.

Figure 2 Summary of reactive and proactive flexibility dualities in HVLV manufacturing

Reactive Flexibility

Proactive Flexibility

* Based on control through “traditional” project management
* Engages operational capabilities
* Adapting to changes in demand
* Based on harnessing uncertainty through “modern” project management
* Engages dynamic capabilities
* Creating changes in demand

# Ambidexterity

The term organisational ambidexterity, first coined by Duncan (1976) and popularised by March (1991), was used to describe the level at which an organisation can undertake both exploration and exploitation activities simultaneously. In the context of organisational learning, March (1991) argued against the dominant thinking at the time which suggested organisations should either focus on exploitation or exploration by claiming organisations can (and should) do both. According to March (1991) and Levinthal and March (1993) both types of activities require fundamentally different organisational characteristics (structures, management practices and so on) in order to be effective. As such, exploitation and exploration are incompatible insofar as they both require distinct resources (or in their context different modes of learning) (Gupta et al. 2006). In this case, a careful balance between the two is required in order for an organisation to remain sustainable in the long term (March 1991). More recent thinking on the subject is geared towards leveraging the benefits of the two approaches and seeing them as complementary (O'Reilly and Tushman 2013). There are two main streams of thought on how to successfully undertake both in varying organisational contexts. The first stream suggests creating an organisational design consisting of distinct structural units specialising in either exploration or exploitation. As O’Reilly and Tushman (2008) and O'Reilly and Tushman (2013) mention, here, each unit should have its own “competencies, systems, structure and culture”. The key in this approach is to achieve some form of strategic alignment between the various business units through careful strategic management practices and encouraging a certain corporate culture (Raisch and Birkinshaw 2008). Others have argued for effective integration of exploration and exploitation at the individual and team level (Andriopoulos and Lewis 2009). Here the focus is very much on management practices, routines and other behavioural phenomena (cultivating trust and discipline) in order to build an organisational “context that promotes behavioural orientation towards a combined capacity for both exploitation and exploration” (Gibson and Birkinshaw 2004).

Both approaches certainly come with their own caveats. From a practical perspective, achieving structural ambidexterity seems difficult for organisations with severe resource constraints (Gupta et al. 2006) and even when undertaken, having one part of the organisation working as a flexible entity responding to changes in market conditions and the other focussed on creating internal efficiencies proves to be difficult to manage (Schreyögg and Sydow 2010). The alternative method (which focuses more on individual and team behaviour) has also been criticized for being too unrealistic in the goals it is trying to achieve and the manner in which it proposes to achieve them (Schreyögg and Sydow 2010). According to Schreyögg and Sydow (2010) this is directed primarily on the notion an individual can effortlessly switch between behaviours that facilitate exploration and exploitation on an on-going basis. There are other social, institutional and cognitive factors that pay a toll on the ability of an individual to do this (Smith and Lewis 2011).

It would seem, in this instance, that structural ambidexterity and contextual ambidexterity are actually linked in that one can have an effect on the other. More recent thinking on ambidexterity has also focussed on making the most out of both approaches (Gibson and Birkinshaw 2004; Eisenhardt et al. 2010). Typical amongst this perspective is the relative agreement on the importance of “paradox thinking” which embraces the organisational tensions between exploration and exploitation (Schreyögg and Sydow 2010; Martini et al., 2013) – a view crucial in understanding the interplay between flexibility and ambidexterity as described in the construction of a conceptual model later-on.

# Paradox thinking, flexibility and ambidexterity – towards a conceptual model for HVLV manufacturing

This research article began with a problem that referred to the seemingly incompatible nature between flexible organisational design and achieving ambidexterity. It was implied that the flexibility the HVLV manufacturer needed to exhibit in order to “deal with” high levels of customisation was inhibiting the ability of the manufacturer to explore new opportunities and innovate – thus leading to a scenario where short-term flexibility presides over longer-term survival. We now narrow the focus onto this problem and begin to construct a conceptual model (shown in Figure 3) outlining the interplay between flexibility and ambidexterity in the context of this research. In recognising the significance of dualities and certain management practices towards achieving flexibility and ambidexterity throughout the literature review, the model also introduces the notion of paradox thinking and “better management practices” (explained in the proceeding sections) to make use of this interplay between flexibility and ambidexterity.

Figure 3: Conceptual Model

## Paradox thinking

Paradox thinking has been used for many decades to try and “make sense” of seemingly incompatible yet highly interdependent phenomena (Schad et al. 2016). In order to understand (and manage) paradox it is necessary to firstly grasp the elements that appear to be contradictory and analyse the manner in which they interact in order to make use of their relationships in a productive manner (rather than separate or resolve). Based on this understanding of paradox Schad et al. (2016) defined the term as “persistent contradiction between interdependent elements” – taking into consideration the dynamic/cyclical nature of paradox as well as the emphasis on interdependence (Lewis 2000).

Paradox thinking has been used in a variety of research streams including psychology, organisational learning, strategic management and more recently organisational ambidexterity in an attempt to provide deeper understandings on tensions between different phenomena (see Hargrave and Van de Ven 2017 for a comprehensive review). As mentioned in the introduction, ambidexterity has been studied at the organisational, team, project and individual level with different management techniques available to embrace the tensions between exploration and exploitation. By adopting paradox thinking as a theoretical lens, authors have been able to take into consideration the tensions between exploitation and exploration (for example) at a wide variety of organisational levels, thus avoiding over-simplification at the expense of rich theoretical understanding (Smith and Lewis 2011). Taking into consideration how intertwined the concept of flexibility is in the fabric of HVLV manufacturing operations and strategy – taking a paradox-based view on organisational ambidexterity seems to be a fruitful endeavour in analysing the interplay between flexibility and ambidexterity.

Organisations in general appear to be built on the premise of contradictions (Clegg et al. 2002; Birkinshaw and Gupta 2013). Tensions are constantly being observed between organisational decisions surrounding control and autonomy as well as separation and integration to name a few. It is the manner in which tensions are observed, characterised and “managed” which differentiates the paradox perspective from others (Hargrave and Van de Ven 2017). Thus, we begin the explanation of the conceptual model with the analysis of tensions followed by some propositions for managing them in HVLV manufacturing.

## Characteristics of Tensions

Tensions, as we understand it, come as a result of individual perceptions of dualities emerging from the process of organising (Smith and Lewis 2011). The perception of tensions is then manifest in the design and implementation of organisational practices and routines which (when experienced in practice and under certain conditions) make them salient to individuals (Hargrave and Van de Ven 2017).

Traditionally, ambidexterity literature would suggest to separate the tensions either through time, space or both (Gibson and Birkinshaw 2004; O’Reilly and Tushman 2008). More recent approaches aim to find synergies in both seemingly incompatible states of organising. In this view, the tensions only exists so-far as the boundaries drawn around them are at the local level. It is in the interaction between the “opposing” elements that synergies start to emerge (Lewis and Smith 2014). In paradox thinking these synergies are short lived as new contradictory elements emerge over time that replace the old synergies, though still carrying the remnants of their previous interactions – as Clegg et al. (2002), citing Benson (1977), mentions “thesis follows antithesis in a never-ending succession, where a given dynamic is followed by its opposite, only to emerge again”. In addition, these interactions are not necessarily predictable in that unintended consequences can emerge as a result of communication between individuals (Stacey and Mowles 2016). As such, the relationship between seemingly contradictory elements is complex insofar as the interactions can continuously affect each element in any number of ways. Synthesis occurs when the relationship between elements is said to be symmetrical (i.e. mutually advantageous) (Hargrave and Van de Ven 2017) and not “obscured by everyday practices” (Clegg et al. 2002) through uncertainty, conflict and politics (Andriopoulos and Lewis 2009). This is demonstrated in the following example.

Take, for instance, a HVLV manufacturer of highly customised capital equipment as a hypothetical scenario. As with most HVLV organisations, this manufacturer needs to accommodate both control and freedom when managing at the project level. Strict planning and scheduling is necessary to ensure that the customer receives the product on-time as well as facilitating seamless entry of other projects in the “product mix” on the factory floor. At the same time, the manufacturer experiences significant uncertainty from the external environment as customers constantly change the requirements and demand fluctuates to the point where one day the machines on the shop floor are at a comfortable level of resource utilisation and the next day the manufacturing system is pushed to its limit as other jobs with higher-priorities are pushed through. In this instance, the project manager would need to have the freedom to improvise and quickly come to a solution to ensure the project progresses in a timely manner.

This scenario is also reminiscent of the planning vs acting paradox (Clegg et al. 2002), control vs autonomy paradox (Langfred and Rockmann 2016) as well stability vs flexibility paradox (Adler et al. 1999). In either case the former can act as a catalyst for the latter as well as the other way around. As an example, going back to the previous scenario and juxtaposing the example provided by Clegg et al. (2002), improvisation requires a certain level of creativity whereby the project manager must now make a decision given the current state of the project and using the existing resources at hand. Action follows reaction as the project manager continually refers back to the plan and makes adjustments as necessary. Here, the management practices conducive to reactive flexibility help aid in the creation of pro-active flexibility – the combination of both in this instance gives rise to synergy in the form of creativity and improvisation. This is also akin to the process of problem solving where convergent and divergent thinking take place on a constant basis (Runco and Acar, 2012; Runco, 2014) and when combined with the right environment and certain individual characteristics gives rise to creative thought (McShane et al. 2013). The interactions of exploration and exploitation result in similar outcomes as exploitation helps facilitate exploration and vice versa (Gupta et al. 2006; Andriopoulos and Lewis 2009; Birkinshaw and Gupta 2013).

At the beginning of this research article we articulated a problem whereby the design of the HVLV organisation to be as flexible as possible was stopping the organisation from being ambidextrous – a core requirement to long-term business survival. Whilst we do attest the design of the organisation has some influence on the ability of the organisation to reach high levels of ambidexterity, after synthesising the outcomes of the literature analysis (nature of flexibility and ambidexterity in HVLV manufacturing) and placing a paradox lens we suggest there are much more latent contradictions and tensions involved. Take the following case study by Clegg and Fitter (1981) as an example:

The case company was a manufacturer of highly customised capital equipment and was operating during periods of variable demand which had an influence on the performance of the organisation. The manufacturer has a proud history of producing high quality products and prides itself on the technical abilities of its employees. It was bought-out by a larger corporation who put pressure on the manufacturer to increase the performance of the manufacturing function whilst presumably increasing sales of these highly customised products. These “pressures” were seen to contribute to far-reaching organisational problems where interpersonal conflict, heightened stress levels and defensiveness resulted in poor organisational performance. The managers had no time to plan given they were too busy fighting fires as they were experiencing these changes as a result of the tensions.

A similar scenario is also found in a study of innovation in project-based organisations by Keegan and Turner (2002). They found that the project-based nature of work did not accommodate an environment that fostered innovation. Innovation was not seen as important as it 1) was too costly and required strict management, 2) it disrupted existing positions and relationships and 3) was only ever useful if the customer explicitly asked for it.

Whilst there could be many reasons for this - including perhaps the organisation falling into a “simplicity trap” (Clegg et al. 2002) whereby good organisational performance was seen to come from giving the customer what they asked for when they asked for it. This could create an inertia leading the organisation to continue exploiting resources and get better at it – the logic will seem to be better delivery equals more business. We contend, in line with Clegg et al. (2002), that the role of unintended consequences of individual behaviour is not taken seriously here. This has resulted in the organisation not being able to cope with the constant tensions that were perceived and materialised in the form of poor organisational practices – including falling into simplicity traps.

In the case study described earlier, the parent organisation was so concerned for the performance of the manufacturer that they held the senior managers personally responsible for different performance criteria. This led to the senior managers “tightening control” over their respective business units. In addition, bonus schemes were set-up to help motivate employees. Both of these had unintended consequences whereby tightening control led to all the people down the hierarchy to come under more pressure to perform and at the same time given less responsibility – leading to decreased quality of communication, alienation and rogue functions (creating their own rules). Bonus schemes also led to further organisational deterioration through increased fragmentation between and within functions – as Clegg and Fitter (1981) emphasise “making someone personally responsible for something makes him even more protective, defensive and increases parochialism”.

 Whilst observing or foreseeing unintended consequences is quite a difficult task given the complex nature of organisations in general and the many interdependencies of their constituent elements – it does not change the fact that tensions are in-fact embedded in the interdependencies between seemingly contradictory elements and that efforts to manage these tensions can bring about unintended consequences during synthesis (Hargrave and Van de Ven, 2017). According to Lewis (2000), responses to tensions can lead to positive or negative reinforcing cycles. In their dynamic equilibrium model of organising, Smith and Lewis (2011) suggest that environmental factors including plurality, change and resource scarcity (all observed in the case study example) make latent tensions salient and when individuals are too focussed on consistency, experience anxiety, defensiveness as well as forces for inertia in organisations (as described in the cases by Keegan and Turner 2002) can lead to these negative reinforcing cycles of poor management practices – driving unintended consequences. Thus, we contend, unintended consequences have a significant effect on the outcomes of tensions between (and within) flexibility and ambidexterity.

That said, the ability of an organisation to “exploit” the tensions involving flexibility and ambidexterity on a going basis also rests on the individuals experiencing it. The higher the level of uncertainty with projects, the more important individual characteristics become in dealing with abnormality (Turner et al. 2016). Thus, in the sections to follow we turn our attention to effective management practices that can facilitate ambidexterity and two specific individual characteristics required to make these practices work (both/and thinking and proactive management).

## The role of better management practices

Throughout this research article we have eluded to the fact that achieving ambidexterity and flexibility rests very much on effective management practices. Indeed, we mentioned many studies that have demonstrated the importance of this. Though, when it comes to managing flexibility and ambidexterity at the same time – there are certain clusters of management practices that (when adopted in unison) complement each other and their interactions facilitate an environment where both can thrive. To demonstrate the role of these so-called “better management practices” in taking advantage of the co-existence of flexibility and ambidexterity we turn our attention to the management practices of a group of high-performing manufacturing SME’s in Germany - Mittelstand organisations.

The Mittelstand was originally a means to classify a group of SME’s that held specific qualitative characteristics relating to size and revenue. Today, though, the term also refers to more qualitative features surrounding a highly successful management model based on 3 core principles: niche-focussed strategy, long-term oriented leadership and the pursuit of uncompromised operational excellence (Venohr et al. 2015). A large portion of Mittelstand organisations focus their efforts towards providing customised solutions at the lowest possible lead-time (Venohr et al. 2015) – akin to the characteristics of HVLV manufacturers in general. They are also known for their resilience to economic hardships where companies like Sennheiser (albeit a large manufacturer though still considered part of the Mittelstand) only suffered a 1% decline in revenue during the global financial crisis in 2009 (Weber 2016). Examples of manufacturing SME resilience is also found in KfW (2016) where manufacturing SME’s in general were seen to experience continuous growth through times of economic downturn. The following discussion draws from Venohr et al. (2015) in describing the three main pillars holding up the Mittelstand’s success.

From a strategic perspective, Mittelstand organisations cater to a very narrow sub-market and mould their entire business model around the needs of customers (primarily other businesses) within that market. This means there is a focus on providing customers with specialised solutions to solve an existing problem and leverage the homogeneity of this need (and solution) in a global context. Indeed, customer needs change over time with respect to advancements in technology and through close collaboration with customers in creating customised solutions, manufacturers in the Mittelstand often have the ability to correctly perceive the latent needs of customers and adjust their business model to suit. In this instance, innovation is led by solving real-world problems through the novel use of existing technologies. Such incremental innovations give way to new market niches and foster a reinforcing cycle of exploration and exploitation through proactive and reactive flexibility. This approach to manufacturing strategy has become a hall-mark of best practice in high labour cost countries such as Australia (see Green et al. 2012 for a description of measures to thrive in a high-cost environment by taking the “high-road” to productivity) where HVLV manufacturers including Marand Precision Engineering have managed to not only survive amidst the decline of key industries but also thrive as an exemplar of innovation in a high cost economy. Marand was significantly impacted by the demise of automotive manufacturing in Australia. Through leveraging their existing resources and engaging in emerging (global) business ecosystems they were able to maintain a strong focus on innovation aimed at achieving flexibility through novel manufacturing methods using existing technologies (KPMG 2015; AAMC 2017).

The basis of competitive advantage at the strategic level in Mittelstand organisations is a heavy focus towards operational excellence. Lean concepts are widely deployed throughout the Mittelstand organisations in order to increase their ability to produce customised products at the lowest lead-time possible. A continuous improvement culture forms the foundation for innovation and organisational learning which helps in achieving the seemingly contradictory goals of reactive flexibility based on control and proactive flexibility based on uncertainty (Adler et al. 1999; Secchi and Camuffo, 2016). Though intuitive (given the large amount of research based on the performance implications of Lean manufacturing), the success of Lean implementations in Mittelstand organisations is a function of a multitude of other complementary management practices including Human Resource policies and performance metrics. This is also corroborated on a global context by the results of large-scale surveys on management practices and manufacturing by Bloom and colleagues which focus on operations management, people management and performance management practices identified as typically better than others (Bloom and Van Reenen 2006; Bloom et al., 2017). In such studies it was found that large differences in organisational performance (including innovation) can be attributed to the extent in which these better management practices are adopted (Agarwal et al. 2014). A case in point is Ferra engineering – a HVLV manufacturer which (similarly to Marand) managed to transform from being reliant on the automotive industry in Australia to becoming a poster company for exports in aerospace and defence industries (APDR 2017). Ferra Engineering employs a wide variety of Lean principles and tools geared towards continuous improvement with the aim of better meeting customers’ requirements of high flexibility in terms of adapting to change and low lead-times (Ferra 2017).

Finally, Mittelstand organisations adopt what has been termed “enlightened family capitalism” whereby a strong focus on family virtues and longevity is emphasised over short-term value. Here, running the organisation as a family affair is encouraged and is seen as a source of competitive advantage. The difference is “family related values” like honesty, trust, reliability and respect are instilled throughout the organisation, starting with members of the leadership team. Such values and corporate culture are known to increase innovations by encouraging risk taking behaviour and collaboration amongst others. As a result, flat hierarchies and decentralised decision making are feasible which reduce the instances of company politics and increase inter-functional communication – all of which were evidently detrimental to the performance of the HVLV manufacturer outlined in the case-study by Clegg and Fitter (1981).

## Managing the tensions through paradox thinking

Throughout this paper we have highlighted (particularly when describing flexibility in HVLV manufacturing) how the management practices within HVLV manufacturing are often geared towards control and stability. We suggested that the unavoidable uncertainty associated with the nature of adopting a HVLV manufacturing strategy has something to do with it and continued to explore alternative ways of managing uncertainty in both HVLV projects and their strategic ties. What we have yet to mention is that reactive approaches to management (most commonly seen in HVLV literature) in the face of uncertainty are, in fact, creating a barrier to organisational ambidexterity. In order to demonstrate this we have to take a step back and look at what is actually happening within the organisation.

The HVLV manufacturing process is said to be composed of both physical processes (manufacturing and assembly) as well as non-physical processes (tendering, design, project management, sales and so on) (Hicks et al. 2000). Each of these processes can be executed by a functional/dedicated team or (in the case of SME) a single individual. What literature seems to take for granted is that each of these “functions” is affected by varying levels of uncertainty (judging by its position on the manufacturing value-chain in the case of HVLV manufacturing) with potentially divergent interests (Jarzabkowski and Fenton 2006). We demonstrate this by going back to the case study by Clegg and Fitter (1981).

According to them, the uncertainty with the manufacturing function came mostly from internal factors in relation to all of the non-physical processes involved in the production of a highly customised product. Clearly, then, each function has distinct characteristics and carries with it its own values and mindset as to how a certain job should be done. Due to the nature of their interactions and the high degree of interdependence, this seemingly unavoidable differentiation between the varying functions can cause major problems throughout the process of making something. Taking it one step further, Clegg and Fitter (1981) also suggest that “lateral disassociation” that was occurring in their case manufacturer had follow-on effects inside the function itself where individuals were forming their own beliefs and their own way of doing things. Combine this scenario with a hypercompetitive market-place and unpredictable fluctuations in demand and we get a glimpse into why executives feel that failures in manufacturing cannot be tolerated. Indeed, this can cause leaders to exert formal control mechanisms over a function in response to knee-jerk reactions to an uncertainty which they perceive to be the root cause of the problems they are having. However, it is not the uncertainty that is causing them grief, it is the poor management decisions triggered by a misrepresentation of the environment. Reactive responses to uncertainty in the environment like the one just mentioned can instigate a vicious cycle of bad managerial decisions (as mentioned) which proves detrimental to exploration activities.

At the project level the uncertainties experienced from the external environment are even more pronounced. Project management is a key capability for HVLV manufacturers and the ability to develop effective plans and place buffers at exactly the right place and the right time is paramount to project (as well as organisational) performance. Uncertainties at the project level are primarily a result of allowing the customer full control over the requirements and design of a particular product (Fox et al. 2009). The more customised the product, the more time it is going to take and the more chance the customer will change their mind. Unfortunately, the problem of constantly changing customer requirements is rife in HVLV manufacturing with knock on effects on the manufacturing system where work-routing and scheduling are significantly affected (Zorzini et al. 2008). In a practical sense no matter how much information a manager can collect – there is very little chance of eliminating such uncertainties (Clegg et al. 2002). This is part of the problem; reactive thinking seeks to make sense of incoming information in order to detect variations from a predefined plan and take measures towards bringing the project back on track and “eliminate” uncertainty - somewhat reminiscent of classic project management (Lechler et al. 2012). Such a view conceptualised uncertainty in a negative sense – something akin to risk – and has hence missed the opportunities associated with uncertainty as well (Perminova et al. 2008). By being open to the possibility of value-added opportunities as a result of uncertainties the HVLV manufacturer has a greater chance to be proactive and come up with novel solutions to project-based problems and exploit them at the organisational level. Thus, we propose HVLV manufacturers should seek to build proactive flexibility capabilities and mindset in order to increase the chances of achieving organisational ambidexterity. This ability to see beyond either positive or negative elements of uncertainty to both positive and negative elements brings us to our second proposition – that related to both/and thinking.

Organisational ambidexterity researchers have long recognised the importance of leadership in being able to undertake exploration and exploitation at the same time (O'Reilly and Tushman 2013). When treating ambidexterity as the simultaneous pursuit of exploration and exploitation, whether you are creating separate business units to address both (Tushman and O'Reilly 1996) or building organisational contexts conducive to simultaneous action (Gibson and Birkinshaw 2004), both approaches require careful strategic alignment, shared values, culture and inter/intra organisational integration (Raisch and Birkinshaw, 2008; Turner et al., 2015). Indeed, what is presented is much more of a leadership problem than it is an organisational one (O'Reilly and Tushman 2013). The problem for leaders is that in order to help facilitate ambidexterity – they must first be able to handle it themselves. This means holding the ability to recognise tensions between seemingly desperate elements and leveraging the synergies as well as contradictory interactions in order to enhance the ability of an organisation to undertake competing goals. This is not; however, the sole responsibility of the top management team, rather, middle managers and floor-staff should also hold these capabilities (Miron-Spektor et al. 2017). In reality, though, being able to do this is quite often a daunting and challenging task for individuals working in organisations.

The research into cognitive problems associated with decision making under competing demands dates back to the times of psychoanalysis and unconscious processes (Stacey and Mowles 2016). When faced with competing demands managers often feel that they have to decide between two contradictory ways of doing things (Clegg et al. 2002). For HVLV managers this could be deciding between short-term or long-term goals, stability or flexibility and empowerment or control. According to Clegg et al. (2002), managers who frame decisions in this way are neglecting the dynamic nature of interaction between seemingly contradictory elements and opting for stability and consistency which according to Smith et al. (2016) is not sufficient in today’s business environment.

In a cognitive sense, adopting either/or style of thinking can also generate anxiety which triggers defensive behaviours (Jarzabkowski et al. 2013) and unproductive conflict between colleagues (Clegg et al. 2002; Stacey and Mowles 2016) – a phenomena also observed by Clegg and Fitter (1981) in his behavioural analysis of a HVLV manufacturer. Although decisions eventually have to be made in such circumstances (Clegg et al. 2002), by explicitly seeking to understand the interdependencies between conflicting elements and the dynamics of their interactions over time, managers (and other members of the organisation for that matter) can begin to see opportunities for leveraging them in practice (Miron-Spektor et al. 2017). This so-called “paradoxical cognition” (Lewis 2000; Smith and Tushman, 2005) is also known as both/and thinking (Smith et al. 2016; Hargrave and Van de Ven 2017).

Both/and thinking is crucial towards harnessing the tensions between collective synergy and individual talent (Hill et al. 2014); enhancing creativity through conflict and integration tensions (Miron-Spektor et al. 2011) as well as improving decision making in organisations experiencing multiple tensions in organisation, learning, performance requirements and identity tensions in individuals/teams that are constantly in a state of change (Smith and Lewis 2011). In the HVLV manufacturing environment, we propose that adopting both/and thinking is necessary in facilitating ambidexterity.

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# Conclusions, Implications and Future Work

Based on issues emerging from an apparent “flexibility paradox” where the flexibility inherent in the design of HVLV manufacturers and the ambidexterity required for their long-term organisational success appear contradictory we asked two questions: what is the relationship between flexibility and ambidexterity in the context of HVLV manufacturing and how can this be managed?

In order to address these questions, we drew on HVLV manufacturing, flexibility, ambidexterity, paradox as well as management practices literature and found the two elements of flexibility and ambidexterity are interrelated on a far more complex manner than the tensions between organisation and innovation would suggest.

The notions of reactive and proactive flexibility were used to build a profile of HVLV manufacturing flexibility and revealed 1) reactive and proactive flexibility permeate multiple levels of organisational decision making and require differing styles of organising in order to function and 2) both reactive and proactive approaches depend on each other as they are both necessary in successfully completing HVLV manufacturing projects as well as helping the HVLV manufacturer compete at the strategic level.

A conceptual model was constructed on the basis of these insights. Through the application of paradox thinking as a theoretical perspective, we demonstrated that different dimensions of flexibility and ambidexterity coexist and interact in a multi-dimensional manner resembling that of paradoxical tensions. The tensions can come from the interaction of routines, processes and management practices (organisational design) – though inspired by implications of research by Clegg et al. (2002) , Smith and Lewis (2011) and Hargrave and Van de Ven (2017) we recognise the material manifestation of tensions between ambidexterity and flexibility through experiencing and acting on organisational phenomena is as much related to salient factors regarding social phenomena and individual cognition as they are to the latent factors through the complex interactions of organisational elements. We also recognise and take seriously the effect of unintended consequences on the relationship between ambidexterity and flexibility – something often taken for granted in organisational research (Clegg et al. 2002). Based on this, we investigated the efficacy of 2 approaches to managing these tensions centred on the adoption of a paradox mindset – that of proactive management and the related both/and thinking.

In adopting the perspective that tensions can be leveraged to achieve greater organisational performance we make a valuable contribution to HVLV manufacturing literature. We build on the contributions of extent HVLV manufacturing literature which traditionally focussed on exploitation through best-practice (Muda and Hendry 2003; Petroni et al. 2017) and production planning and control (Stevenson 2009; Hendry et al. 2013) by also taking into consideration the necessity to innovate – something which appears to be less emphasised in the context of HVLV manufacturing (Petroni et al. 2017). Moreover, literature in HVLV manufacturing implies the existence of a trade-off which is treated as a dilemma (see for example Cransberg et al. (2016) where a trade-off between balancing the shop floor and accommodating rush orders is resolved through distinct either/or decisions). By applying a paradox lens we build on the contributions of trade-off studies and further our understanding of the tensions ensued in adopting such a complex manufacturing strategy in order to build theory which accommodates todays’ necessity for both/and thinking (Smith et al. 2016).

From a managerial perspective, by shedding some light on the complex interactions and interrelationships between flexibility and ambidexterity, our conceptual model can help guide HVLV manufacturers in explicitly recognising the dynamic tensions between these seemingly competing elements towards making more informed choices. This is becoming increasingly important as mature industries like HVLV manufacturing come to recognise the value of ambidexterity and flexibility in ensuring long term survival whilst accommodating short-term profits and customer satisfaction.

Whilst recognising the rather abstract nature of this research article which attempts to provide a holistic theoretical understanding of the tensions between flexibility and ambidexterity, we note that this is done at the expense of an in-depth micro understanding – something which is increasingly being recognised as critical towards understanding paradox (Hargrave and Van de Ven 2017; Miron-Spektor et al. 2017). Thus we suggest further research is needed in empirically investigating these micro-level phenomena as well as their interplay with organisation-wide behaviour. There is also considerable gaps surrounding the implications of proactive flexibility towards innovation in HVLV manufacturing that has impaired the theoretical understanding of their relationships and the subsequent tensions that ensue. Further research in this area is needed in order to build on the contribution of this research article.

Key Questions for Reflection:

1. What is the relationship between flexibility and ambidexterity in the context of HVLV manufacturing?
2. How do the management practices associated with reactive and proactive flexibility impact ambidexterity?
3. How can paradox-thinking improve the understanding of the relationship between flexibility, management practices and ambidexterity?

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1. Time refers to the time it takes to adapt; range is the ability to adapt to foreseeable and unforeseeable changes; intention is whether the organisation takes an “offensive” or “defensive” position in the face of change and finally focus refers to where the flexibility is being created and in what context (typically characterised as internal or external contexts). [↑](#footnote-ref-1)