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Business Processes Reconfigurability in Dynamic Operating Environments

by

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Glasgow, March 2019- Margaret's son, Precious's husband, Imani and Aryela's dad-
Isimemeh Osagie

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Abstract

The need for rapid changes to business processes in an organisation has been amplified by factors such as globalisation, competition and an increasingly complex consumer market, this requires a re-evaluation of the current approaches to business process change. This research investigates the concept of Business Process Reconfiguration (BPRC) as a platform that would enable rapid, frequent and transformational business process changes whilst reducing the level of disruption to the organisation.

A review of the literature on business process change management from the lens of dynamic capability and agility is contained herein. Five themes of *sensing*, *responding*, *reconfiguring*, *speed* and *disruption* emerged as critical to enabling reconfigurability in business process management, from which five propositions on the concept of business process reconfiguration were developed. A classic experimental research method was used to investigate and test the validity of these propositions.

In developing the notion of business process reconfiguration, three distinct contributions are made. *First*, this PhD contributes by identifying the gaps in the business process management literature from the context of dynamic capabilities and agility. *Second*, using the concept of predictability and modularity, this research presents an agenda for developing a more robust knowledge of business process reconfiguration, which was subsequently tested and validated. *Third*, by introducing business process reconfiguration (BPRC); this research contributes to existing processual theory and extends knowledge of business processes. Therefore, the *significant contribution* to knowledge of this thesis is the influence of predictability and modularity on

reconfigurability of business processes in a dynamic operating environment. Together the three factors of predictability, modularity and reconfigurability have created a platform for more scholastic discussion on the topic of business process change in a dynamic operating environment.

Chapter 1. Introduction

The 21st century has heralded an unprecedented level of change to organisational operations; factors like the rate of technological change, globalisation, aggressive competition, government deregulation, privatisation, venture capitalism, social media, mergers and acquisitions amongst others have greatly influenced the competitive dynamics of doing business (Chen & Miller, 2012a; D'Aveni *et al*., 2010; Ndofor *et al*., 2011). Together or singularly, these factors create a significant challenge to business operations; for example, the need to make business process changes frequently and rapidly (Ahsan and Musteen, 2011; Rice et al., 2008). Therefore, to remain sustainable in a dynamic operating environment, organisations require the ability to adapt and respond rapidly and efficiently (Benner, 2009; Braunscheidel and Suresh, 2009).

It is important to note that paradigms of organisational ingenuity are usually triggered by competitive needs, for example, the industrial era, prompted by the industrial revolution in the eighteenth century was the catalyst of the transit from craft to mass production (Dove, 1996). Subsequently, the need for efficiency and quality, prompted by the competitive basis of cost and limited time heralded quality management principles (Deming, 1986; Juran, 1991). Now, this research argues that the uncertainties and complexities caused by a dynamic operating environment today have a significant impact on business processes and therefore necessitate the need for a more robust methodology on change from a business process perspective. More recently, the competitive driver for change relates to the uncertainties and complexities caused by a dynamic operating environment, which has had a significant impact on business operations and subsequently business processes. In operations management, much has been discussed about the dynamism in the organisational operating environment, an example is the discourse on VUCA- Versatility, Uncertainty, Complexity, and Ambiguity (Bennett and Lemoine, 2014a, 2014b; Mack et al., 2015). The effect of these uncertainties on business process change is of particular importance, hence a conceptualisation of the term “dynamic operating environment” as is used in this thesis which is more adequately described in Section 2.5

An appreciation of all of the various aspects of the management of change means it is not feasible in the context of a PhD. research to exhaustively investigate all of the underpinning tenets in order to enhance sustainability in a dynamic operating environment. For example, factors like culture, technology and human resources all provide a significant contribution in enabling change (Müller *et al*., 2014; Trkman, 2010). However, this research justifies the choice of business processes as the unit of assessment because a process encapsulates the interconnectedness of tasks, roles, people, departments and functions required to provide the output of a product or service towards an organisational goal (Earl, 1994). Hence, this research focuses on the business process because of its ineffaceable connection with change; changes in an organisation’s operations invariably lead to changes to the business process (Harmon, 2014).

The business process change initiative emphasised in the 90s created an awareness of the benefits of analysing organisational activities in relation to required output (Davenport and Short, 1990; Hammer, 1990; Hammer and Champy, 1993; Zairi, 1997; Zairi and Sinclair, 1995). Whilst there is scholastic evidence of the success of business process change initiatives, like business process re-engineering and improvement, this research puts forward the argument that traditional forms of reactive processual analysis are not sufficient to effectively take advantage of or mitigate the opportunities and threats in a dynamic operating environment. The reason being, previous forms of change have either been incremental and slow (to have a transformational effect) or rapid and disruptive. This research further argues that the current operating environment necessitates the need for business process change initiatives that proactively, rapidly, adapt and respond appropriately.

In doing so; this research, through the lenses of two bodies of management literature (dynamic capabilities and agility), that advocate the concept of responding rapidly to changes in an organisation's operating environment (Ambrosini and Bowman, 2009; Eisenhardt and Martin, 2000; Teece *et al*., 1997; Vogel and Güttel, 2013; Winter, 2003; Doz & Kosonen, 2010; Gligor & Holcomb, 2012; Overby *et al*., 2006; Yusuf *et al*., 2014).

1.1. Research Motivation

This research's literature started by exploring the gaps in knowledge of business processes from the context of a dynamic operating environment to contribute to the business process body of knowledge. In high velocity and rapidly changing competitive business landscapes, the ability to be responsive and adaptive is crucial to organisational sustainability (D'Aveni *et al*. 2010; Ndofor *et al*. 2011; Chen and Miller 2012). In a bid to address these influencing factors and remain competitive, it is generally accepted that business processes play a pivotal role in responding to these uncertainties. The importance of managing change in business processes is widely emphasised in this context. Harmon (2010), Bititci *et al*., (2011b) and Nadarajah and Kadir (2014) state that how organisations configure and manage their business processes can be a catalyst for rapid change. It is important to also state that elements other than business processes contribute to an organisation's ability to survive a dynamic operating environment, factors like culture, technology and human resources all provide significant contribution (Müller *et al*., 2014; Trkman, 2010). However, the focus of this research is on business processes because of its significant role in enabling or inhibiting change management initiatives (Harmon, 2014).

Since the publication of the seminal work "Reengineering work: don't automate, obliterate", by Hammer (1990), the literature around business process management (BPM[1]) has mainly been developed in two spheres: business process re-engineering (BPR) and business process improvement (BPI). Business processes can be radically re-

[1] For the purpose of clarity, in this chapter the term business process management (BPM) is used to describe all business process management methods including incremental business process improvement (BPI) and transformational business process re-engineering (BPR).

engineered, i.e., BPR (Davenport, 1993; Hammer and Champy, 1993; Hammer, 1990) or alternatively they can be continuously improved, i.e., BPI (Stoddard and Jarvenpaa, 1995; Zairi and Sinclair, 1995). Re-engineering involves radical change, which delivers transformational changes whilst being disruptive[2] (Vakola and Rezgui, 2000) with limited scope for frequent re-engineering (Harrington, 1998; Malhotra, 1998; Mumford and Hendricks, 1996). The level of disruption, effort and time attributed to BPR inhibits an organisation's ability to respond to change quickly and frequently. However, an organisation's ability to respond to dynamic industry conditions necessitates the need for frequent transformational changes that are responsive and seamless. With regard to BPI, the literature reveals that BPI is akin to continuous improvement, which is inclined towards incremental and not transformational change (Coronado and Antony, 2002; Hendricks and Singhal, 1997; Womack and Jones, 1996). This incremental nature of BPI, whilst not disruptive, inhibits the capability for transformational change in response to the dynamism in an organisation's operating environment.

Having established the tenets of managing change (Lewin, 1952; Kotter 1995), recent debate has evolved from merely being able to manage change to ensuring that organisations have the inherent capability to sense, seize and transform, i.e., dynamic capability *(Helfat et al.*, 2007; Winter 2003; Teece *et al*. 1997); and also the speed by which change is responded to, i.e., agility (Ganguly *et al.* 2009; Seethamraju and Seethamraju 2009; Sambamurthy *et al*. 2003).

[2] The term "disruptive" or "disruption" is used to describe the degree of disturbance, interruptions and disorder caused to normal business operations as a result of change negatively influencing factors like cost, staff engagement, quality, and customer experience. In section 2.2.2, the concept is further explained in the context of this research

Some notable examples of change initiatives undertaken by organisations described in the literature include Rolls-Royce offering of a TotalCare Solution where a per engine fly hour rate is agreed with its customers rather than outright purchase of the engines (Neely 2007; Christopher and Ryals 2014), Google's exploration into software operating systems, and Northrop Grumman's move to reduce production of the popular stealth bomber and invest in unmanned aerial vehicles (Jackson, 2010). Although these examples and the literature demonstrate an understanding of the need to change rapidly, there is scarce research into the role of business process management in facilitating rapid and responsive changes in a dynamic operating environment. Whilst the literature indicates the connection between rapid transformation and BPM (vom Brocke *et al*. 2014; Jurisch *et al*. 2014), the debate on this relationship has not advanced beyond the remit of BPI and BPR. Particularly, there is little or no evidence of research that attempts to interpret the BPM literature from the lenses of dynamic capabilities and agility; this is particularly significant because both spheres of literature indicate the criticality of business processes (Vogel and Güttel 2013; Agarwal and Selen 2009; Schreyogg and Kliesch-eberl 2007).

In conclusion, because of the current dynamic industrial climate, and the significance of business processes to this climate, we examine the business process literature, which has scarcely advanced from the remit of re-engineering (BPR) and improvement (BPI). To understand this dynamic, the business process literature is examined from the lenses of dynamic capabilities and agility. From the investigation of business processes from the context of a dynamic operating environment, the concept of business process reconfiguration (BPRC) emerges as a complementary approach to current process change initiatives. This notion was built on the concept of predictability and modularity enabling process reconfiguration which was necessary for rapid, frequent and transformational changes in a dynamic operating environment. A more detailed discourse on the complementary nature of BPRC in relation to BPR and BPI is in Section **2.5.4.**

Hence, the aim of this research is to investigate whether predictability and a modular approach to business process construct can complement existing business process change initiatives like BPR and BPI in a dynamic operating environment. Since dynamic capabilities and agility advocate the ability of an organisation to respond with speed, a couple of questions emerge on the implication of these attributes to the business process. To this aim, the following *literature review* questions are asked.

- With regards to rapid changes in a dynamic operating environment, what are the current gaps in knowledge of business process management and,
- What opportunities would a study of business processes in a dynamic operating environment yield?

Therefore, the objectives of this research is to make a contribution to the BPM literature by:

1. Exploring the existing BPM literature through the lenses of dynamic capability and agility; and in doing so, identify gap(s) in the business process body of knowledge and future research opportunities.
2. Designing a rigorous program of research to address the identified gap(s) in knowledge of BPM, i.e. to test the validity of BPRC by investigating the import of predictability and modularity on business process design in a dynamic operating environment.

3. Theorising the findings in relation to processual theory, where the business process literature is derived from.

To establish a fundamental understanding of key themes, a review of the dynamic capability and agility literature is contained. Then, through the lenses of dynamic capabilities and agility, a critical review of business process management literature is undertaken. The synthesis and analysis of this review lead to the identification of three distinct contributions in the body of knowledge on business process management. *First*, this PhD contributes by identifying the gaps in the business process management literature from the context of dynamic capabilities and agility. *Second*, using the concept of predictability and modularity, this research presents an agenda for developing a more robust knowledge of business process reconfiguration, which was subsequently tested and validated. *Third,* and most significant, by introducing business process reconfiguration (BPRC); this research contributes to processual theory and extends existing knowledge of business processes. Therefore, the principal contribution of this thesis is the influence of predictability and modularity along with reconfigurability of business processes in a dynamic operating environment. Together the three factors of predictability, modularity and reconfigurability have created a platform for more scholastic discussion on the topic of business process change in a dynamic operating environment.

1.2. Thesis structure

This thesis has been structured into chapters and sections in order to facilitate and enhance readability. Each chapter begins with an introductory section that reveals the objectives of the chapter, and the end of each chapter there is a brief summary of the content of the chapter. This thesis has been structured around the eight chapters described below.

In this first chapter, a description of the motivations and nuances that have influenced the researcher and the choice of research are detailed. Further on, this chapter also elucidates the wider context of this research as well as introduces the topic, key concepts, and the structure of this thesis. These motivations are investigated theoretically in the second chapter.

In Chapter 2, an explanation of the method employed for the theoretical investigation of key concepts of this research is detailed. Further on this chapter delineates the review of the literature into three phases; in the first phase a review of dynamic capabilities and agility is contained, and in the second phase the key concepts derived from the first phase are used to evaluate the business process literature. The third phase of the review examined the notion of reconfigurability along with the key tenets that underpin it; predictability and modularity. Chapter 2 is summarised with propositions derived from an analysis of the literature. These propositions were tested in Chapter 5.

In Chapter 3, the research methodological options and selection are detailed. The chapter itemises the most significant options available in a researcher's methodological journey. The selection criteria for each methodological choice is described based on the options available followed by a justification of the choices made in relation to the aims of the research.

Consequently, Chapter 4 contains a description of the research design strategy in relation to the broad-based research problem is detailed. Furthermore, in this chapter, the iterative process of formulating the strategy that led to the eventual research design is described.

In Chapter 5, a description of the data collection and the results from the experiment are provided. The process of data gathering from the experimental approach employed in this research is explained. This chapter also enumerates the results from the data collection process.

In Chapter 6, an analysis of the results of the data derived from the experiment is contained. By evaluating the transcribed data from the workshops, and the results of the experiments, analysis in relation to the propositions derived from the literature is done. Here, the validity of each proposition is analysed in relation to the results from the experiment, and the objectives of the research.

Chapter 7 articulates the contributions of this research to the business process body of knowledge, to industrial practise as well as processual theory. By reviewing existing knowledge of processual theory, current process management practice and the existing body of knowledge on business processes, a discussion on the contributions from this research and its significance is articulated. Furthermore, in Chapter 8 the research discusses the limitations, and future directions.

Chapter 2. Literature review

2.1. Introduction & Methodological considerations

A three-phased literature review methodology has been adopted. The justification for this three-phased review method being, first, this research investigates the business process literature through the lens on dynamic capabilities and agility lens in order to identify the gaps in the business process body of knowledge and future research opportunities. Second, the discussion on reconfigurability emerged as a platform to examine the applicability of reconfiguration within the context of business processes. Therefore, all three phases review and analyse the notion of BPM from different lenses ensuring that the business process remains the focus of the research. In the first phase, the focus of the literature review was agility and dynamic capability, whilst the second phase used the key themes that emerged from the first phase to conduct a focused review of the BPM literature. The third phase of the review contains a critical analysis of the synthesis of the focused review on business process management from the dynamic capability and agility lens. From the analysis in the third phase, a subsequent notion of reconfigurability emerged; this notion was further explored in relation to business processes, and finally in the third phase of the review five propositions are postulated. To summarise the three phases; Phase 1 was on dynamic capabilities and agility; in Phase 2, the BPM literature is explored; and in Phase 3, the key themes and definitions from dynamic capability and agility literature were synthesised with those from the BPM literature.

In Phase 1, this research was focused on uncovering key definitions and themes associated with dynamic capabilities and agility. In order to achieve this, the search was limited to key/seminal papers[3], conceptual review papers, book chapters, and research papers that provided key definitions and themes. Tabular description of the methodology for the first phase of the literature is contained in Table 2.1.

The keyword search was limited to “dynamic capbilit*”, “agility” and “agile”, as indicated in Table 2.1, this search returned over 1230 results from a timeframe of between 1990 and 2015 from specifically selected databases (Web of Science, Science Direct, Emerald Insight, and JSTOR). After excluding unrelated research, double occurrences, languages other than English, and research that did not fit with the inclusion criteria, the total number of papers included in the second phase of the review reduced to 48. The rationale and justification of this timeframe were to eliminate results that do not relate to the focus of dynamic capabilities and agility from a management perspective. Academic management discussion on dynamic capabilities (Teece and Pisano, 1994; Teece et al., 1997) and agility (Gould, 1997; Iacocca Institute, 1991; Roth, 1996) came to fruition in the 90s; expanded on from the concepts of the Resource-Based View (RBV) and organisational competitive advantage (Barney, 1991; Mahoney and Pandian, 1992; Wernerfelt, 1984). Since the emphasis of this research is on business process management in a dynamic operating environment, the discussion on dynamic capabilities and agility was required to provide a lens to explore current knowledge of business processes. Therefore, the review of dynamic capabilities was limited to a high-level understanding in the form of key themes, which was used to review and analyse

[3] For the purpose of this review, key/seminal papers are those with the highest number of citations on the topics of dynamic capability and agility

the business process management literature. It is also important to note that the concept of dynamic capability and agility highlight the challenge of organisational sustainability in a turbulent operating environment, which consequently creates a robust context for investigating the BPM literature. Subsequently, the key themes (i.e., sensing, responding, reconfiguring, speed and disruption) that emerged from the literature on dynamic capability and agility were used to inform the review of the BPM literature, in the second phase as seen in Table 2.1.

Table 2.1 Framework for systematic review of Dynamic capabilities and Agility

	Dynamic Capabilities	**Agility**
Time Frame	1990-2015	1990-2015
Search Terms	"Dynamic capabilities" "Dynamic capability"	"Agility"
Database Search	Web of Science, Science Direct, Emerald Insight, and JSTOR	Web of Science, Science Direct, Emerald Insight, and JSTOR
Search Results	Over 500 results	Over 730 results
Exclusion Criteria	Not English, Double Occurrence, Unrelated to Inclusion Criteria Unrelated to management literature	Not English, Double Occurrence, Unrelated to Inclusion Criteria Unrelated to management literature
Inclusion Criteria	Conceptual Literature Review Research Paper and books Seminal Papers Key definitions & themes	Conceptual Literature Review Research Paper and books Seminal Papers Key definitions & themes
Analysis **Initial title and abstract review** **Re-categorisation of papers into themes relevant to the aim and objectives of this research** **Systematic analysis using concept maps** **Preliminary notions discussed, analysed and refined to create a final research framework** **The final number of papers included -48**		

The second phase of the literature review, informed by the key themes that emerged from the first phase, used a systematic literature review approach (Tranfield *et al.*, 2003) to develop an understanding of the business process management body of knowledge as indicated in Table 2.2. In line with the dictates of a systematic literature review (Denyer and Tranfield 2008; Rousseau *et al.*, 2008) initial keyword searches were used to identify papers published in specific databases: Web of Science, Science Direct, Emerald Insight, and JSTOR. Keyword search was focused on business processes in relation to the themes that emerged from the first phase; ("business process" + sensing), ("business process" + responding), ("business process" + reconfiguring), ("business process" + speed), ("business process + disruption). An initial keyword search returned over 30,000 results between 1980 and 2015. After excluding unrelated research, double occurrences, languages other than English, and research that did not fit with the inclusion criteria, the total number of papers included in the second phase of the review reduced to 72 (See Table 2.2).

Table 2.2 Framework for Systematic Review of Business Process Literature

	Business Process + Key Themes	**BPM Literature**
Time Frame	1980-2015	1980-2015
Search Terms	(Business Process + Sensing) (Business Process + Respond) (Business Process + Reconfiguration) (Business Process + Speed) (Business Process + Disruption)	"Business Process"
Database Search	Web of Science, Science Direct, Emerald Insight, and JSTOR	Web of Science, Science Direct, Emerald Insight, and JSTOR
Search Results	Over 90 results	Over 30,000 results
Exclusion Criteria	Not English, Double Occurrence, Unrelated to Inclusion Criteria	Not English, Double Occurrence, Unrelated to Inclusion Criteria
Inclusion Criteria	Conceptual Literature Review Research Paper Definitions, Attributes & Antecedents	Conceptual Literature Review Research Paper and books Seminal Papers, Definitions and Attributes, Classification and Critique Operationalisation
Analysis **Initial title and abstract review** **Re-categorisation of papers into themes relevant to the aim and objectives of this research** **Systematic analysis using concept maps** **Preliminary notions discussed, analysed and refined to create a final research framework** **The final number of papers included - 72**		

In analysing the literature, for example seminal works like Hammer (1990); Hammer and Champy (1993); and Davenport (1993) as well as more recent conceptual papers on the subject (Sidorova and Isik 2010; Zellner 2011; Nadarajah and Kadir 2014) provided an appreciation of the tenets of business processes. Furthermore, a read through the papers and coding of the key messages enabled the researcher to systematically re-organise the key messages until a conceptual understanding was developed. A concept that emerged was the significance of reconfigurability to BPM in a dynamic operating environment. Two key tenets were considered vital to enabling reconfigurability: predictability and modularity, and since the concept of reconfigurability is established within product manufacturing and software development, the tenets that underpin reconfigurability were also considered relevant to any form of business process reconfiguration.

The methodological journey of this literature review is illustrated in Figure 2.1.

The review of literature began with the need to explore the BPM literature through the agility and dynamic capability lens; in doing so, the objective was to identify the gaps in the business process body of knowledge and future research opportunities. The review was split into two phases; the first phase entailed a review of dynamic capability and agility literature, where five themes emerged as influential. These five themes were then used as a lens by which the researcher examined the business process literature in the second phase of the review. After which synthesis and analysis of the findings from the first and second phase of the review were undertaken; this involved an iterative process of reviewing, discussing (with the focus group), and writing.

Based on this analysis, the notions put forward in this chapter start to materialise and the final propositions emerged. In Figure 2.1, an entire description of the literature review methodological journey is depicted.

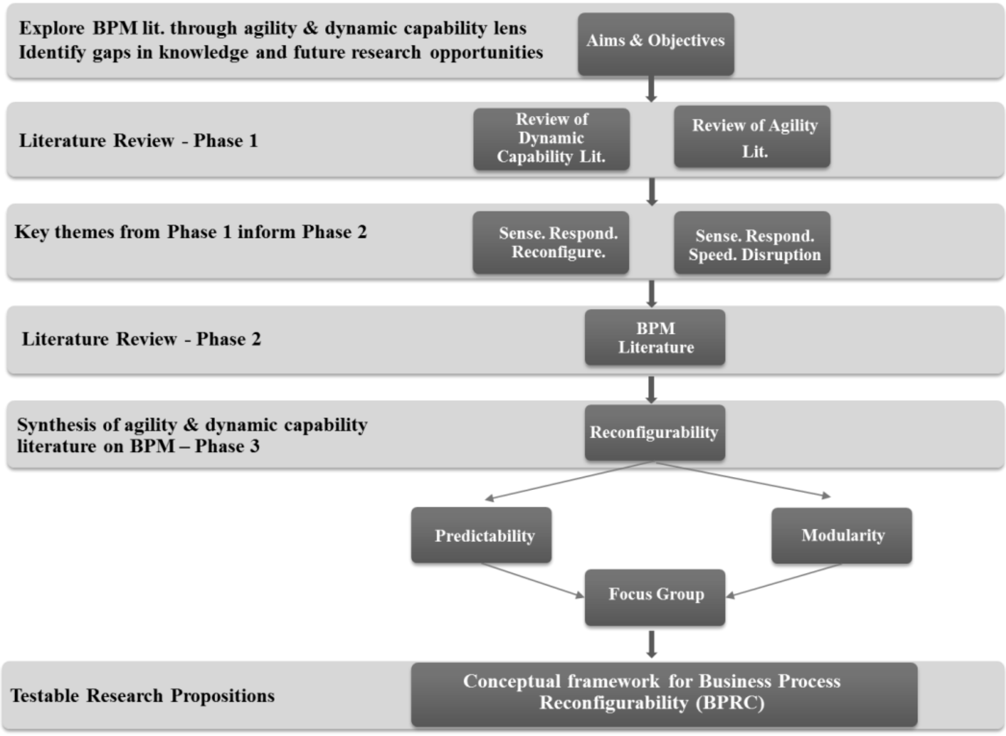


Figure 2.1 Literature review methodology framework

2.2. Phase 1 - Dynamic capability and agility

In recent times the organisational operational landscape has been burdened with the challenge of uncertainty, such as globalisation, increasing consumer complexity and competition (D'Aveni *et al*. 2010; Ndofor *et al*. 2011; Chen and Miller 2012). In response to increasing levels of uncertainty, scholarly literature heralded the concepts of dynamic capability (Teece and Pisano 1994; Teece *et al*. 1997; Eisenhardt and Martin 2000) and agility (Iacocca Institute, 1991; Overby *et al*., 2006; Sambamurthy *et al*., 2003).

A common point of reference between the two concepts is the significance of business processes. Dynamic capability literature places business processes at its core; in essence, the literature advocates the ability to change, reconfigure, and renew processes as essential to dynamic capabilities (Teece and Pisano 1994; Teece *et al.* 1997; Eisenhardt and Martin 2000; Zahra *et al.* 2006; Zollo and Winter 2002). The agility literature emphasises the need for rapid business process change in response to the demands of the organisation's operating environment (Yusuf *et al.* 2014; Chen *et al*. 2014; Seethamraju and Seethamraju 2009). The following sections contain a review of dynamic capability and agility literature in order to establish the key themes that underpin both concepts.

2.2.1. Dynamic Capability

The capability required for organisational sustainability in an operating environment that is constantly changing has been defined as dynamic capability (Eisenhardt 1989; Brown and Eisenhardt 1997; Eisenhardt and Martin 2000; Teece 2007; Helfat, *et al* 2007; Ambrosini and Bowman 2009; Wang and Ahmed 2007; Vogel and Güttel 2013).

The concept of dynamic capability has developed since the 1980s from several studies, some notable examples are organisational routines (Nelson and Winter 1982), core competence (Wernerfelt 1984; Hamel and Prahalad 1990; Amit and Schoemaker 1993), core capability and rigidity (Leonard-Barton, 1992) and, most specifically, the Resource Based View (RBV) propagated by Barney (1991). The RBV stipulates that the resources in an organisation that are altogether Valuable, Rare, Inimitable and Non-substitutable (VRIN) provide a distinct competitive advantage (Barney, 1991). The quintessential premise of the RBV is that the competitive advantage of a firm lies in its resources and capabilities; these resources include business processes (Wang and Ahmed 2007; Barney 1991). The literature further argues that these resources are heterogeneous and distributed across firms in an industry which subsequently makes this heterogeneity continue over time (Wernerfelt 1984; Barney 1991; Mahoney and Pandian 1992; Wang and Ahmed 2007; Ambrosini and Bowman 2009). Whilst the significance of the RBV cannot be diminished, it, however, fails to resolve the *de facto* issue of changes to the operational environment of an organisation. The RBV does not proffer a solution on how the current stock of VRIN resources can address the needs of a dynamically changing operating environment; hence the introduction of the Dynamic Capability concept (Eisenhardt and Martin 2000; Wang and Ahmed 2007; Ambrosini and Bowman 2009). The dynamic capability perspective enhances the resource-based view by including the dynamism of the industrial environment with an evolutionary view of organisational resources (Teece *et al*. 1997; Eisenhardt and Martin 2000; Zahra and George 2002). Literature has provided various definitions of dynamic capabilities; however, Teece's original version (Teece and Pisano 1994, p.541) and an elaborated version (Teece et al., 1997, p. 516) have gained the most prominence (Furrer et al., 2008; Di Stefano et al., 2010). They define dynamic capabilities as a *"firm's ability to integrate, build, and reconfigure internal and external competencies to address rapidly changing environments"* (Teece et al., 1997, p. 516). Other definitions of dynamic capabilities more or less advocate the same principle (Eisenhardt and Martin 2000; Zollo and Winter 2002; Zahra *et al*. 2006; Winter 2003; Pavlou and Sawy 2005; Helfat *et al.* 2007; Ambrosini and Bowman 2009; Schreyogg and Kliesch-eberl 2007; Wang and Ahmed 2007; Helfat and Peteraf 2015).

In all the definitions there is an implicit and indivisible connection between the business process and dynamic capabilities (Ambrosini and Bowman, 2009; Eisenhardt and Martin, 2000; Wang and Ahmed, 2007). However, the relationship between the business process and dynamic capabilities is not explicitly defined; in some quarters it is argued that dynamic capabilities are bundles of business processes that can be referred to as best practices or routines (Eisenhardt and Martin 2000). Others, like Wang and Ahmed (2007), state that dynamic capabilities are not processes but capabilities embedded in processes. Ambrosini and Bowman (2009) advocate a similar view of the relationship between business processes and dynamic capabilities; they argue that dynamic capabilities are business processes that influence the organisation's resource base. Regardless of whichever viewpoint you deem more accurate, the implication is that business processes are inextricably linked to dynamic capabilities; and the business process forms a significant building block of dynamic capabilities.

In investigating the cognitive underpinnings of dynamic capabilities, Helfat and Peteraf (2015) place emphasis on the triplicate micro-foundations ("sense", "seize", and "reconfigure") of dynamic capabilities espoused by Teece (2007). In the manuscript,

Teece (2007) disaggregates the components of dynamic capability into three micro-foundations: (1) to sense and shape opportunities and threats; (2) to seize opportunities; and, (3) to maintain competitiveness through enhancing, combining, protecting and, when necessary, reconfiguring the business enterprise's intangible and tangible assets (Teece, 2007, p.1319). Sensing, also referred to as environmental scanning or exploration, has been described as the ability to anticipate opportunities and threats before they become fully apparent (Denrell *et al*. 2003; Peteraf and Bergen 2003). It is also argued that through exploration, business leaders could also shape new opportunities (Alvarez and Barney 2007; Helfat and Peteraf 2015).
The second micro-foundation of dynamic capability is seizing; this is referred to as the process of planning or preparation. Seizing occurs after sensing and before reconfiguration (Teece 2007; Helfat and Peteraf 2015). Taking advantage of future opportunities or avoiding threats requires preparation; seizing includes redefining the business model in preparation for change, and improving and maintaining competencies and assets (Helfat and Peteraf 2015; Teece 2007). This cannot be done without significant change to business processes – before the process of reconfiguration commences. In essence, this research describes seizing as every endeavour undertaken by an organisation in readiness for change, based on knowledge gained from sensing.
The third micro-foundation of dynamic capability espoused by Teece (2007), is reconfiguring, which he elucidates as the process of enhancement, alignment and redeployment of a firm's organisational resources and capabilities to sustain performance (Helfat and Peteraf 2015).

Therefore, the three micro foundations (sensing, seizing, and reconfiguring) of dynamic capabilities are described in the literature (Barreto, 2010; Di Stefano *et al*., 2010; Helfat

& Peteraf, 2015; O'Reilly & Tushman, 2008; O'Reilly & Tushman, 2011; Teece, 2007) as:

- Sensing – *all activities are undertaken to enable an organisation to anticipate/predict future deviation from expected goals (with a degree of accuracy) that could have an impact (opportunity/threat) on its operations;*
- Seizing – *all activities from planning to execution undertaken to enable an organisation to act counteractively in relation to anticipated or existing factors that could impact its operations;*
- Reconfiguring – *all activities that enable reorganisation of organisational assets, structures and processes in relation to anticipated or existing factors that could have an influence on an organisation's operations*.

Dynamic capabilities are exhibited when these three micro foundations are active within an organisation (Teece *et al*., 1997; Teece, 2007; Winter, 2003). Whilst Teece's (2007) transcript on the micro-foundations of dynamic capabilities was centrally focused on enterprise and strategic level capacity, there is a recognition of the importance of business processes contained therein. A sensing process identifies opportunities and threats; the seizing process devises a response to these opportunities and threats; the reconfiguring process relates to the transformation of the operational business process in response to opportunities or threats. Based on this, we would assert that dynamic capabilities implicitly categorise processes in two distinct ways: the managerial processes that instigate dynamic capabilities; and, the operational processes that need to be reconfigured in response to the change. This distinction is more explicitly elaborated in the review of the business process literature in Section 0. At this point, it is sufficient to assert that the first key themes that underpin dynamic capabilities are *sensing, seizing* and *reconfiguring.*

When these three micro foundations are active within an organisation; the organisation exhibits dynamic capabilities (Teece *et al*., 1997; Teece, 2007; Winter, 2003). Hence the dynamic capability process of an organisation may be described as the ability of an organisation to “sense” opportunities and threats, and then “seize” them by ensuring organisational readiness to either mitigate the threat or take advantage of the opportunity by “reconfiguring” organisational assets, structures and processes.

2.2.2. Agility

The notion of agility came to fruition in the early 1990s in America by the Agile Manufacturing Enterprise Forum (AMEF). A consortium of over 150 manufacturing practitioners and researchers of the Iacocca Institute in Leigh University partook in a research study that culminated in the birth of the term “agile manufacturing” (Iacocca Institute, 1991). This study was undertaken with the assertion that there was a paradigm shift in the state of manufacturing. The results of this report contained two arguments. First, the dynamic operating environment is cause for a strategic change in the manufacturing industry; second, manufacturers with capabilities to respond to this new dynamic environment will be more sustainable. Factors like, globalisation, aggressive competition, government deregulation, venture capitalism, social media, mergers and acquisitions have greatly influenced the operating environment.

Since the revelations from AMEF emerged, researchers and practitioner alike have grappled with the concept of agility and come up with various definitions. Table 2.3 lists

15 of these definitions, which whilst not being exhaustive, represent the majority of the views in the literature.

From the definitions of agility in Table 2.3 and other literature that do not explicitly define agility, an observation can be made that they emphasise the same principle; which is the ability of an organisation to *sense* and *respond* with *speed* (Dove 1999; Dove 2001; Sambamurthy *et al*. 2003; Overby *et al.* 2006; Goldman *et al.* 1995; Yusuf *et al*. 1999; Raschke 2010; Doz and Kosonen 2010; Doz and Kosonen 2008; Tallon and Pinsonneault 2011; Gligor and Holcomb 2012). From the definitions of agility in Table 2.3, an observation can be made of a consistent reference to *sensing*, *responding*, and *speed* (Ashrafi et al., 2005; Brown and Eisenhardt, 1997; D'Aveni, 1994; Mathiyakalan et al., 2005). However, these terms have not been quoted verbatim in all instances in the definitions, but implicitly; for example, some definitions use the term "detect" and "seize" (Brown and Eisenhardt, 1997; D'Aveni, 1994), which can be interpreted as *sensing* and *responding*. Other examples included in the definition of agility in Table 2.3 have been underlined and made bold; examples like "reacting quickly" can be interpreted as *responding* with *speed*. The literature on agility also provides evidence of a relationship between agility and business processes (Heininger 2012; Raschke 2010; Seethamraju and Seethamraju 2009). The underlying association between the concept of agility and business process is change, i.e. rapid change (Roberts & Grover 2012; Ganguly *et al*. 2009; Santos Bernardes & Hanna 2009); the ability to make these changes rapidly in an organisation is underpinned by how quickly business processes can be changed.

Table 2.3 Definitions of Agility

Reference	Definition
D'Aveni (1994)	The ability to **detect** and **seize** market opportunities with speed and surprise.
Goldman *et al*., (1995)	The capability of an organization to operate profitably in a competitive environment comprised of continually changing customer habits.
(Cho *et al*., 1996)	Capability to survive and prosper in a competitive environment or continuous and unpredictable changes by **reacting quickly** and effectively to changing markets, designed by customer-designed products and services.
(Brown and Eisenhardt, 1997)	The ability to **detect** and **seize** market opportunities with speed and surprise.
(Mcgaughey, 1999)	The ability of an enterprise to **respond quickly** and successfully to change.
(Yusuf *et al*., 1999)	A successful **exploration** of competitive bases (speed, flexibility, innovation proactivity, quality and profitability) through the integration of reconfigurable resources and knowledge management to provide customer-driven products and services in a fast-changing market environment.
(Christopher and Towill, 2000)	The ability of an organization to **respond rapidly** to changes in demand, both in terms of volume and variety.
(Aitken *et al*., 2002)	Ability to have visibility of demand, flexible and **quick response** and synchronized operations.
(Sambamurthy *et al*., 2003)	The ability of a firm to redesign their existing processes **rapidly** and create new processes in a **timely** fashion in order to thrive and be able to take advantage of the unpredictable and highly dynamic market conditions.
(Ashrafi *et al*., 2005)	An organization's ability to **sense** environmental changes and **respond** effectively and **efficiently** to that change.
(Raschke and David, 2005)	The ability of a firm to dynamically modify and/ or reconfigure individual business processes to accommodate the required and potential needs of the firm.
(Mathiyakalan *et al*., 2005)	The ability of an organization to **detect** changes (which can be opportunities or threats or a combination of both) in its business environment and hence providing focused and **rapid responses** to its customers and stakeholders by **reconfiguring** its resources, processes and strategies.
(Ganguly *et al*., 2009)	Effective integration of **response**-ability and knowledge management in order to **rapidly**, efficiently and accurately adapt to any unexpected (or unpredictable) change in both proactive and reactive business/ customer needs and opportunities without compromising with the cost or the quality of the product/ process.
(Seethamraju and Seethamraju, 2009)	The ability of a firm to dynamically modify and/or **reconfigure** individual business processes to accommodate the required and potential needs of the firm.
(Tallon and Pinsonneault, 2011)	Ability to **detect** and **respond** to opportunities and threats with **ease**, **speed**, and dexterity.

Hence, three core themes emerge from the literature on agility: an organisation's ability to *sense* and *respond* with *speed* to threats and opportunities. In the literature on agility, particular emphasis has been placed on the concept of *speed* as a core component of agility. Dove (1996) earmarked four domains of agility: cost, time, scope and robustness, and opined that agility should be defined within these four parameters in order to be effective. Cho *et al.* (1996) in defining agility also stressed the need for effectiveness, whilst Ashrafi *et al.* (2005) emphasised efficiency and effectiveness in dealing with agility. Tallon and Pinsonneault (2011) highlighted the term "ease" as a necessary component of agility. What this implies is that the ability to sense and respond with speed is only as relevant as the value gained from the effort of the associated change. It is the classic example of the proverbial question "is the juice worth the squeeze?" hence, a fourth theme, the issue of *disruption*, is introduced. The importance of disruption is emphasised because rapid and transformational changes are usually accompanied with discomfort (Al-Mashari et al., 2001). Here, this research defines disruption as the degree of disturbance, interruptions and disorder caused to normal business operations as a result of change negatively influencing factors like cost, staff engagement, quality, and customer experience.

Based on the above discussion the four themes of *sensing*, *responding*, *speed* and *disruption*, underpin the concept of agility.

2.2.3. Synthesis of dynamic capability and agility literature: Key themes

At the fundamental level, agile and dynamic capabilities are similar: both concepts concern using organisational competencies in relation to capabilities to sense and respond to opportunities and threats. Indeed, some definitions from the literature on agility and dynamic capability could be used interchangeably, for example, Teece, (2000) and Seethamraju and Seethamraju (2009) define agility and dynamic capability as the ability to modify and/or reconfigure individual business processes to accommodate required and potential needs of the firm. The interconnectedness of these two spheres of literature is emphasised in the work of Doz and Kosonen (2008; 2010) on strategic agility, where they described it as being strategically sensitive, having resource fluidity and the capability to rapidly reconfigure business systems (Junni et al., 2015). Another significant commonality observed from literature on both concepts is the emphasis on business processes whether in relation to dynamic capabilities[4] (Eisenhardt and Martin 2000; Wang and Ahmed 2007) or agility [5](Heininger, 2012; Overby *et al.*, 2006; Raschke, 2010; Sambamurthy *et al.*, 2003; Seethamraju and Seethamraju, 2009).

On the surface, the dynamic and agile concept is related to how business processes *sense* and *respond* to the need to change in the midst of operational uncertainty. However, on scrutiny of the literature on dynamic capability and agility, five themes emerged: *sensing*, *seizing/responding*, *reconfiguring*, *speed* and *disruption*. Furthermore, there is a disparity in terminologies used by the dynamic capability and agility literature concerning the notions of "seizing" and "responding" respectively. Whilst the dynamic capability literature uses *seizing* in reference to the preparatory tasks undertaken before reconfiguring, the agility literature uses *responding* as all activities (including preparatory and reconfiguring) undertaken after sensing. Thus, the disparity between the two bodies of literature on both terminologies is what each encompasses. For example in interrelating dynamic capabilities and strategy, Teece (2014, p.341) combines the two micro-foundations of dynamic capabilities as "seizing/transformation". Therefore, it is posited that the process of *responding* actually begins with seizing and ends with reconfiguring. In Figure 2.2 the relationship between the key themes and the micro-foundations of dynamic capabilities discussed in this subsection is illustrated. The notion put forward in Figure 2.2 is that a response is not initiated at the point when a change occurs (i.e. reconfiguring of organisational assets), but actually begins when plans are put in place (i.e. seizing) to enable change in response to the explorative activities of

[4] state that dynamic capabilities are not processes but capabilities embedded in processes
[5] Ability of a firm to redesign their existing processes rapidly and create new processes in a timely fashion in order to thrive and be able to take advantage of the unpredictable and highly dynamic market conditions

sensing, and is concluded at reconfiguration. So *reconfiguring* is a critical component of responding, and consequently dynamic capability.

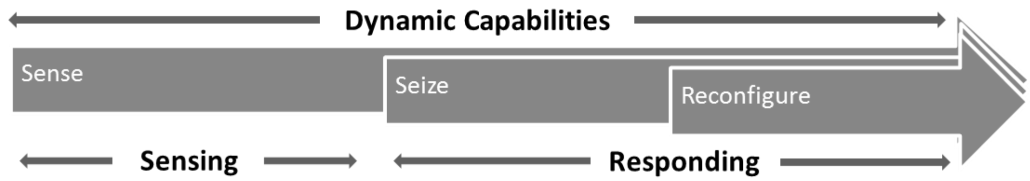


Figure 2.2 Dynamic capabilities, micro foundations, and key themes

From a business process perspective, the preparatory effort undertaken in the process of seizing relate to the design or redesign of the process map, whilst the process of reconfiguring relates to the actual process change (Aguilar-Savén, 2004; Melao and Pidd, 2000; Nurcan *et al*., 2005).

Another fundamental difference between both concepts (dynamic capability and agility) is the emphasis placed on *reconfiguration* from the dynamic capability literature (Barreto 2010; Eisenhardt and Martin 2000; Helfat and Winter 2011; Helfat and Peteraf 2015; Pavlou and Sawy 2005; Schreyogg and Kliesch-eberl 2007; Teece *et al*. 1997; Wang and Ahmed 2007) and *speed* and *disruption* from the agility literature (Dove 1996; Doz and Kosonen 2008; Doz and Kosonen 2010; Ganguly *et al*. 2009b; Gligor and Holcomb 2012; Junni *et al*. 2015; Sharifi and Zhang 1999; Sharifi and Zhang 2001; Tallon and Pinsonneault 2011) in relation to sensing and responding to change (Ashrafi *et al.* 2005; Tallon and Pinsonneault 2011; Teece 2007; Helfat and Peteraf 2015). See Table 2.4 for a definition of these five themes.

Table 2.4 Themes from Dynamic Capability and Agility

Theme	Definition	Reference
Sensing	All activities undertaken to enable an organisation to anticipate/predict future deviation from expected goals (with a degree of accuracy) that could have an impact (opportunity/threat) on its operations.	Teece 2007; Helfat and Peteraf 2015; O'Reilly *et al*. 2009; O'Reilly and Tushman 2011; Watkins and Bazerman 2003
Responding	All activities from planning to execution undertaken to enable an organisation to act counteractively in relation to anticipated or existing factors that could impact its operations.	D'Aveni *et al*. 2010; Tallon and Pinsonneault 2011; Teece *et al*. 1997; Wang and Ahmed 2007; Teece, 2014
Reconfiguring	The ability to reorganise organisational assets, structures and processes in relation to anticipated or existing factors that could have an influence on an organisation's operations.	Teece 2007; Helfat and Peteraf 2015; O'Reilly and Tushman 2008
Speed	The ability to rapidly sense and respond to anticipated or existing factors that could have an influence on an organisation's operations.	Lieberman and Montgomery 1988; Kerin *et al*. 1992
Disruption	The degree of disturbance, interruptions and disorder caused to normal business operations as a result of change negatively impacting on cost, staff engagement, quality, and customer experience.	Dove 1996; Cho *et al*. 1996; Ashrafi *et al*. 2005; Tallon and Pinsonneault (2011)

In Table 2.5 below, a list of literature on dynamic capabilities and agility is itemised along with their corresponding emphases on the themes they each advocate. Whilst this table does not contain an exhaustive list of all the literature on dynamic capability and agility, they were selected based on the highest number of citations and that they contained a description of dynamic capabilities or agility. From Table 2.5, it can be observed that dynamic capability and agility literature both stress the notion of sensing and responding as being a vital component.

Table 2.5 List of papers reviewed on dynamic capabilities and agility

Dynamic Capabilities	Author	Sense	Respond	Reconfigure	Speed	Disruption
	Ambrosini and Bowman (2009)			X		
	Barreto (2010)	X	X	X		
	Brown and Eisenhrdt (1997)					
	Di Stefano *et al* (2014)	X	X	X		
	Eisenhardt (1989)					
	Eisenhardt and Martin (2000)	X	X	X		
	Helfat *et al* (2007)			X		
	Helfat and Peteraf (2015)	X	X	X		
	O'Reilly and Tushman (2008)					
	Pavlou and Sawy (2011)	X	X	X		
	Peteraf *et al* (2013)					
	Schreyogg and Kliesch-eberl (2007)	X	X	X		
	Teece and Pisano (1994)					
	Teece *et al* (1997)	X	X	X		
	Teece (2000)	X	X		X	X
	Teece (2012)	X	X	X		
	Teece (2014)	X	X	X		
	Wang and Ahmed (2007)	X	X	X		
	Winter (2003)			X		
	Zahra *et al* (2006)			X		
	Zollo and Winter (2002)			X		
Agility	**Author**	**Sense**	**Respond**	**Reconfigure**	**Speed**	**Disruption**
	Ashraf *et al* 2005	X	X			X
	Braunscheidel, and Suresh (2009)		X		X	
	Christopher (2000)		X		X	
	Christopher and Towill (2000)	X	X			
	Dove (1996)	X	X		X	X
	Doz and Kosonen (2008)	X	X	X	X	
	Doz andKosonen (2010)	X	X	X	X	
	Ganguly *et al* (2009)	X	X		X	X
	Gligor and Holcomb (2012)	X	X		X	X
	Goldman *et al* (1995)		X			X
	Gunasekaran (1999)	X	X		X	
	Junni *et al* (2015)	X	X	X	X	
	Kidd (1994)	X	X	X	X	
	Overby *et al* (2006)	X	X			
	Raschke (2010)	X	X	X	X	
	Ren *et al* (2003)					
	Sambamurthy *et al* (2003)	X	X	X	X	
	Seethamraju and Seethamraju (2009)			X		
	Sharifi and Zhang (1999)	X	X		X	X
	Sharifi and Zhang (2001)	X	X		X	X
	Sherehiy *et al* (2007)	X	X	X	X	
	Tallon and Pinsonneault, (2011)	X	X		X	X
	Yusuf *et al* (1999)	X	X	X	X	

In the following section, using the parameters (*sense, respond, reconfigure, speed* and *disruption*) established from the literature on agility and dynamic capabilities the literature on BPM is explored.

2.3. Phase 2- Business Process Management (BPM)

The notion that business processes have been around since the early 1980s was first popularised by Hammer (1990) and has since gained widespread acceptance across a range of academic and practitioner communities alike. The literature provides numerous definitions for “business processes”, all of which essentially reflect the same ontology, that a *business process is a series of continuous or intermittent cross-functional value-adding tasks that are connected with work flowing through them for a particular purpose* (Davenport 1993; Hammer and Champy 1993; Ould 1995; Bititci and Muir 1997; Zairi, 1997; Malhotra, 1998; Lin *et al.*, 2002; Bititci *et al.*, 2011a; Slack *et al.*, 2009). Processual thinking underpins the distinctiveness of the business process approach; the ability to focus on tasks, and the inter-connectedness of these tasks to bring about an output (Pettigrew 1997; Van de Ven 1992; Dawson 1996). Business processes not only emphasise what is done and/or how they are done but also places emphasis on how these activities are interconnected and how work flows through these activities to produce efficient and effective results.

2.3.1. Business Process Change Classification

Ever since the concept of business process change became popular in industrial and academic circles, various terminologies have been branded in relation to the different approaches to business process change (Baines, 1996; Zairi and Sinclair, 1995). For example “business process improvement (BPI)” (Harrington, 1991), “business process redesign” (Carr, 1993), “Business Process Re-engineering- BPR” (Hammer, 1990), and “continuous improvement” (Deming, 1986; Imai, 1986; Juran, 1991; Juran and Gryna, 1993). Regardless of the term employed, business processes are fundamentally classified into two spheres, either radically re-engineered or incrementally improved (Zellner, 2011). Others have attempted to classify business processes according to their characteristics, as illustrated in Table 2.6. These classification has been done using either the cognitive characteristics of business processes, i.e., artistic versus scientific processes (Hall and Johnson 2009; Trkman 2010; Benner and Tushman 2003) or the functional characteristics of business processes i.e., manage processes, support processes and operate processes (CIMOSA 1989; Bititci *et al.* 2011a). In Table 2.6, this research aggregates the various classifications (cognitive and functional) from the literature to create a tabular understanding of the cognitive and functional characteristics of business processes.

Table 2.6 Business Process Classification

Cognitive Categorisation		**Functional Categorisation**		
Artistic Processes	**Scientific Processes**	**Managerial Processes**	**Operational Processes**	**Support Processes**
Require significant amount of cognition.	Transactional or mechanistic, requires less cognition.	Processes concerned with direction setting, organisational sustainability and future performance.	Processes concerned with present-day performance and work execution.	Processes concerned with supporting the operational and managerial processes.

From a conceptual perspective, the business process literature takes a broad view that maintains the relevance of the BPR and BPI approaches to all types of processes (Hall and Johnson 2009; Trkman 2010; CIMOSA 1989; Bititci *et al.* 2011a). However, from a practical perspective, the majority of works focus on BPI or BPR in mainly scientific operate and support processes rather than artistic and managerial processes. Nevertheless, before drawing conclusions about the BPM literature in the context of agility and dynamic capabilities, in the following paragraphs, a further examination of the BPR and BPI concept is detailed.

2.3.2. *Business Process Re-engineering*

In relation to BPR, the adoption of the re-engineering approach to business process change has been widespread and accounts of the revolutionary effect of BPR have been publicised in academic and industrial domains alike. Some notable examples include Ford's 75% improvement on the payable headcount, Mutual Benefit Life Insurance's 40% improvement in underwriting, and 75% improvement on order fulfilment process by Xerox accumulating a saving of around $500M (Grover and Malhotra, 1997; Hammer, 1990). In obliterating the current accounts payable process and redesigning a new procurement process, Ford introduced a central database that eliminated re-work; they were also able to reduce procurement process activity and consequently the headcount. With regards to Mutual Benefit Life Insurance, a typical life insurance policy application process cycle time was an average of 22 days, working through five departments and 19 people with a total of 30 tasks. In re-engineering the process, Mutual Benefit Life Insurance was able to reduce cycle time to between two and five days, double handling capacity whilst reducing headcount by around 50%.

However, the radical changes associated with BPR initiatives, whilst being transformative, tend to be relatively slow and highly disruptive thus making the prospects of frequent BPR initiatives less feasible (Deakins and Makgill, 1997; Harrington, 1998; Mumford and Hendricks, 1996; Vakola and Rezgui, 2000). For example, American Express undertook a re-engineering exercise that saved the company in excess of $1.7B, which was actualised over a period of two years (Grover and Malhotra 1997). The implication being that whereas BPR does deliver transformative change with huge financial benefits, that it took two years to implement also reveals the unsuitability of BPR in a dynamic operating environment where the motivation for change is frequent and unpredictable. In a dynamic operating environment, the time-consuming nature of BPR increases the likelihood of disruption and as previously stated, the time taken to change is a crucial element of disruption. It is also worth stating that since the early realisations of spectacular improvements gained from the application of BPM, the literature has not documented more recent success stories; hence the somewhat dated examples above.

2.3.3. Business Process Improvement

In relation to BPI, continuous improvement initiatives like Total Quality Management (Hendricks and Singhal, 1997), Lean (Womack and Jones, 1996) and Six Sigma (Coronado and Antony, 2002) have yielded positive results. BPI's incremental improvement approach whilst being speedy to implement with minimal disruption is not transformative. In BPI, whilst each incremental step of improvement can be achieved in a relatively short timescale, it takes time for these incremental changes to accumulate to have a transformational impact (Kettinger et al., 1997; Kettinger and Grover, 1995a). The implication being that whilst the application of a single BPI initiative is rapid and less disruptive, it fails to deliver large-scale non-incremental transformations that are required in a dynamic operating environment.

It appears that since the advent of the business process literature, the debate has scarcely moved from the remit of BPR and BPI in relation to facilitating change. In the context of dynamic capabilities and agility, the ability to sense and respond to opportunities and threats faster than your competitors is described as a critical capability (Helfat *et al*. 2011; Bititci *et al*. 2011b; Teece *et al*. 1997; Yusuf *et al*. 2014; Overby *et al*. 2006; Ofoegbu 2012). In essence, organisations need to have the capability to sense and respond to threats and opportunities in their operating environment more frequently and with greater speed. The review of the BPM literature in general and BPR and BPI literature, in particular, reveal little advancement in relation to this challenge.

2.3.4. Business process and transformation

The agility and dynamic capability literature implicitly recognise the existence of two types of business processes: “transforming” processes, and “transformed” processes. Organisational routines or processes such as sensing, responding, reconfiguring are seen as transforming processes as their function is to transform the other, more operational, processes in response to strategic change (Bititci *et al.* 2011a; Bititci *et al.* 2011b). The business process literature classifies these processes as the “Manage” or “Managerial” processes (Childe *et al.* 1994; Davenport 1993; Armistead and Machin 1997; Garvin 1998; Bititci *et al*. 2011a). The transformed processes are those operational and support processes that need to be or are transformed in response to strategic change by the transforming processes (Eisenhardt and Martin 2000; Ambrosini and Bowman 2009; Teece *et al.* 1997). The business process literature *functionally* classifies these processes as “operate” and “support” processes (Childe *et al.* 1994; Davenport 1993; Armistead and Machin 1997; Bititci *et al*. 2011a; Bititci *et al.* 2011b). Based on these categorisations of processes; this research supports the notion that organisational capabilities like sensing opportunities and threats, developing appropriate responses and responding are capabilities embedded within managerial processes. In Figure 2.3, these processes are represented as transforming processes because they instigate transformation to the support and operational processes. The support and operational processes, referred to as transformed processes, are subject to a higher degree of reconfiguration activities.

Figure 2.3 illustrates the relationship between different business processes types, the themes emerging from the review of dynamic capabilities and agility literature, and their relationship with transformation.

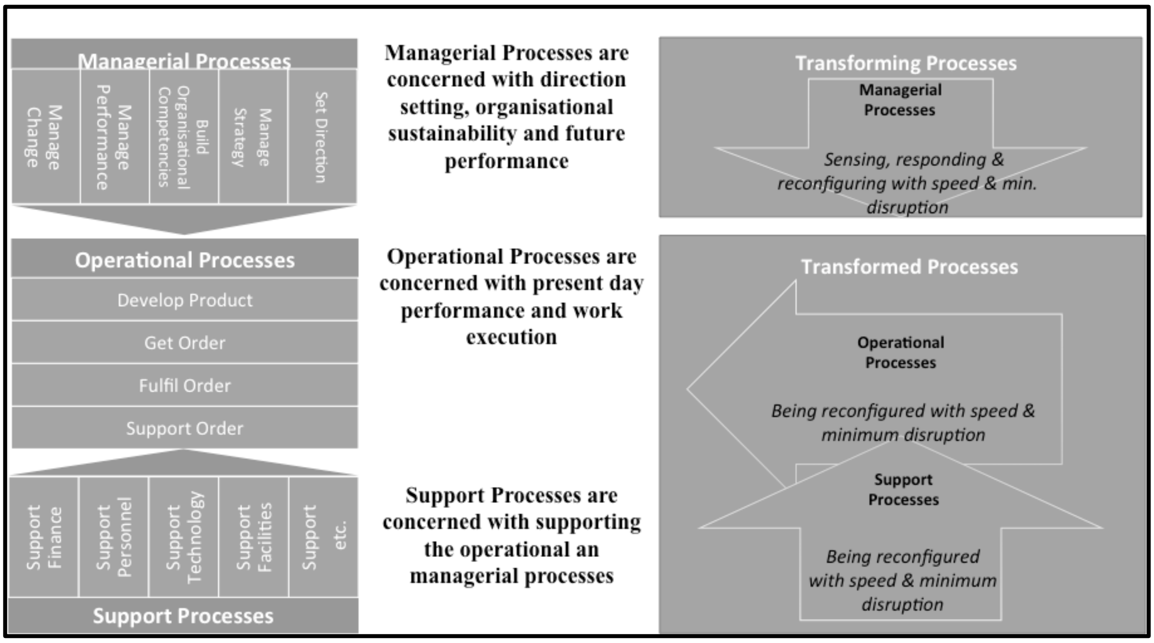


Figure 2.3 Transformation from a business process perspective

From the literature (Benner, 2009; Benner and Tushman, 2003), it is also stated that the more reconfigurable processes are, the more rapidly, and with fewer disruptions organisations will be able to respond to opportunities and threats. Thus, in the context of operate and support processes, the concept of ***reconfigurability*** becomes critical. Reconfigurability is the ability to consistently change and rearrange the sub-components of a system in an efficient and effective way.

2.4. Phase 3: Business Processes and reconfigurability

The concept of reconfiguration is not new; it has been extensively used in the dynamic capability literature to describe the restructuring of organisational assets in relation to dynamically changing environments (Helfat and Peteraf, 2015; Teece, 2007). Practical application of reconfiguration can be observed in the fields of product design and software engineering. A good example of reconfiguration in product design can be found with Dell computers; they were designed to enable a degree of reconfiguration by the customer (Jiang, 2002). The product not only provides the customer with the ability to tailor/configure the specification of their intended purchase, but it also provides the customer with the ability to upgrade (or reconfigure) various components at a later date. In contrast, the automotive industry offer similar services to customers enabling them to configure specifications (Borja *et al*. 2000; Jose and Tollenaere 2005; Simpson 2004), however, it becomes much more difficult for customers to reconfigure their vehicles at a later date. The concept of reconfiguration is based on the ability of the designers predicting the likely options (or possible configurations), and then the product is designed to be reconfigurable in relation to the predicted options. Hence, a discussion on configuration design ensues.

In product development, reconfigurability vis-à-vis configurations are achieved through modular product design (Jose and Tollenaere 2005; Sanchez 1995; Sanchez and Mahoney 1996). Modular products comprise components or modules that have been designed to function independently and with a degree of interchangeability within the system (Pil and Cohen 2006). With regard to modular system design, a standard interface is designed that integrates all other customisable components of the system (Baldwin and Clark 2000, 2003). This physical decoupling of components enables reconfigurability and, in turn, minimises disruption because of the interchangeability of modules. Likewise, software reconfiguration is concerned with making changes to an application's configuration at runtime, i.e. after it has been deployed (Gomaa and Hussein 2004). This is achieved using configurable process models such as configurable event-driven process (Rosemann and van Der Aalst, 2007). The implication being, that changes can be applied to the software at almost any stage of its development or even after deployment, reusing the functionality of existing systems rather than building them from scratch. This enables changes to occur frequently (if the need arises) whilst minimising disruption.

The business process literature has not been exempt from the influence of reconfigurable software; the idea is instigated through service-oriented architecture (SOA). SOA is an approach that addresses the requirements of loosely coupled, standard-based, and protocol independent distributed computing (Zhai et al., 2009). This functionality is provided by the Enterprise Service Bus (ESB) that is an integration platform utilizing web services standards as functional modules to support communications patterns over multiple transport protocols for SOA applications (Papazoglou and van den Heuvel 2007; Gäth *et al*. 2014). This concept of process reconfiguration embedded in software applications is dependent on specific sets of functional requirements capable of fulfilling a set of predicted scenarios (Papazoglou and Van den Heuvel 2007). As with modular product design, the principles are similar: a standardised interface (ESB) is created that enables integration of independent modules to facilitate concurrent changes and reuse to software functions without the need to redesign software from scratch.

First, from the discussion above, an observation can be made that the notion of reconfigurability is well established in the product and manufacturing process design as well as in software engineering. Manufacturing process design and software engineering are naturally working with forms of processes, albeit more scientific and technical processes and not “business” processes (Balaban et al., 2011; Bider and Jalali, 2014; Giaglis, 2001). The fundamental difference between the “technical” and “business” process management is the focus of the output; with the former, the emphasis is on achieving lower level technical goals, whilst the focus of the latter is to achieve higher-level business targets. Regardless of whether it is “technical” or “business”, the same processual principle applies; which is the inter-connectedness of tasks to bring about an output using inputs, resources, and controls (Dawson, 1997, 2005; Pettigrew, 1997; Sminia, 2016; van de Ven, 1992)

Thus, it is posited that the notion of reconfigurability can be applied to more general forms of business process management.

This leads to the first proposition:

P1- ***existing knowledge of reconfigurability in product manufacturing systems and software engineering can be transferred and/or replicated for business processes.***

Second, from the discussion above on reconfigurability in manufacturing systems and software engineering; an observation can also be made that *predictability* and *modularity* along with *standard interfaces* are critical components that underpin reconfigurability (Jose and Tollenaere 2005; Sanchez 1995; Sanchez and Mahoney 1996; Papazoglou and Van den Heuvel 2007). In essence, reconfigurability is based on the ability to predict (to a degree) future scenarios and based on these predictions, allow modular designs enabled by standard interfaces to be created.

2.4.1. Predictability and modularity along with standard interfaces

Predictability deals with the issue of managing uncertainty with a degree of confidence; according to Milliken (1987), uncertainty is the inability to make predictions with a degree of precision. Ahsan and Musteen, (2011) describe uncertainty as the inability to determine the probability of a circumstance due to the lack of cause and effect information. In their manuscript for managing project uncertainty, De Meyer *et al*. (2002) developed four predictability profiles based on four degrees of uncertainty: variation, foreseen uncertainty, unforeseen uncertainty and chaos. Based on these four levels of uncertainty they propagate the design of predictability profiles: *"a qualitative characterisation of the degree to which each type of uncertainty may affect the project"* (De Meyer *et al*., 2002, p. 62). In essence, there should be an acknowledgement of the varying degrees of changes that could occur and a corresponding agreed action plan to mitigate these changes. For example, minor improvements to existing processes could be categorised as minor changes, whilst major transformations could be categorised as major changes. To achieve that from a business process perspective, a degree of predictability of the factors that could potentially require a change in the output of the process has to be established, and a plan to take advantage or mitigate them would be integrated into the process design. These "contingency plans" can be denoted from a business process perspective as modular business processes. However, contingency plans are typically reactive, whilst modular processes have been designed up front. Consequently, modular processes will help manage contingency, therefore, the degree of accuracy in predictions will significantly affect the reconfigurability of the business process design.

This leads to the second proposition:

P2- ***A high degree of predictability will enable a more modular approach to process design.***

The advantages of modularity have been widely reported in the literature: flexibility, cost savings, diverse product offering, customisation and rapid responses are some of the elements of a modular system (Jose and Tollenaere 2005; Bask *et al*. 2010; Bask *et al*. 2011; Rahikka *et al*. 2011). There is a general consensus on the definition of modularity in the literature as building complex products or designing processes from smaller subsystems that can be designed independently yet function together as a whole (Baldwin and Clark 1997; Campagnolo and Camuffo 2009; Bask *et al*. 2010; Bask *et al*. 2011). The concept of modularity entails avoiding strong interdependencies but fostering loose coupling underpinned by standard interfaces which ultimately enable configuration and reconfiguration of components (Campagnolo and Camuffo 2010; Bask *et al*. 2011). From an organisational perspective, modularity facilitates process flexibility by breaking processes into standard and customised sub-processes with standard interfaces (Sanchez and Mahoney, 1996).

From the literature on modularity, an observation is made that modular products are designed based on anticipated knowledge of required configurations (Baldwin and Clark, 1997; Campagnolo and Camuffo, 2009; Furlan et al., 2013); similarly, a modular business process can also be designed based on knowledge of anticipated changes. It appears that the wider literature, including product development, manufacturing process design and software engineering, contains a breadth of reconfigurability examples and applications. Thus, a framework that enables a better understanding of reconfigurability from a business process perspective could enhance an organisation’s ability to change frequently and transformatively, but this would also require a degree of predictability. In short, greater levels of predictability (the anticipation of potential future scenarios with a degree of accuracy), will enable greater levels of modularity which, in turn, will enable the development of more reconfigurable business processes. This argument is further illustrated in Figure 2.4; which demonstrates the relationship between predictability and modularity along with standard interfaces, and how they could combine to enhance process reconfigurability. Furthermore, Figure 2.4, also demonstrates how dynamic capabilities and agility through the key themes identified (sensing, responding, reconfiguring, speed, and disruption) enable an organisation to have frequent and transformational change.

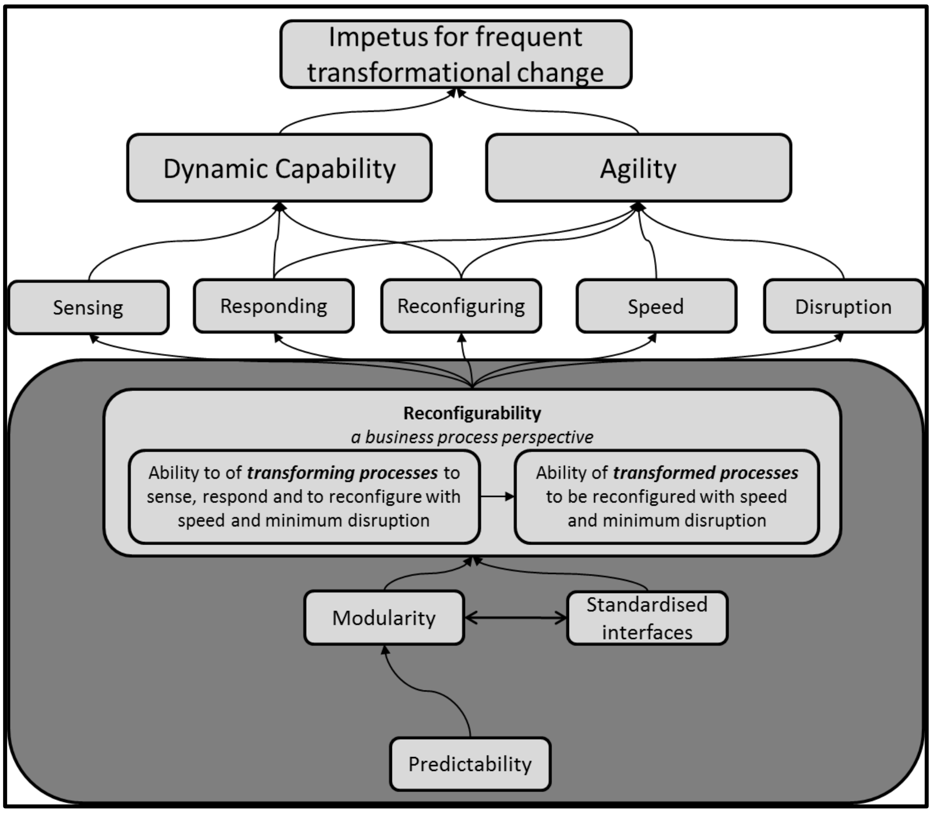


Figure 2.4 BPRC, dynamic capability, agility & transformational change

2.4.2. Scale of change, speed of change and levels of disruption

The dynamic nature of today's business climate necessitates a transformational business process approach that enables frequent and rapid responses to change whilst minimising disruption (D'Aveni *et al*. 2010; Ndofor *et al*. 2011; Chen and Miller 2012). The current body of literature on business processes does not sufficiently explore this capability, hence, to expand on the relationship between disruption (because of changes to a business process) and rapid response; speed is defined. In physics, speed is a metric that is derived from the calculation of a specific distance covered over a period of time. Similarly, for the purposes of this research:

Speed is defined as a metric that measures the distance between the disruptive changes to a business process over the time taken to respond and adapt to the disruption. Here, distance is measured as the difference between the current process (as is) and the future desired state of the process (to be).

From literature, an observation can be made that although BPM[1] offers viable alternatives for responding to opportunities and threats, there is a trade-off to be made between speed of change, the scale of change and the level of disruption. BPR offers high scale transformational changes but is very disruptive and slow to implement; BPI initiatives, conversely, are not disruptive, but quick to embed; however, they do not proffer high scale transformational change, see Figure 2.5. Here, the illustration positions the notion of Business Process Reconfiguration (BPRC) in relation to the BPR and BPI based on the three components that significantly impact change initiatives: the scale of change, the speed of change and the level of disruption.

Thus, a third proposition is postulated***:***

P3- ***A more modular approach to business process design, based on predictable outcomes would enable transformational changes to occur rapidly and with reduced disruption.***

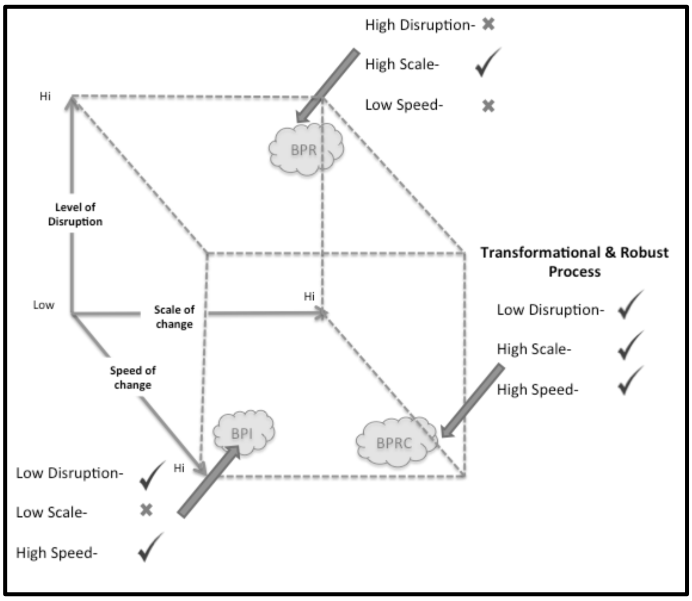


Figure 2.5 BPM, requirements for transformation.

2.4.3. Designing and managing reconfigurable business processes

The business process literature largely agrees that improvement is attained by identifying the activities making up the process and redesigning them for efficiency and effectiveness (Armistead *et al.*, 1999; Zairi, 1997; Harrington, 1998; Lee and Dale, 1998; O'Neill and Sohal, 1999; Melao and Pidd 2000; Bititci *et al*. 2011a). The academic and practitioner literature contains a wide range of methodologies, techniques and tools such as lean thinking, six sigma, Structured Systems Analysis and Design Method (SSADM), and value stream mapping that enable analysis of the current process and definition of future, improved processes (Coronado and Antony, 2002; Gane and Sarson, 1979; Motwani et al., 2004; Womack and Jones, 1996; Yourdon, 1989). Although, the practice for improving business processes is well understood and established (O’Neill and Sohal 1999; Melao and Pidd, 2000; Bititci *et al.*, 2011a); the same cannot be said for developing reconfigurable business processes.

This leads to the fourth proposition:

P4- ***existing business process management change methods, would not be appropriate, or even sufficient to enable the design of reconfigurable business processes.***

With BPR and BPI, change usually takes place in response to the identification of the need for change. However, in the case of designing processes for reconfigurability, a reactive response is not sufficient. To enable reconfigurability, one needs to anticipate the likely change and build the future response into the process. Thus, conceptually, BPRC requires a proactive approach whereas BPI and PBR are usually reactive. Due to this complexity, this research anticipates that the design of reconfigurable business processes would require additional amounts of effort and ingenuity when compared to traditional forms of process design. Thus, this research postulates that the initial process design for reconfigurability would be significantly more disruptive and time-consuming than in a standard process redesign but will be far less so when the subsequent need for change arises.

This leads to the fifth proposition:

P5- ***the amount of effort and ingenuity required to design reconfigurable business processes would be significantly more than traditional forms of process design.***

In relation to process design, it is also important to note that earlier discussion suggested that much of the BPR and BPI effort is focused on scientific and transactional processes rather than artistic and cognitive processes. This is because scientific and transactional processes are easier to conceptualise, describe and model (Hall and Johnson 2009; Trkman 2010; Benner and Tushman 2003).

In relation to managing reconfigurable business processes, it is commonly understood that once a business process is designed or re-engineered, there is an expectation that it would be continuously improved. This then raises a challenge around the compatibility of designing a process for reconfigurability and continuous improvement. The challenge is that once a process has been designed for reconfiguration, any further changes to the process, because of continuous improvement initiatives, may result in distorting the reconfigurability of the process.

2.5. Conceptualising the research

The aim of this research was to investigate whether predictability and a modular approach to business process construct can complement existing business process change initiatives like BPR and BPI in a dynamic operating environment.
From the review of literature on business processes, dynamic capability and agility, a research agenda in the form of propositions was developed to investigate the validity of BPRC in a dynamic operating environment. In developing the propositions from the review of literature, several concepts that are critical to the examination of the propositions have emerged. To adequately investigate the propositions derived from literature, a definition and justification on each of the key concepts ensues:

2.5.1. Dynamic Operating Environment

According to a recent report from Doheny, Nagali and Weig, (2012), there is increasing uncertainty that has led to complications for businesses trying to compete, organisations that can are better able to manage these pressures will identify opportunities and limit risks. In a bid to understand and determine the requisite actions of a leader of an organisation in a VUCA environment, Bennett and Lemoine, (2014) explain volatility as inconsistent and erratic change, where there is a degree of understanding. Uncertainty, as not knowing the impact of the change, but understanding causality; Complexity, as highly intricate information and processes that may or may not involve change and finally; Ambiguity, as a lack of understanding of causality. Furthermore, the operating conditions have also been characterised as stable, changing and turbulent (Boyne and Meier, 2009; Gustafson and Reger, 1995). Here, stable refers to the operating conditions where there is almost always no change and the ability to anticipate future changes to the operations of the organisation rarely occurs and when they do, they are predictable.

Changing operating environment refers to an operating environment where changes are made to existing processes and are incremental rather than radical and finally, turbulent operating environment refers to an environment where changes are constant, radical and completely unpredictable. In the context of this research, a dynamic operating environment is somewhere between a changing environment and a turbulent one, see Figure 2.6 for details. For the purpose of this research, "dynamic operating environment" *is:*

described any operating environment that includes any or all of the four elements of VUCA to the degree that it creates disruption to the effectiveness or efficiency of an operation.

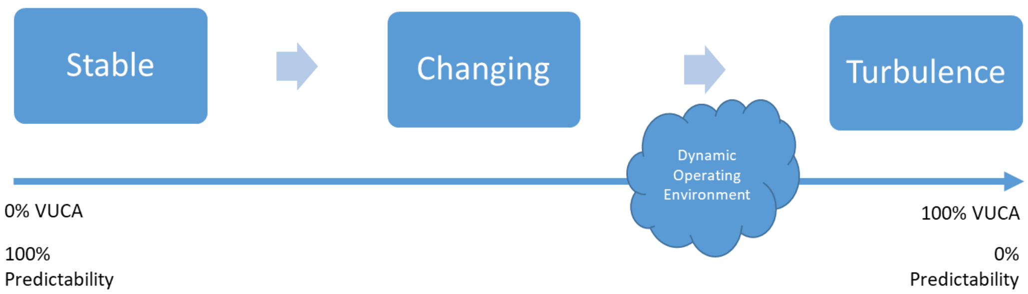


Figure 2.6 Dynamic Operating Environment

2.5.2. Justification for the use of Dynamic Capability and Agility

The notion of business process change is examined from the lenses of dynamic capability and agility; however, it is important to note that this research does not in any way attempt to extend the concepts of Dynamic Capability & Agility, but rather borrowed the principles from these concepts to enhance knowledge of Business processes in dynamic operating environments.

The justification for the use of the concepts of Dynamic Capability & Agility as foundation for the investigation of business process change in dynamic operating environment is twofold; the historical perspective of process change and the principles that pertain to it.

First, the historical perspective of process change; the current business process change management concepts on improvement and radical re-engineering (BPI and BPR) introduced in the early 90s predates the present state of dynamism in today's organisational operating environment as well as the discourse on dynamic capabilities and agility. The requirements for change at the time did not necessitate the need for frequent transformational changes, hence, the current business process change initiatives are not fit for a dynamic operating environment. In essence, whilst the process change management initiatives (i.e. BPI and BPR) were introduced in a different era of change, the more recent dynamism in the organisational operating environment then gave rise to the concepts of dynamic capability and agility. Therefore, any new discourse on processual change requires a re-examination from the lenses of the more expedient notions of dynamic capability and agility.

Second, the dynamic capability and agility theory which has its origins in the resource based view, which states that the competitive advantage of a firm lies in its resources and capabilities; some scholars describe these resources as business processes (Wang and Ahmed 2007; Barney 1991). Exploiting these capabilities for the benefit of the organisation was not sufficient in a changing and unpredictable environment, hence the emergence of dynamic capabilities (Eisenhardt and Martin 2000; Wang and Ahmed 2007; Ambrosini and Bowman 2009). Capabilities with the ability to reconfigure assets in relation to the changing environment (O'Connor, 2008). Having established that the emergence of dynamic capability and agility correlates with the challenges caused by a dynamic operating environment, it is therefore justifiable to examine the notion of processual change from these two lenses.

2.5.3. Micro foundations of Dynamic Capability and Agility

The first objective of this research was to explore the existing BPM literature through the lenses of dynamic capability and agility; and in doing so, identify gap(s) in the business process body of knowledge and future research opportunities. A review of the literature on dynamic capabilities and agility, identified five core micro foundations: *sensing, responding, reconfiguring, speed* and *disruption*.

The first three micro foundations (sensing, responding and reconfiguring) refer to the *actions* an organisation need to take in order to be sustainable in a dynamic operating environment. However, this research argues that the latter two micro foundations (speed and disruption) are the significant *attributes* that underpin the success of the former three micro foundations. Speed, rather than taking an action, speed is a necessary attribute in the deployment of the first three micro foundations, meaning the action of sensing, responding and reconfiguring needs to be done quickly. Additionally, it is necessary to not only sense, respond and reconfigure processes quickly but also to do it efficiently, hence the focus on the other attribute- disruption. By reducing disruption, transformational business process changes can be done quickly and frequently.

2.5.4. BPR, BPI, BPRC and Transformational change

To justify the need for BPRC, a discussion on BPI and BPR is critical, their attributes, and their deficiencies.

BPR has been defined as an analysis and radical redesign of business processes for the purpose of attaining dramatic improvements in cost, quality, service and time (Kim and Jang, 2002; Motwani et al., 1998).

The varied application of BPI whether in the form of TQM or Six Sigma makes it challenging to provide a singular definition for it. However, the purpose of a process improvement initiative is to identify and improve organisational processes, thus ensuring better customer satisfaction by improving quality, efficiency and effectiveness of the process (Damij et al., 2008). According to Harrington *et al.*, (1997), the focus of BPI is on the continuous improvement of activities and tasks within a process and in order to maximise the benefit of BPI, the improvement process needs to be continuous and usually provide an annual return of between 10-15%. Furthermore, BPI has been used as a blanket term for various forms of process improvement initiatives, continuous improvement initiatives like Total Quality Management (Hendricks and Singhal, 1997), Lean (Womack and Jones, 1996) and Six Sigma (Coronado and Antony, 2002) have yielded positive results

These two spheres (BPR and BPI) of business process change management have been categorised as evolutionary or revolutionary; transformational change relates to the latter; which involves strategic and structural alterations (Tushman and Romanelli, 1985). Furthermore, revolutionary change refers to high scale, fast paced change that requires significant process shift that encompass the entire organisation, whilst evolutionary changes are usually implemented slowly and revolve around particular processes (McNulty and Ferlie, 2004).

Specifically, Greenwood and Hinings, (1996) describe process transformation as changes to the dominant hierarchical structures in an organisation as opposed to convergent changes within an existing process. Whilst the literature on process transformation proffers sufficient detail on the difference between transformational and incremental change or revolutionary and evolutionary change, it does not provide ample evidence of the relationship between processes and transformation.

The deficiencies of BPI and BPR are evident in either one or two of these performance attributes speed, scale and disruption. As stated previously, the deficiencies of BPR and

BPI are only evident in dynamic operating environments. Specifically, with regards to BPR, the deficiencies relate to the high level of disruption caused by its implementation. Whilst the radical redesign of processes in relation to new requirement(s) produces a scale of change that is transformational, it also ensures that BPR is highly disruptive and ultimately inhibits an organisation's ability to make these transformational changes frequently. It is generally agreed that the average time take between BPR initiatives is between three and five years (Deakins and Makgill, 1997), which is not suitable in a dynamic operating environment.

The BPR methodology is based on a radical redesign and change of process, this is achieved by understanding existing processes, to identifying the specific need for change, then implementing the change and evaluating the new process performance. Second, whilst the scale is transformational, it is also slow to implement, the average time taken to carry out a BPR initiative is generally agreed to be about a year. These two factors of high disruption (which inhibits frequent implementations) as well as the time taken to implement are significant deficiencies in a dynamic operating environment.

With regards to BPI in a dynamic operating environment, a notable deficiency is the scale of change. BPI initiatives are quick to implement, the disruption during or as a result of the change is comparably low, but the issue of transformative scale persists. As stated in Section 2.3.3**,** process improvement initiatives are generally focused on improving existing processes, so, the changes are contained within the process as opposed to changing the direction of the output of the process. Therefore, the objective of these types of change is to improve customer satisfaction by refining the quality, and efficiency of the existing process.(Damij et al., 2008).

Business Process Reconfigurability is an approach to BPM where an anticipation of potential future changes to the process operation is used to create a predesigned modular structured process, thus enabling organisations make frequent transformational changes whilst reducing disruption. This is achieved through transforming processes sensing, responding and reconfiguring with speed, as well as the ability for transformed processes to be reconfigured with speed. Predictability and modularity act as underpinnings of reconfigurable business processes that help minimise disruption.

From literature, an observation can be made that although BPM[1] offers viable alternatives for responding to opportunities and threats, there is a trade-off to be made between speed of change, the scale of change and the level of disruption. BPR offers high scale transformational changes but is very disruptive and slow to implement; BPI initiatives, conversely, are not disruptive, but quick to embed; however, they do not proffer high scale transformational change, see Figure 2.5. Here, the illustration positions the notion of Business Process Reconfiguration (BPRC) in relation to the BPR and BPI based on the three components that significantly impact change initiatives: the scale of change, the speed of change and the level of disruption.

Furthermore, in Table 2.7 a table that emphasises the differences between the three concepts of BPR, BPI and BPRC is illustrated.

Table 2.7 Differences between BPR, BPI and BPRC

	BPR	BPI	BPRC
Responsiveness	More reactive than proactive	More reactive than proactive	More Proactive than Reactive
Design	Total redesign, large change and widespread Disruption across the process	Localised redesign, Incremental change in specific parts of the process- Low Disruption	Preconfigured design, transformational change Low Disruption
Speed	Quick to transform	Slow to transform	Quick to transform
Rate of change	Cannot be done frequently	Can be done frequently	Can be done frequently
Type	Radical Re-engineering	Incremental Improvement	Reconfigurable through Predictability and Modularity

2.6. Summary

The initial motivation for this research was to explore the business process management literature through the agility and dynamic capability lens to identify gaps in knowledge and future research opportunities. This led to the question of whether a study on the business processes in a dynamic operating environment would yield new opportunities for research. If so, what are they?

By reviewing the literature on dynamic capabilities and agility, this question was answered. The review identified five core themes: *sensing, responding, reconfiguring, speed* and *disruption*. Table 2.8 contains a description of these themes in relation to the business process; together these five themes informed the analysis of the business process literature. The review also revealed that whilst current business process change methods (BPR and BPI) are relevant as agents of radical and incremental change respectively, the disruption attributed to BPR and the inability of BPI to ensure large-scale transformation would inhibit the possibility of rapid transformational changes occurring frequently. In this context, this review makes three distinct contributions to the field of business process management.

First, in a dynamic operating environment, there is an underlying issue regarding the time it takes to respond to change from a business process perspective. Change process initiatives like process improvement (BPI) and process re-engineering (BPR) appear insufficient to be able to adequately resolve this challenge. Consequently, by exploring the business process management literature from a dynamic capability and agility lens, the review identified a significant gap in knowledge that gives rise to the feasibility of reconfigurable business processes as a means to facilitate rapid responses. In other words, although the concepts, methods and tools of BPI and BPR are well understood, the same is not true for business process configuration.

Second, this review presents a research agenda (in the form of propositions) for developing a more profound knowledge of the possibility of reconfigurable business processes as a means to more rapid transformational change. The research propositions that emerged from the discussion are summarised in

Table 2.9 below.

Third, by introducing the notion of business process reconfiguration it creates a platform for more scholastic discussion on the topic of business processes with far reaching implication on academic research and industry practice.

Table 2.8 Themes from Phase 1 & 2 of the Literature Review

	Phase 1-Dynamic Capability & Agility	
Theme	**Definition**	**Thesis Location**
Dynamic operating environment	For the purpose of this research, "dynamic operating environment" is any operating environment that includes any or all of the four elements of VUCA to the degree that it creates disruption to the effectiveness or efficiency of an operation. (Doheny, Nagali and Weig, 2012; Bennett and Lemoine, 2014)	Page 47, Section 2.5.1
Sensing	The ability to anticipate future occurrences (with a degree of accuracy) that could have an impact on an organisation's operations. (Teece 2007; Helfat and Peteraf 2015; O'Reilly *et al*. 2009; O'Reilly and Tushman 2011; Watkins and Bazerman 2003)	Pages 28, Section 2.2.3
Responding	The ability to act counteractively in relation to anticipated or existing factors that could have an influence on an organisation's operation. (D'Aveni et al. 2010; Tallon and Pinsonneault 2011; Teece et al. 1997; Wang and Ahmed 2007)	Pages 28, Section 2.2.3
Reconfiguring	The ability to reorganise organisational assets, structures and processes in relation to anticipated or existing factors that could have an influence on an organisation's operations. (Teece 2007; Helfat and Peteraf 2015; O'Reilly and Tushman 2008)	Pages 28, Section 2.2.3
Speed	The ability to rapidly sense and respond to anticipated or existing factors that could have an influence on an organisation's operations. (Lieberman and Montgomery 1988; Kerin et al. 1992)	Pages 28, Section 2.2.3
Speed (in a Business Process)	Speed is defined as a metric that measures the distance between the disruptive changes to a business process over the time taken to respond and adapt to the disruption. Here, distance is measured as the difference between the current process (as is) and the future desired state of the process (to be).	Pages 42, Section 2.4.2
Disruption	The degree of disturbance, interruptions and disorder caused to normal business operations as a result of change negatively impacting on cost, staff engagement, quality, and customer experience.(Dove 1996; Cho *et al*. 1996; Ashrafi *et al*. 2005; Tallon and Pinsonneault 2011)	Page 24-25, Table 2.2.2
	Phase 2- Business Process Management	
BPR	BPR has been defined as an analysis and radical redesign of business processes for the purpose of attaining dramatic improvements in cost, quality, service and time (Kim and Jang, 2002; Motwani et al., 1998).	Page 49, Section 2.5.4
BPI	a process improvement initiative to identify and improve organisational processes, thus ensuring better customer satisfaction by improving quality, efficiency and effectiveness of the process (Damij et al., 2008; Harrington *et al.*, 1997).	Page 50, Section 2.5.4
BPRC	Business Process Reconfigurability is an approach to BPM where an anticipation of potential future changes to the process operation is used to create a predesigned modular structured process, thus enabling organisations make frequent transformational changes whilst reducing disruption.	Page 52, Section 2.5.4
Predictability	Predictability is the ability to anticipate future occurrences with a degree of confidence.(Milliken, 1987; Ahsan and Musteen, 2011; De Meyer *et al*. 2002)	Page 39, Section 2.4.1
Modular Product Design	The ability to build complex products or designing processes from smaller subsystems that can be designed independently yet functions together as a whole.(Baldwin and Clark 1997; Campagnolo and Camuffo 2009; Bask *et al*. 2010; Bask *et al*. 2011)	Page 36, Section 2.3.4
Modular Business Process	modularity is reflected by the degree of interchangeability between modules, and the connectivity with other modules across the entire process.	Page 163, section 6.2

Furthermore, five testable research propositions were suggested around the theme of reconfigurability.

Reconfigurability was identified as another key theme that could enable the creation of responsive business processes that facilitate rapid transformational change and reduced disruption. The wide use of the concept of reconfigurability in parallel fields such as product and manufacturing systems design as well as software engineering, where the underlying principles of reconfigurability appear better understood, established and practised. Thus, in the context of business process management, this research would infer that business process reconfiguration is a valid concept requiring further investigation.

By analysing the concept of reconfigurability, *predictability* and *modularity* along with *standard interfaces* were also identified as prerequisites to reconfigurability. In Table 2.9, five testable research propositions are introduced to further investigate the feasibility of the reconfigurable business process. Particularly, empirical research into business process configuration is required to facilitate an applicable understanding of reconfiguration in the context of business process change. This will further enhance existing knowledge of business processes and consequently facilitate rapid and frequent responses to change in a dynamic operating environment.

Table 2.9 A research agenda for business process reconfigurability

Propositions	**Description**
1st Proposition	*Existing knowledge of reconfigurability in product manufacturing systems and software engineering can be transferred and/or replicated for business processes.*
2nd Proposition	*A high degree of predictability will enable a more modular approach to process design.*
3rd Proposition	*A more modular approach to business process design, based on predictable outcomes would enable transformational changes to occur rapidly and with reduced disruption.*
4th Proposition	*Existing business process management change methods would not be appropriate, or even sufficient to enable the design of reconfigurable business processes.*
5th Proposition	*The amount of effort and ingenuity required to design reconfigurable business processes would be significantly more than other traditional forms of process design*

Chapter 3. Research methodological overview and selection

The review of the literature identified eight themes (see Table 2.8) that underpin an organisation's ability to enable transformational change quickly, and frequently, from a business process perspective in a dynamic operating environment. Through these eight themes, five testable propositions in the form of a research agenda (see Table 2.9) were developed that assert to the viability of the notion of BPRC. The purpose of this chapter is to determine a robust means (methodology) of testing these propositions in order to validate and evaluate the concept of BPRC.

Specifically, this chapter investigates the research methodology literature to highlight the methodological choices available to management researchers ranging from philosophical assumptions to techniques. By undertaking a study of a researchers' methodological journey, this chapter demonstrates what philosophical stances are available in relation to the requirements of this research, and subsequently which stances are most appropriate in the context of the objectives of this chapter. Section 0 to Section 3.6 provides an overview and discussion of all the relevant methodological choices, without any implications to this research. Subsequently, Section 3.7 discusses the methodological choices made by the researcher as they pertain to this research, whilst Section 3.8 provides a summary of this chapter. The credibility of this research is hinged on the justification of methodological choices (Crotty, 1998).

In Figure 3.1, the framework from Saunders, (2016) research onion is largely (but not entirely) adopted; for example, Section 0 and Section 3.2 on the philosophical and ontological debate is included but not in the research onion. The methodological journey has been subdivided into five phases namely: philosophy, methodical choice, methodical approach, strategy, and technique. The justification for this research adopting Saunders' research onion over others is mainly because of its emphasis on "business" research methods and the applicable framework. Other business research method materials (Barratt et al., 2011; Benz and Newman, 2008; Bhattacherjee, 2012; Bryman and Bell, 2015; Charmaz, 2008; Easterby-Smith et al., 2012; Johnson and Clark, 2006; Yin, 2015) were referenced. Whilst the business research methods sources referenced above provided useful information and criteria for understanding research methods, it was often specific to a topic rather than encompassing. For example, Yin (2015) is focused specifically on case studies in qualitative research, whilst Bhattacherjee, (2012) is focused on social science research methods but does not provide an encompassing framework. The seventh edition of the Saunders et al., (2016) manuscript also includes more sections and sub-sections within the onion than other research frameworks. Therefore, for the purposes of this research, the research onion provides an appropriate methodological guide on the methodological choices available to business research, as illustrated in Figure 3.1.

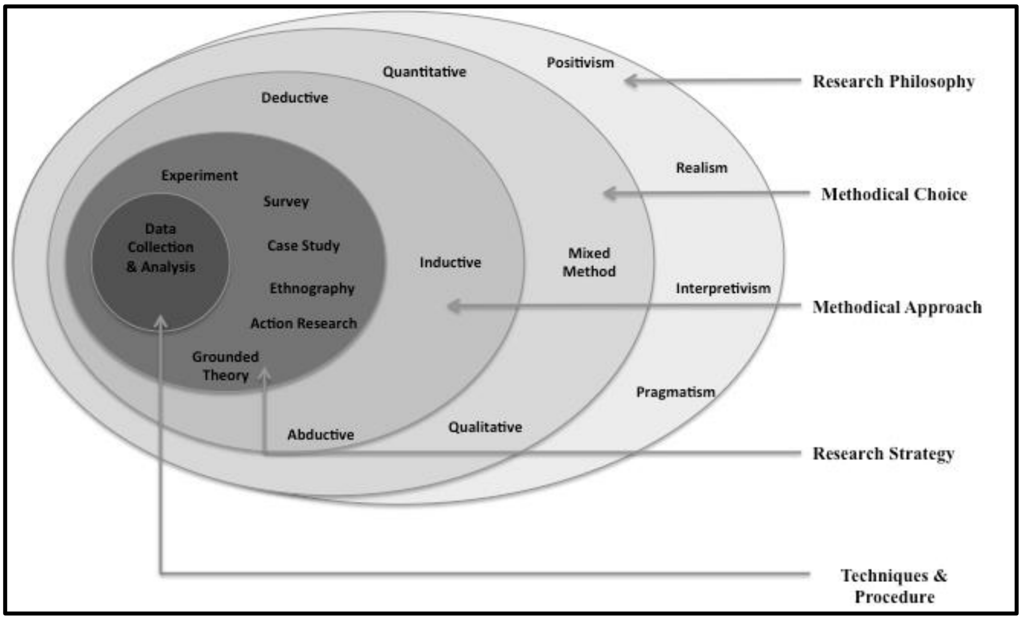


Figure 3.1 Research Onion (Saunders *et al.*, 2016)

3.1. The philosophical debate

All research is influenced by assumptions, and in every phase of research, assumptions are made. These assumptions can relate for example to human knowledge or the nature of realities faced in the course of investigating research (Saunders *et al*. 2012). Ultimately, this guides how research questions are comprehended; the methods employed and how results are interpreted (Crotty, 1998; Saunders *et al*. 2012). The philosophical approach a researcher adopts will underpin the research strategy and methods employed. Management researchers need to be aware of the philosophical choices made as part of the research strategy, as this will have a significant impact on what is undertaken, and how research is understood (Johnson and Clark, 2006; Saunders et al., 2016). According to Johnson and Clark, (2006), the issue is not about how much emphasis is placed on the research philosophy, but rather on how well the research is able to reflect on these philosophical choices and defend them in relation to alternatives not chosen (Saunders *et al*. 2012).

Easterby-Smith et al., (2012) give three significant reasons for understanding philosophical assumptions in research:

- It gives clarity to research design by aiding researchers in recognising which research strategy will work and which would not,
- It proffers a researcher with the ability to identify or even create a research design that may be outside the researcher's scope of knowledge, and,
- The central philosophical considerations in research are ontological and epistemological.

Ontology is concerned with the nature of reality and existence; and epistemology is concerned with the best ways of enquiring into the nature of the world (Saunders *et al*. 2012; Easterby-Smith *et al*. 2013).

3.2. Ontological stance

The study of ontology is concerned with the nature of reality or social entities (Bryman and Bell, 2011; Saunders *et al*. 2016). Ontology is concerned with assumptions of researchers in relation to the way the world operates and the commitment to particular views. The discussion on ontology in management research is primarily focused on two aspects; objectivism and subjectivism (Saunders *et al*. 2012). Objectivism is defined as an "ontological position that asserts that social phenomena and their meanings have an existence that is independent of social actors" (Bryman and Bell, 2011, p.21). What this means is that interaction with social phenomena in everyday discourse gave an existence that is not inclusive of the actors. Objectivism depicts that things, such as social entities, exist as a meaningful reality external to social actors associated with their existence (Crotty, 1998; Saunders *et al*. 2012). Subjectivism depicts that social phenomena are created through the perceptions and consequent actions of social factors in relation to the phenomena (Saunders et al., 2016).

Subjectivism infers that social phenomena are created from the perceptions and corresponding actions of the social actors. This indicates that it is essential to study the details of a circumstance in order to comprehend the reality of what is happening (Saunders *et al*. 2012). In Figure 3.2 adopted from Beech, (2005), the key differences between the objective and subjective ontological stances are highlighted. As illustrated in Figure 3.2, Beech, (2005) uses six factors to differentiate objectivism and subjectivism; facts or meaning; causality or understanding; singularity or entirety, deductive hypothesising or inductive interpretation; specificity in the measurement of large samples or multiple forms of measurement over time. All these factors help determine and reflect the ontological stance of research.

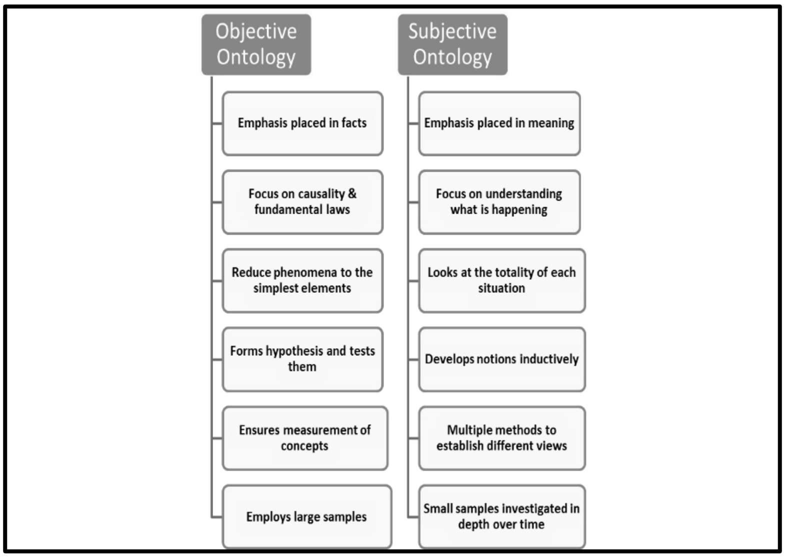


Figure 3.2 Objective vs. Subjective Ontology

3.3. Epistemological Stance

Epistemology is primarily concerned with the most appropriate methods of enquiring into the nature of the world; this includes the physical and social worlds (Easterby-Smith *et al*. 2013). A researcher's view of the nature of the world is formed through personal experiences, in that sense epistemology can be defined as "a general set of assumptions about the best ways of inquiring into the nature of the world" (Easterby- Smith *et al*. 2004, p31). According to Saunders *et al*., (2016) these differing perspectives in business management research can be categorised into five epistemological stances: positivism; critical realism; interpretivism; pragmatism and postmodernism.

3.3.1. Positivist stance

The primary concept concerning the positivist stance is that the social world exists externally, and its properties should be measured objectively, rather than subjective inferences ranging from sensationalising to reflection or intuition (Easterby-Smith *et al*. 2013). The stance that positivism offers the best mode of investigating human and social behaviour came as a reaction to the metaphysical (Aiken, 1956).

Table 3.1 provides an itemised list of the philosophical assumptions that guide the positivist stance.

3.3.2. Critical Realist stance

Realism is a philosophical stance that relates to scientific query. The main ethos of this stance is the perception that "what we sense is reality: that objects have an existence independent of the human mind" (Saunders *et al*. 2012, p.136). Crotty, (1998) opines that realism is opposed to idealism (a theory where only the contents of the mind are taken into consideration).

There are two forms of realism, namely critical realism and direct realism. Whilst the notion of direct realism is that our senses directly and accurately depict the reality of a circumstance, the notion of a critical realist is that our senses depict an image of reality that we assume to be accurate (Saunders *et al*. 2012). The distinctive difference between direct and critical realism is that the latter asserts that we experience the world in two stages; firstly, there is the object of observation and the sensation it conveys; then secondly there is the mental interaction between the sensations from the object of observation and our senses. Direct realism opines that the first stage is sufficient (Saunders *et al*. 2016).

3.3.3. Interpretivist stance

Interpretivism is often referred to as a contrasting epistemological stance to positivism (Bryman and Bell, 2011). It advocates the necessity of the researcher to understand the differences between humans in our role as social actors, which places emphasis on understanding the difference between research conducted with humans as the object of observation and the research done where the central consideration is not on humans (Saunders *et al*. 2012). The interpretivist stance usually takes an "open-minded" view and begins from data and not a theory or hypotheses to be tested. For example, the interpretivist approach in organisational research will involve in-depth observations, conversations and secondary data analysis with a view to overcoming any assumptions (Easterby-Smith *et al*., 2004).

3.3.4. Pragmatist stance

The pragmatist affirms that concepts are only significant or relevant where they support action (Kelemen and Rumens, 2008). What this implies is that the most important determinant of a position is the research question (Saunders *et al*. 2012). The pragmatist stance advocates that the importance of an idea (research finding) is in its practical implication. It also states that there is no single way, but instead multiple ways of interpreting the world and undertaking research (Saunders *et al*. 2012). However, this does not imply that the pragmatist necessarily uses multiple methods but rather they use the method or methods that facilitate credible, well-founded, reliable and relevant data to be collected that advance the research (Kelemen and Rumens, 2008).

3.3.5. Postmodernist stance

The postmodernist is concerned with the role of language and relationships, is largely sceptical about accepted norms; postmodernism emerged in the late twentieth century as an advancement on intellectual poststructuralism (Saunders *et al*., 2016). The primary foci of postmodernism are language and the dynamics of the relationship. Whilst it states that language can be restricted and inadequate, it argues that order can only be achieved through language (Chia 2003). With regards to the dynamics of the relationship, the postmodernist argues that power (within the context of relationships), rather than any substantiated "fact "or ideology is what is collectively decided as truth (Saunders *et al*., 2016). From a research perspective, postmodernism aims to expose and question the power relations that sustain realities. Postmodernism is significantly opposed to positivism and objectivism but instead emphasises the notion of flux, movement and change (Saunders *et al*., 2016).

Table 3.1 Comparison of research philosophies (Saunders *et al*. 2016)

Ontology (nature of reality)	Epistemology (what is knowledge)	Typical corresponding methods
Positivism		
Real, external, independent one true reality (universalism) **Granular (things) ordered**	Scientific method Observable and measurable facts Law-like generalisations Numbers Causal explanation and prediction as a contribution	Typically, deductive, highly structured, large samples, measurement, typically quantitative methods of analysis, but a range of data can be analysed
Critical realism		
Stratified/layered (the empirical, the actual and the real) **External, independent** **Intransient** **Objective structures** **Causal mechanisms**	Epistemological relativism Knowledge historically situated and transient Facts are social constructions Historical causal explanation as a contribution	Reproductive, in-depth historically situated analysis of pre-existing structures and emerging agency. The range of methods and data types to fit the subject matter
Interpretivism		
Complex, rich Socially constructed through culture and language **Multiple meanings, interpretations, realities** **The flux of processes, experiences, practices**	Theories and concepts too simplistic Focus on narratives, stories, perceptions and interpretations New understandings and worldviews as a contribution	Typically, inductive. Small samples, in-depth investigations, qualitative methods of analysis, but a range of data can be interpreted
Pragmatism		
Complex, rich, external **"Reality" is the practical consequences of ideas** **The flux of processes, experiences and practices**	The practical meaning of knowledge in specific contexts "True" theories and knowledge are those that enable successful action Focus on problems, practices and relevance Problem-solving and informed future practice as a contribution	Following the research problem and research question The range of methods: mixed, multiple, qualitative, quantitative, action research Emphasis on practical solutions and outcomes
Postmodernism		
Nominal Complex, rich socially constructed through power relations **Some meanings, interpretations, realities are dominated and silenced by others** **The flux of processes, experiences, practices**	What counts as "truth" and "knowledge" is decided by dominant ideologies Focus on absences, silences and oppressed/ repressed meanings, interpretations and voices Exposure of power relations and challenge of dominant views as a contribution	Typically, deconstructive; reading texts and realities against themselves In-depth investigations of anomalies, silences and absences Range of data types, typically qualitative methods of analysis

3.4. Methodical choices

The methodology is a “combination of techniques used to inquire into a specific situation” (Easterby-Smith *et al*., 2004, p. 31). The research method or design employed by a researcher is the general plan of how it is intended to answer the research question (Saunders *et al*. 2012). It should include clear objectives derived from research inquisition; it should also include data sources, the method and analysis for sourcing the data. Additionally, constraints and ethical issues should be considered (Saunders *et al*. 2012). The first methodological consideration is to choose between qualitative and quantitative or alternatively a mixed method approach. Each direction requires a different set of elements to achieve coherence in the research.

3.4.1. Qualitative research

This form of research can be described as a research strategy that places emphasis on words over numerical quantification in the collection of data and analysis (Bryman and Bell, 2011). According to Denzin and Lincoln, (2011), qualitative research can typically be associated with an interpretative philosophy. This is due to the subjective and socially construed meanings from which research has to be understood (Saunders *et al*. 2016). Qualitative research is usually initiated with an inductive approach; this implies that the research is instigated from a naturalistic and emergent research framework which goes on to develop a richer theoretical perspective that correlates with existing literature, see Table 3.2 (Saunders *et al*. 2012). Alternatively, Yin, (2015) reveals that there are other qualitative research methods that start with a deductive approach; for example, to test an existing theoretical view using qualitative methods.

Qualitative research involves studying participants and meanings as well as the relationship between them; this is achieved by using a variety of data collection techniques and analytical methods to develop a conceptual framework and theoretical contribution (Saunders *et al*., 2016). No standardised format of data collection is particularly encouraged, except that data collection should not be statistical. The reason for this is to ensure that the research questions and framework is naturalistic and interactive (Saunders *et al*. 2012).

3.4.2. Quantitative research

This form of research can be described as a research strategy that places emphasis on numbers over other forms of qualification in the collection of data and analysis (Bryman and Bell, 2011). Quantitative research is usually linked with a positivist philosophical approach as a result of its tendency to employ predetermined and highly structured data collection techniques (Saunders *et al*. 2012). Nevertheless, it is important to note that there is a difference between data on the attributes of people, organisations and data based on opinions (often referred to as qualitative numbers) (Saunders *et al*. 2012). The significance of noting this is that, for instance, some survey research whilst conducted quantitatively may be seen to fit partly with an interpretivist philosophy (Saunders *et al*. 2012).

Quantitative research is usually linked to the deductive approach, where the aim is to use data to test theoretical perspectives. Nevertheless, in some instances, it can also be employed to incorporate an inductive approach where data is used to develop theory (Saunders *et al*. 2012).

Quantitative research involves studying the relationship between variables that are numerically measured and analysed using statistical techniques. It usually incorporates controls to guarantee the validity of data, data collection is often performed in a standardised way (probability sampling techniques) - hence the significance of ensuring questions are expressed clearly so they are interpreted uniformly (Saunders *et al*. 2012).

Table 3.2 Comparison of Methodical choices (Saunders *et al*., 2016)

	Qualitative	**Quantitative**
Research philosophy	Qualitative research is often associated with an interpretivism Qualitative research may also be used within realist and pragmatist philosophies	Quantitative research is generally associated with positivism. Quantitative research may also be used within realist and pragmatist philosophies
Approach to theory	Qualitative research is usually associated with an inductive approach to theory development, where a naturalistic and emergent research design is used to build theory or to develop a richer theoretical perspective than already exists in the literature. Some qualitative research strategies start with a deductive approach, to test an existing theory using qualitative procedures	Quantitative research is usually associated with a deductive approach, where the focus is on using data to test the theory. However, it may also incorporate an inductive approach, where data are used to develop theory.
Characteristics	Qualitative research studies participants' meanings and the relationships between them, Often associated with a variety of data collection techniques and analytical procedures, to develop a conceptual framework and theoretical contribution.	Examines relationships between variables Often associated with single data collection technique Data is measured and analysed numerically using statistical and graphical techniques.
Research Strategies	Qualitative research is associated with a variety of strategies. Some of the strategies used are action research, case study research, ethnography, and Grounded Theory.	Quantitative research is principally associated with experimental and survey research strategies

3.5. Research approach

The emphasis on the methodological approach employed in the use of theory may be made explicit in the design of research; nevertheless, it is pertinent to ensure that this is explicitly represented whilst presenting the findings and conclusions from research (Saunders *et al*. 2012). There are largely two fundamental methodological approaches used in research design involving theory, namely deduction and induction. More recently (as illustrated in Table 3.3), the third approach to research design has been introduced; the Abductive approach (Saunders *et al*. 2016). In Sections 3.5.1 to 3.5.3, this research will review these three methodological approaches to the use of theory.

3.5.1. Deductive approach

The Deductive approach transpires when a conclusion is derived logically from a set of premises, the conclusion being true when all premises are true (Ketokivi and Mantere 2010). The deductive approach is usually related to scientific research and has its origins in the natural sciences; it relates to the development of theory from testing hypotheses or propositions (Saunders *et al*. 2012). The process of a deductive approach has been broken down into six sequential steps by Blaikie (2009):

1. An idea, premise, hypothesis, or a set of testable propositions (on the relationship between concepts) is presented.
2. By using existing literature, or by specifying the conditions under which the theory is expected to hold, deduce testable proposition(s).
3. Examine the premise and the logic of the argument, compare them with existing theories to see if it offers an advance in understanding if so continue.
4. Test premise by data collection that is measured and analysed.

5. The results of the analysis are either consistent with the initial premise or inconsistent with the premise; if inconsistent then the test failed and so the theory is rejected or modified, and the deductive process is reinitiated.
6. If the results of the analysis are consistent with the premise the theory is corroborated.

This deductive process of developing theory is illustrated in Figure 3.3; the deductive process is initiated from theory, which then leads to the development of proportions/hypotheses. Based on these proportions, data is collected by testing and analysis, the data collected will either affirm prior assumptions or reject them. If affirmed, the theory is formed if the rejected theory is revised, see Figure 3.3 for details.

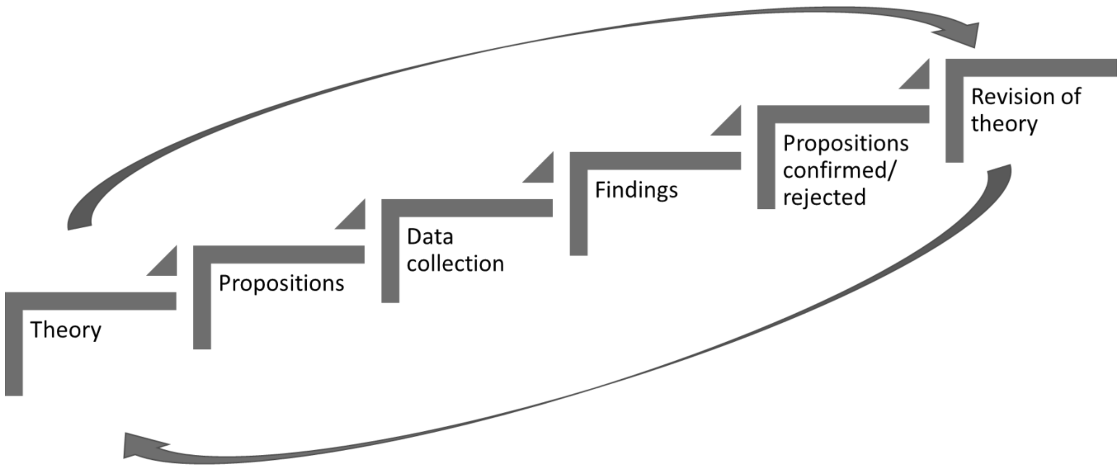


Figure 3.3 Process of deduction

3.5.2. Inductive approach

The inductive stance is more closely related to the qualitative research strategy where emphases are on observation and interview, where the focus is more on informal social relationships. The primary finding from an inductive approach is theory; this implies that the inductive process entails drawing generalizable inferences from observation (Bryman and Bell, 2011). To state it explicitly; whilst deduction entails a process of moving from theory to observation or finding, the induction process is the reverse in that it moves from observation or finding to theory (Bryman and Bell, 2011). Figure 3.4 illustrates the inductive process where it is initiated at the point of research inquisition, which then follows on to observation and a hypothesis/proposition is formed. This proposition is tested and analysed in order to draw a conclusion and form theory, see Figure 3.4 for details.

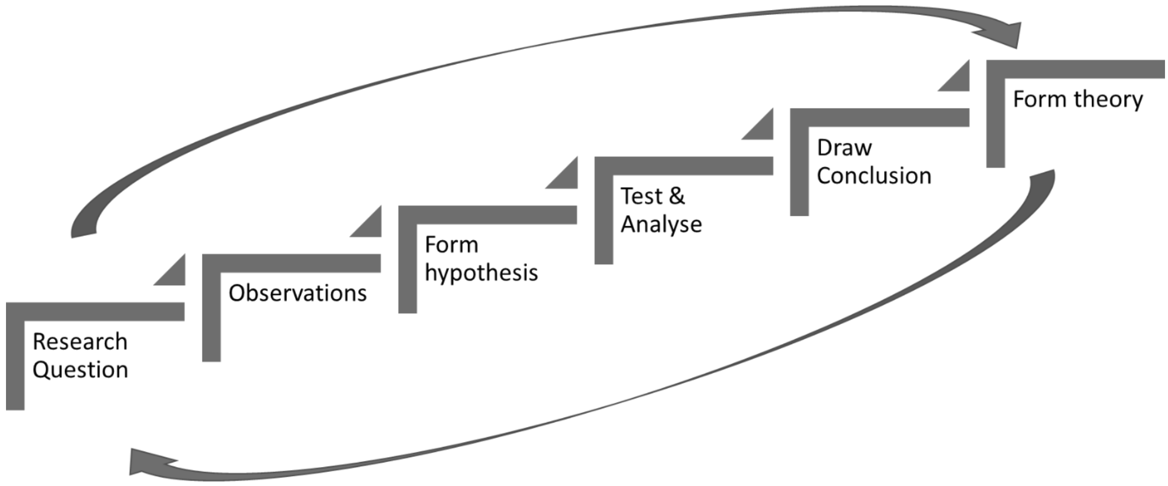


Figure 3.4 Process of induction

3.5.3. Abductive approach

The notion of abduction differs from deduction (moving from theory to finding) or induction (moving from observation to theory); but a combination of deduction and induction by moving back and forth between finding and theory (Suddaby, 2006). "Abduction begins with the observation of a 'surprising fact'; it then works out a plausible theory of how this could have occurred" (Saunders *et al*. 2012, p.147). On occasion these plausible theories can account for what is observed better than others, hence they help discover more surprising facts (Van Maanen *et al*. 2007). In Table 3.3 an illustration (derived from Saunders *et al*. 2012) of the differences between deduction, induction, and abduction from the perspective of logic, generalisability, data collection and theory is highlighted.

Table 3.3 Methodological Approaches to Research (adapted from Saunders *et al.*2012)

	Deduction	**Induction**	**Abduction**
Logic	Deductive inference- When the premises are true; the conclusion must be true	Inductive inference- Known premises are used to generate untested conclusions	Abductive inference- known premises are used to generate testable conclusions
Generalisability	Generalising from the general to the specific	Generalising from the specific to the general	Generalising from the interactions between the specific and the general
Data collection	Is used to evaluate propositions/hypotheses in relation to existing theory	Is used to explore a phenomenon, identify themes and patterns and create a conceptual framework	Is used to explore a phenomenon, identify themes and patterns, locate these in a conceptual framework and test through subsequent data collection
Theory	Theory falsification or verification	Theory generation and building	Theory generation or modification; incorporating existing theory where appropriate, to build/modify new/existing theory

3.6. Research strategies and techniques

The research technique or strategy (this research uses both terms interchangeably with the same inference) of choice is reviewed in this section. Denzin and Lincoln (2005) described the research strategy as the blueprint of a researcher's journey to answering a research question; they go on to state that it is the methodological link between research philosophy and subsequent choice of methods to collect and analyse data. It is significant to note that no strategy is generally superior to the other, but only more appropriate in relation to the aim of the research. The fundamental principles guiding the choice of the technique employed in research is to achieve a significant degree of coherence that enables the researcher to answer the research question and fulfil the obligations of the research (Saunders *et al*. 2012). Coherence in this instance relates to how the research question and objectives link to philosophy, approach and purpose of the research. Other significant factors that guide the choice of research strategy include the extent of existing knowledge, amount of time and resources afforded for the research, access to data and participants (Saunders *et al*. 2012).

In subsequent subsections an explanation of available research techniques is discussed; however, it is important to note that these techniques are not necessarily exclusive but could be used in combination. An obvious example is the use of a survey alongside a case study. Particular emphasis has been placed on the experimental strategy in relation to the nature of research questions derived from the literature in the preceding chapter.

3.6.1. Survey

This technique is used to collect data from either a single source or multiple sources; surveys could be in the form of questionnaires, interviews and focus groups (Fink, 2005; Scholarios, 2005). The survey strategy is usually linked to the positivist paradigm and the deductive research approach, the aim is to achieve systematic observation, interviewing and questioning through predetermined research question with the purpose of attaining standardisation and consistency (Moser and Kalton, 1971; Saunders *et al*. 2012). It is a popular technique in business and management research that is usually employed to answer ‘what?’, ‘where?’, ‘who?’, ‘how much?’, and ‘how many?’ questions (Yin, 2015; Saunders *et al*. 2012). Surveys are either descriptive or analytical; the former provides knowledge of existing or historical context, whilst the latter articulates relationships between variables in using an explorative approach. According to Fink (2005), the survey strategy is comprised of the following:

- Delineate purpose and scope in relation to research questions and hypotheses
- Operationalise key constructs
- Design sample strategy
- Survey administration and data collection
- Data analysis
- Interpretation and presentation of research findings

3.6.2. Case study

The case study strategy investigates the focus of research within its context, or a number of factual circumstances like an organisation’s activity (Saunders *et al*. 2012). Yin (2009) concurs with the significance of context in a case study, also stated that the boundaries between the phenomenon being studied and the context within which it is studied is not always evident. This technique significantly differs from the survey technique in the sense that whilst research is undertaken in context, the capability to explore and understand relationships within the context is limited by a large number of variables (Saunders *et al*. 2012). According to Eisenhardt and Graebner, (2007) the case study approach is significantly more important when the aim of the research is to have a better understanding of the processes and the context within which these processes are being enacted. This approach is usually preferred when undertaking explanatory or exploratory research, the case study approach helps answer the "why?" as well as the "what?" and the "how?" research questions (Saunders *et al*. 2012). The case study approach may also use quantitative, qualitative, or a combination of both methods to analyse data; this could include interviews, observation, documentary analyses and questionnaires (Yin, 2009). Typically, there are four major case study strategies in two dimensions; the first dimension is between single and multiple case studies, and the second dimension is between holistic and embedded case study strategy (Yin, 2009).

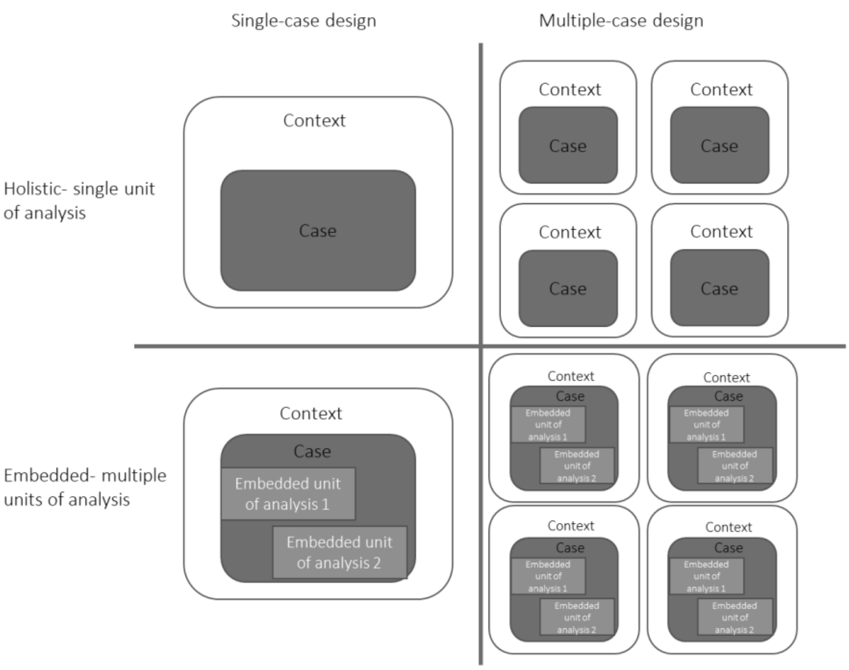


Figure 3.5 Case study strategies (adapted from Yin, 2009)

A single case is preferred in situations where the case in question represents a critical or very unique perspective in relation to the research question; a typical example would be a part-time researcher fulltime company employee and the research in question pertains to the organisation. Multiple case studies are used when the focus is on checking for replication; literal replication is the term used to describe replication across multiple cases. In other instances where multiple cases are selected for specific variances, and the impact of this variance is consistent with the predictions of the researcher this is referred to as literal replication (Yin, 2009; Saunders *et al*. 2012).

The second case study categorisation by Yin, (2009) is between the holistic and embedded case; this relates to the unit of analysis used in relation to the case. A good example of the holistic approach is when the research pertains to events in an organisation as a whole; whilst the embedded approach is when the research pertains to events in different departments or subunits within the same organisation (Saunders *et al*. 2012). The case study approach is especially useful when exploring the existing theory (Saunders *et al*. 2012).

3.6.3. Ethnography

The research approach of studying groups is referred to as ethnography; the study of groups (ethnography) dates back to the 16th century and it is referred to as the first form of qualitative research strategy (Saunders *et al*. 2012). It originated from colonial anthropology and was created to study what was then referred to as primitive cultures to enhance imperialist rule (Saunders *et al*. 2012).

The early anthropologists adopted a detached method of observation; this they assumed was a scientific approach with the aim of producing monographs that would reveal precise and timeless interpretations of the various cultures (Denzin and Lincoln, 2005; Tedlock 2005; Saunders *et al*. 2012). A shift from this detached method of observation in the ethnography approach was first applied in the 1920s through the research work of the University of Chicago, which used ethnographic methods to study social and urban challenges in groups within America (Saunders *et al*. 2012). A seminal example of this shift from detached observation to involvement was the research study of Whyte (1943) Street Corner Society, which studied street gangs in Boston. Cunliffe, (2010) described this involved approach of ethnography as the researcher living in the midst of those being observed, in order to study, and interact with them, this he stated would produce detailed cultural accounts of shared views, conducts, language, customs that shape their lives. Cunliffe, (2010) describes three forms of ethnography: interpretive ethnography: realist ethnography; and, critical ethnography. Interpretive ethnography puts more emphasis on subjective impressions than on objectivity; this form of ethnography "believes in the likelihood of multiple meanings rather than being able to identify a single, true meaning" (Saunders *et al*. 2012: p182). Realist ethnography puts emphasis on objectivity, facts, and true meaning over subjectivity and multiple meanings (Saunders *et al*. 2012). Critical ethnography places emphasis on the dynamics of the relationships within a group; it explores the influence of power and authority on those subject to these influences (Saunders *et al*. 2012).

3.6.4. Action research

Action research is an emergent and iterative process of investigation with the purpose of developing solutions to existing organisational challenges through a participative and combined approach. It requires the use of various sources of knowledge the result of which creates implications for the participants and organisation beyond the scope of research (Shani and Pasmore, 1985; Reason, 2006; Reason and Bradhury 2008; Coghlan and Brannick, 2014; Saunders *et al*. 2012).

The aim of action research strategy is to encourage organisational scholarship to create applied practical outcomes by detecting issues, planning, taking and evaluating actions (Saunders *et al*. 2012). Coghlan and Brannick, (2014) describe action research as research in action and not research about action; whilst Reason, (2006) is of the opinion that it addresses practical objectives. The iterative and emergent nature of action research creates a processual strategy that begins within a specific research framework and research question; however, through the different stages of iteration focus on the original research context could change (Saunders *et al*. 2012). Participation is a significant aspect of action research; according to Greenwood and Levin, (2007), the components of research, action and participation make up action research. One of the outputs of action research is knowledge; according to Reason, (2006) action research is informed by propositional knowledge, the experiential knowledge of participants, and finally, knowledge garnered from practical application.

3.6.5. Grounded theory

Grounded theory can be referenced in three distinct ways; as a methodological approach, as a method of inquiry, and as an outcome of a research process (Charmaz, 2008; Bryant and Charmaz, 2007; Corbin and Strauss, 2008; Saunders *et al*. 2012). Grounded theory as a methodological approach describes the strategic choice of conducting research chosen by the researcher. Grounded theory as a method of inquiry relates to the data gathering and analytical process used by the researcher; and finally, as the outcome of a research process, it is a theory that has been developed inductively from a dataset (Saunders *et al*. 2012). The origins of grounded theory can be traced to the work of Glaser and Strauss (1967) in response to the positivist nature of social research (Suddaby, 2006). In order to understand the daily experiences of social actors in particular situations; the process of grounded theory was created to investigate, deduce and elucidate meaning (Glaser and Strauss 1967; Suddaby, 2006). The primary focus of the grounded theory strategy is to generate theory grounded in data from the experience of social actors (Saunders *et al*. 2012). This is usually done inductively, however, research (Strauss and Corbin, 1998; Suddaby, 2006) now suggests that an approach that oscillates between inductive and deductive might be more appropriate. A significant aspect of the grounded theory is coding, and depending on which research you look at it could have two (Charmaz, 2006) or three stages (Strauss and Corbin, 1998). The three stages of coding delineated by Strauss and Corbin, (1998) are: open coding-the reclassification of data into groups; axial coding-identifying the relationships between the groups; selective coding-the integration of the groups to produce theory. Supported by a significant number of sampling, Charmaz, (2006) outlines two stages of coding as initial coding and focused coding.

3.6.6. Experimental research

Experimentation is a method of research that is strongly linked to natural sciences; it is also linked with other research spheres like psychology and social science (Saunders *et al*. 2012). The aim of conducting experiments is to analyse the probability and cause of change between variables; whether dependent or independent (Hakim, 2000). Experiments tend to be linked with exploratory and explanatory research to find answers to “what”, “how”, and “why” questions (Saunders *et al*. 2012). Variables play a significant role when conducting experiments; six distinct variables and their meanings are described below in Table 3.4. More detailed analysis of each variable is detailed in Chapter 6.

Table 3.4 Types of variables

Variable	Meaning
Independent variable	Manipulated or changed to measure the effect on a dependent variable.
Dependent variable	May or may not change in response to changes in other variables; observed results or outcome is a consequence of manipulation of other variables.
Mediating variable	Located between the independent and dependent variables.
Moderator variable	The introduction of this variable will have an impact on the relationship between the independent and dependent variables.
Control variable	Variable to be kept constant in order to ensure there is no undue impact on the dependent and independent variables.
Confounding variable	Peripheral but challenging to observe variables that can potentially undermine the outcomes of the independent and dependent variables; requires consideration to avoid spurious conclusions.

According to Saunders *et al* (2012), there are three main experimental approaches; with each having its own distinct advantage and disadvantage, particularly in relation to control and confounding variables. These experimental research designs are a classical experiment, quasi-experiment, and within-subject design experiment.

The classical experiment requires a selected sample of participants that are split into two groups at random; a control group and an experimental group. A form of (previously planned) manipulation or influence will be exerted on the experimental but not the control group to ensure the control group is excluded from influence. Hence, changes to the dependent variable could only be attributed to the manipulation (Saunders *et al*. 2016), see Figure 3.6.

The quasi-experiment, as well as classical experiments, also use two groups (control and experimental groups) during experiments; however, the difference between the two approaches is the use of matched-pair analysis and not a random selection of participants (Saunders *et al*. 2012). Matched pair analysis involves matching participants and placing them in groups based on their similarities (age, gender, department…) rather than randomly selecting them.

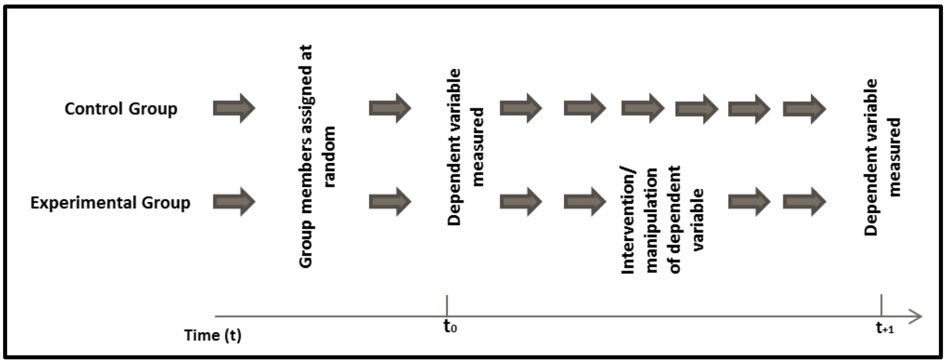


Figure 3.6 Classic Experiment Strategy (Saunders *et al* 2016)

With both experimental approaches, the dependent variable is tested before and after an intervention is introduced; this is done to be able to compare the two tests and ultimately determine the influence of the intervention on the dependent variables (Saunders *et al*. 2012). These two forms (classical and quasi-experiment) of experimentation are referred to as between-subjects because participants belong to either the control group or experimental group design and not both. Another reason for this categorisation is because tests and measures are compared between the two groups; where an additional test is required, a separate experimental group is essential for each test; this is referred to as independent measures (Saunders *et al*. 2012).

The last experimental approach advocated by Saunders *et al* (2012) is referred to as within-subjects design; in this form of experimentation, participants are not divided into groups, as there is only one group. With this form of experimentation, a practice referred to as repeated measures are used; this involves a process of planned interventions done repeatedly to every participant (Saunders *et al*. 2012). According to Saunders *et al* (2012), a within-subject design offers more practicality than a between-subject design; they offer this opinion based on the number of participants required. A within-subject design requires fewer participants than a between-subject design. Whilst this is true, they also suggest that repeated measures on fewer participants could lead to tiredness and familiarity that could ultimately distort the validity of the findings. A potential solution for this is to create a counterbalanced design that takes into consideration the familiarity and fatigue of the participants and develop a different set of tasks in a different order (Saunders *et al*. 2012).

3.7. Positioning of research strategies and techniques

As stated previously, the aim of this chapter is to determine a robust means (methodology) of testing the propositions in order to validate or reject the concept of BPRC derived from the literature review. By specifically reviewing the research methodology literature to have an understanding of the methodological choices available in the context of the objectives of this chapter, in this section, the research aims to select the most appropriate choices.

With a background in project management, which processes plays a vital role in, an interest in studying for a PhD on the subject of business processes was a natural progression for the researcher, however a lack of scholastic funding opportunities on BPM related activities meant that any ambitions of a PhD had to be self-funded. There was no specific set objective prior to the commencement of the research except that the researcher along with the supervisory team wanted to investigate business process management. Further discussion between the researcher and the supervisory team prior to the commencement of the research, determined that the issue of business processes along with the challenge of a dynamic operating environment with frequent change would be a PhD research area that would benefit from further investigation.

This is significant because it helps explain the exploratory nature of this research upon commencement, which lends itself to a more inductive styled research. Hence, the initial objective was to explore the BPM literature through the dynamic capability and agility lens; and in doing so, the objective was to identify the gaps in the business process body of knowledge and future research opportunities.

Following the review of the literature, five propositions were derived that give credence to the notion of reconfigurable business processes as a means of making transformational changes quickly and frequently. By deriving propositions from literature and deciding on a method to validate or reject these propositions, this phase of the research lent itself more closely to deductive styled approach. With regards to these various influences, the methodological choices necessary to fulfil the demands of this research were selected.

3.7.1. Ontological stance- Subjective

In the context of making an ontological choice (whether subjective or objective) for this research, the following factors were considered: the aims and objectives of the research; and, the researcher's interpretation of social phenomena. Therefore, this research commenced with the intent to understand the underpinnings of business processes and their relationship with a dynamic operating environment. The emphasis of subjectivism is in understanding meaning rather than facts, and an objective ontological position is one where social phenomena that pertain to everyday life exist independent from actors to Bryman and Emma, (2015). In this research, the results of the experiment were independent of social phenomena i.e. they were largely numerical, however, these numbers were not self-explanatory. To elicit meaning from the results from this research a significant amount of subjective reasoning was required. So, whilst on the basis of literature, the results of the research and the method employed imply that the ontological stance is objective, there was a subjective element to it. For example, in order to properly understand all the nuances that influence processual activity, meaning rather than facts provides a more robust platform for interpreting knowledge. Subsequently, according to Bryman and Emma, (2015), the implications of an objective ontological position is that social phenomena exist independent from actors, in investigating the relationship between business process change in a dynamic operating environment that assertion cannot be made categorically. Since a business process is a series of activities with work flowing through it to reach the desired outcome, an argument can be made that it is generic and largely dependent on the desired outcome, which makes it significantly challenging to interpret objectively. However, in this research, where the validity of the concept of BPRC is tested, an objective result ensues. Hence, this research lends itself more to an objective stance than a subjective one.

Furthermore, the literature (Bryman and Emma, 2015; Saunders, Lewis and Thornhill, 2016) asserts that how a researcher interprets social phenomena will significantly affect the research methodology employed. In this research, the methodology employed was the classical experiment which lends itself more to an objective stance than it does subjective. Nevertheless, this research would argue that rather than a researcher having one ontological perspective, it is more appropriate for the researcher's ontological stance to be based on the phenomena in question. Table 3.5 provides a comparison of the subjective and objective ontological stances in relation to the objectives of this research. In Table 3.5, to justify the selection of the objective stance over the subjective stance, a comparison of both ontologies in relation to the objective of this research is done. Whilst Objectivism is focused on facts, causality and fundamental laws, Subjectivism emphasises the need for understanding, both of which are related to the output from this research. Investigating the validity of the propositions/hypothesis is deemed objective, however the interpretations of the results from experiment leans towards a subjective stance.

Table 3.5 Ontological comparison in relation to research objectives

Subjectivism	Objectivism	Research Ontological Stance
Emphasis on meaning Focus on understanding	Emphasis on facts Focus on causality & fundamental laws	Objective; focus is on testing the validity of the propositions derived from literature. The numerical results obtained from the experiment are objective
Looks at the totality of each situation	Reduce phenomenon to the simplest elements	Again, by reducing the phenomena of understanding business processes in a dynamic operating environment to testing the validity of BPRC, this research lends itself to an objective ontological stance.

3.7.2. Epistemological stance- Critical Realist

The epistemological orientation is concerned with what constitutes as acceptable knowledge; five philosophical paradigms (positivism, critical realism, interpretivism, postmodernism, and pragmatism) have been considered in relation to the research objectives. In Table 3.6 below, a comparative analysis of all five philosophical choices is detailed in three segments, namely: what constitutes as knowledge; how is knowledge measured; and, examples of knowledge from each philosophical view.

What constitutes as knowledge? The positivist paradigm conveys law-like generalisations usually in the form of numbers to derive knowledge, which is in contrast with the exploratory nature of the objectives of this research. First, by exploring the BPM literature through the lenses of dynamic capability and agility in order to identify gaps and opportunities in the BPM body of knowledge. Second, in developing propositions to be tested, this research does not allude to the positivist paradigm because here knowledge was not derived using statistical or numerical generalisations. The interpretivist paradigm derives knowledge through the interpretation of narratives and perceptions. This research contains a degree of interpretation of the BPM narrative in relation to dynamic capabilities and agility. The epistemological paradigm for this research is critical realism; the focus of the critical realist is to expound observation and experience in terms of the principal factors of reality that influence the observable events (Saunders *et al* 2016). Concerning this research, critical realism is the most justifiable epistemological paradigm for the aims and objectives of this research because first, knowledge was initially derived through critical analysis and understanding of the causal relationship between BPM and a dynamic operating environment. Second, by deriving a set of propositions from the literature to be tested, this research validated the knowledge derived from theory without using statistical methods (not positivist), or simplistic theories (interpretivist), but through analysis and testing, this research was able to convey the mental interaction between the sensations from the object of observation and our senses. Concerning the postmodernist and pragmatic epistemological paradigms, Table 3.6 indicates there is no relationship between the objectives of this research and how knowledge is derived from a postmodernist and pragmatic paradigm.

Table 3.6 Comparative analysis of epistemological paradigms (Adapted from Saunders *et al* 2016)

	What constitutes knowledge?	How is knowledge measured?	How is knowledge Validated?
Positivist	Law-like generalisations Numbers	Scientific method; observable and measurable facts	Causal explanation and prediction as a contribution
Critical Realism	knowledge historically situated and transient Facts are social constructions	Epistemological relativism; critical analysis of observation	Historical causal explanation, critical analysis and tested as a contribution
Interpretivism	Focus on narratives, stories, perceptions and interpretations	Theories and concepts derived through simplistic means	New understanding and worldviews as a contribution
Postmodernism	Focus on absences, and repressed meanings, and interpretations	What counts as truth and knowledge; is decided by dominant ideologies	Exposure to power relations and challenge of dominant views as a contribution
Pragmatism	Research initiated and sustained by the researcher's doubts and beliefs	Value-driven research	Researcher reflexive
Research relevance	Knowledge of this research is understanding how business processes can enable organisations to transform frequently and quickly. This requires an understanding of the causal relationship between business process and a dynamic operating environment	By investigating established concepts and their causal relationships, then derived testable propositions Not by measurable facts (positivism), or by simplistic theories (interpretivism), or dominant ideologies (postmodernism). There is a degree of pragmatism as the results of the research will add value to organisations in dynamic operating environments.	Validated knowledge by testing propositions

3.7.3. Methodical choice- Qualitative

The methodical choice employed for this research is qualitative rather than quantitative, the literature on qualitative and quantitative research all agree that a key difference between both choices is the use of non-numeric data for qualitative research, and numeric statistical data for quantitative research (Bryman and Bell, 2015; Saunders et al., 2016). This research goes further to differentiate these two research methods and also justify the selection of qualitative over quantitative using four categories; research philosophy, approach to theory, characteristics, and research strategies.

The research philosophy usually associated with qualitative research is interpretivist and critical realist (Denzin and Lincoln, 2011), whilst the quantitative research philosophy is usually associated with positivism and pragmatism (Saunders *et al*., 2016). The reason for these distinctive philosophical choices is because qualitative research is more concerned with understanding subjective and socially construed meaning whilst quantitative research is concerned with interpreting numerical and statistical data. Concerning this research, the initial focus was to understand the gaps in the BPM literature in relation to a dynamic operating environment; hence, the research philosophy employed was critical realist. From a philosophical standpoint, this research is qualitative and not quantitative; the emphasis on observation and understanding meaning is evident with regards to the investigation of BPM from the lens of dynamic capabilities and agility. In order to derive testable research propositions from the literature, it was important to have an understanding of BPM and its interrelatedness with a dynamic operating environment.

The qualitative approach to theory is inductive, usually because of the naturalistic and emergent nature of the research, whilst the quantitative approach is deductive, where the emphasis is on using data to test theory (Saunders *et al*., 2016). In this research, the initial investigation of the BPM literature was inductive, however, after observing and understanding the gaps in the BPM literature, a correlation started to emerge with other disciplines like software reconfiguration. This led to an abductive form of research where the research borrowed principles from other disciplines in order to develop research propositions to be deductively tested. Hence, the approach to theory in this research contained inductive, deductive and abductive elements to it, the implication being that the approach to theory cannot be used singularly as a basis to determine if the methodical nature of this is qualitative or quantitative.

The characteristics of a qualitative and quantitative research method range from how data is understood to the types of data collection See Table 3.7. For example, qualitative research uses a variety of techniques for data collection in order to develop a theoretical contribution, whilst quantitative research is usually associated with a specific numerically measurable data collection technique. In this research data, it is suspected that data collection would largely be theoretic, even in the instance where numerical data is collected, the analysis of the data would not be statistical or graphical, hence the characteristics of this research allude to a more qualitative than quantitative research method.

The research strategy for qualitative and quantitative research methods vary; for example, qualitative research methods are usually associated with strategies like action research, case study research, ethnography, and grounded theory, whilst quantitative research methods are usually associated with strategies like surveys and experimentation. In this research the classical experimental strategy was employed to test the propositions derived from literature, however, it is important to note that the classical experiment employed did not involve statistical or graphical analysis, but theoretical contribution supported using numerical data from the experiment.
Hence, using these four parameters of research philosophy, approach to theory, characteristics, and research strategy, this research method is qualitative rather than quantitative. See Table 3.7 for details.

Table 3.7 Comparative analysis of methodical choice

	Qualitative	Quantitative	Relevance to research
Research philosophy	Qualitative research is often associated with interpretivism Qualitative research may also be used within critical realist and pragmatist philosophies	Quantitative research is generally associated with positivism. Quantitative research may also be used within realist and pragmatist philosophies	Research philosophy is critical realism
Approach to theory	Qualitative research is usually associated with an inductive approach to theory development, where a naturalistic and emergent research design is used to build theory or to develop a richer theoretical perspective than already exists in the literature. Some qualitative research strategies start with a deductive approach, to test an existing theory using qualitative procedures	Quantitative research is usually associated with a deductive approach, where the focus is on using data to test the theory. However, it may also incorporate an inductive approach, where data are used to develop theory.	Research had inductive and deductive elements to it. For instance, the initial review of the literature on BPM from the lens of dynamic capabilities and agility was conducted inductively. Then deriving and testing the propositions was both deductive and abductive. Since, the theory was not built on numerical data or analysed statistically, the approach to theory is qualitative.
Characteristics	Qualitative research studies participants' meanings and the relationships between them, Often associated with a variety of data collection techniques and analytical procedures, to develop a conceptual framework and theoretical contribution.	Examines relationships between variables Often associated with single data collection technique Data is measured and analysed numerically using statistical and graphical techniques.	Studied meanings and relationships between BPM, dynamic capabilities and agility in a dynamic operating environment. Data was not numerical or statistical but theoretical and conceptual. In essence, the characteristics of this research are qualitative.
Research Strategies	Qualitative research is associated with a variety of strategies. Some of the strategies used are action research, case study research, ethnography, and Grounded Theory.	Quantitative research is principally associated with experimental and survey research strategies	The research strategy employed for this research was the classic experimental, but conclusions were derived from a theoretical and conceptual framework that aligns more with the qualitative rather than the quantitative research

3.7.4. Approach to theory development- Abductive

The methodological approach to theory that was used in this research is abductive; the abductive approach to theory combines elements of induction and deduction, by moving back and forth from data to theory, and theory to data (Suddaby 2006; Saunders *et al*., 2016). In Table 3.8, this research differentiates the three approaches to theory in relation to logic, generalisability, data collection, and theory.

The logical approach to theory from a deductive perspective dictates that when premises are true, the conclusions must also be true; whilst the inductive approach stipulates that known premises are used to generate untested conclusions; and in abductive approach known premises are used to generate testable conclusions, see Table 3.8 (Saunders *et al*., 2016). Like with abduction, this research begins with the premise that current business process change initiatives would not be sufficient in a dynamic operating environment. Based on this premise, the research inductively explores the BPM literature to develop testable propositions.

Generalisability in deduction is moving from the general to the specific; whilst in induction, it is moving from the specific to the general, and in abduction, it consists of the interactions between the specific and the general (Saunders *et al*., 2016). Like with abduction, this research interfaces between deductive and inductive inferences, as stated in the preceding paragraph, it begins inductively (by specifically exploring the gaps in BPM literature in relation to a dynamic operating environment) but derives research propositions that are deductively tested.

In a deductive approach to theory, data collection is used to support the evaluation of already assumed propositions or hypotheses in order to either validate or falsify these assumptions. Alternatively, in an inductive approach to theory, data collection is used explanatively to identify themes in order to build theory. The abductive approach to theory incorporates both perspectives; initial data collection is inductively used to explore a phenomenon and identify themes, which are now deductively tested, the results of these tests either generate or modify existing theory where appropriate, see Table 3.8 (Saunders *et al*., 2016).

In this research, initial data collection was done inductively by exploring the literature on BPM from the lens of dynamic capability and agility to identify gaps and themes in the literature (like reconfigurability), then by appropriating existing theory on similar disciplines (software reconfiguration), the research developed testable propositions. These propositions would be deductively tested in order to either validate or falsify them. Since, the approach to theory in this research not only integrates deductive and inductive elements but also appropriated existing theory, then the approach to theory building is abductive and not deductive or inductive.

Table 3.8 Comparative analysis of approach to theory

	Deduction	**Induction**	**Abduction**	**Research Relevance**
Logic	Deductive inference- When the premises are true; the conclusion must be true	Inductive inference- Known premises are used to generate untested conclusions	Abductive inference- known premises are used to generate testable conclusions	Abductive- Known premise- business process change initiatives would not be sufficient in a dynamic operating environment; based on this premise the research inductively explores the BPM literature to develop testable propositions.
Generalisability	Generalising from the general to the specific	Generalising from the specific to the general	Generalising from the interactions between the specific and the general	Abductive- research interfaces between deductive and inductive inferences, by specifically exploring the gaps in BPM literature in relation to a dynamic operating environment but derives research propositions that are deductively tested
Data collection & Theory	Is used to evaluate propositions or hypotheses in relation to existing theory. Theory falsification or verification	Is used to explore a phenomenon, identify themes and patterns and create a conceptual framework. Theory generation and building	Is used to explore a phenomenon, identify themes and patterns, locate these in a conceptual framework and test through subsequent data collection. Theory generation or modification; incorporating existing theory where appropriate, to build/modify new/existing theory	Abductive- by exploring the literature on BPM from the lens of dynamic capability and agility to identify gaps and themes in the literature (like reconfigurability), then by appropriating existing theory on similar disciplines (software reconfiguration), the research developed testable propositions. These propositions would be deductively tested in order to either validate or falsify them.

3.7.5. Research strategy and technique- Experimental

The research strategy selected for data collection is experimental, an illustration of the various strategies and techniques available to this research in relation to a set of five criteria necessary for fulfilling the objectives of this research is itemised.

In the most basic sense, the strategy is a plan to achieve an objective; hence, the justification of the research method or strategy chosen to collect and analyse data is dependent on the objectives of the research. In this section, the intended objective is to select the most appropriate strategy for collecting and analysing data, specifically to ascertain the validity of the propositions derived from literature. Based on this understanding, a criterion necessary to fulfil the task of selecting a data collection method was developed.

To justify the selected strategy for data collection, the five criteria necessary for this research to meet its objectives were evaluated in relation to the strategies reviewed in Section 3.6 on research strategies and techniques. Furthermore, each strategy is evaluated against the five criteria, this would help ascertain the appropriateness of the implementation strategy. The propositions derived from literature purport that the notion of BPRC will facilitate rapid transformational changes with reduced disruption in a dynamic environment; subsequently, the researcher opines this would be complementary to previous business process change methods, namely radical re-engineering (BPR) and incremental improvement (BPI). Therefore, the first criteria necessary to enable a robust data collection strategy is to ensure a dynamic operating environment that involves a degree of complexity that comes with persistent change requirements.

Second, since the concept of BPRC is proposed as a complementary notion to BPR and BPI, then the second criteria require a strategy that enables a degree of comparison between all three business process change initiatives (BPRC, BPI and BPR), including the ability to measure disruption. Since disruption is a key determinant of effectiveness and efficiency of a business process change, it is critical that in comparing the different business process change methods, a means of measuring disruption is defined within the context of the research design.

Third, BPRC focusses on business processes being reconfigurable, and as stated previously reconfigurability is underpinned by predictability and modularity. Therefore, the third criteria require a strategy for data collection that enables a degree of intervention over the factors of predictability and modularity.

Fourth, the significance of ensuring the propositions are tested in a dynamic operating environment necessitates a research design that enables the researcher to examine all three concepts of BPR, BPI and BPRC in relation to change. In order to adequately examine all three concepts in relation to a dynamic operating environment, it is vital for the research design to observe and capture the design (mapping of the process) and implementation elements of the process. Hence, the fourth criteria require a strategy that captures the design and implementation elements of all three concepts of business process change.

Fifth, it is important to state some of the contextual limitations of this research; because this is a PhD research, there is a limitation on time and resources. Typically, the timeframe for PhD. research is between a three to a four-year period, so whatever strategy for data collection selected needs to be able to be implemented within that time. From a resource perspective, the research is physically conducted by one principal researcher, so every strategy selected has to be achievable with respect to this limitation. Lastly, the limitation of financial resource is particularly significant in this research because the research was largely self-funded. Hence, the fifth criteria necessitated a data collection strategy that ensured the strategy's feasibility within the context of these constraints. Together these five criteria guided the design strategy that enabled the researcher to test the validity of the research propositions and subsequently enabled data collection.

Since the focus of this research relates to a business process in a dynamic operating environment; the first logical data collection strategy considered was the case study strategy. The first criteria defined for data collection concerning the case study strategy was to ensure a dynamic operating environment that involves a degree of complexity due to persistent change requirements. With regards to the first criteria, this research agrees that the case study strategy for data collection is feasible; since the case study strategy advocates the use of at least four cases (Yin, 2015), where four organisations in a dynamic operating environment could be used as cases. The second criteria necessitate the strategy enables a degree of comparison between all three business process change initiatives (BPRC, BPR and BPI), and this comparison would enable measurement of disruption. Ideally, this is implementable with three organisations in a dynamic industry, with each process adhering to the tenets of one of either BPRC, BPR or BPI, however, a challenge persists. In order to adequately compare and measure disruption, how would the researcher ensure each organisation's process receives the same degree of change? Without this, any comparison of the three business process initiatives in relation to a dynamic operating environment would be erroneous, and therefore would not adequately test the validity of the propositions derived from literature. This challenge is again prevalent with the third, fourth and fifth criteria, a central theme of the propositions derived from literature is the significance of predictability and modularity to enhance BPRC (see,

Table 2.9).

It is, therefore, crucial to be able to observe the effect of predictability, and modularity on the design and implementation of business processes. In a case study strategy, it is possible to observe predictability and modularity in a business process over a period of time. The challenge, however, is the ability to ensure a consistent degree of intervention (like designing a modular business process based on predictions) and ensure the length of time required to implement is within the timeframe of a PhD. The case study strategy for data collection is implementable but not the most appropriate with regard to the defined criteria. To ensure it meets the stipulated criteria would require an industry that is dynamic, and organisations willing to allow interruptions to operations. Whilst this is possible, it was not an adequate data collection strategy for this research.

The second data collection strategy itemised is the survey method. In a survey, the objective is to attain standardisation and consistency through systematic observation, interviewing and questioning (Moser and Kalton, 1971). In relation to the objectives of this research, a survey fails to address the criteria necessary for this research design; because the survey method is more closely associated with questions relating to what, where, who, how much, and how many (Saunders et al., 2016), but it does not provide demonstrable evidence. Using the previously defined criteria to evaluate the suitability of the survey method; the first criteria (which is to ensure a dynamic environment) is feasible, however, this data collection strategy does not adequately meet the requirements of subsequent criteria. For example, the third criteria require a degree of intervention over the factors of predictability and modularity This would be particularly challenging because the nature of survey does not allow the researcher any degree of manipulation of the subject of research, but rather observational analysis after the fact. For this reason, the survey strategy for data collection was inadequate.

The next strategy considered by the researcher was action research; the ability to design and implement business process change in real time in an organisation influenced the consideration of this strategy. Action research is an emergent and iterative process of investigation with the purpose of developing solutions to existing organisational challenges through a participative and combined approach (Shani and Pasmore, 1985; Reason, 2006; Reason and Bradhury 2008; Coghlan and Brannick, 2010; Saunders et al. 2016). This participative approach could be significant to this research because of the necessity to observe the three concepts of business process change in operation. An action styled research strategy enables a participative approach, which complies with the third criteria stipulated. Furthermore, this strategy also provides an opportunity to work with a business operation, as well as observe and analyse the design and implementation of the three business processes. Similar to a case study strategy, a significant challenge here is first, the time taken to test these propositions since the effect of most re-engineering efforts take up to three years to be properly assessed. Second and more significant, in order to have a robust comparative analysis between BPRC, BPR and BPI, the researcher requires a degree of control to ensure that all three concepts were designed and implemented under the same organisational circumstance. This is hardly feasible in an action styled research.

The final research strategy considered was the experimental approach to data collection. The aim of conducting experiments is to analyse the probability and cause of change between variables; whether dependent or independent (Hakim, 2000). The implication being that an experimental data collection strategy provides the platform to test the propositions put forth in the literature by enabling comparative analysis of business process change methodologies in a dynamic operating environment.

The first criteria defined for data collection was to ensure a dynamic operating environment that involves a degree of complexity due to persistent change requirements. By ensuring consistent and previously unknown changes are introduced to the process by the mediator, a dynamic operating environment is maintained throughout the design and implementation of the process. This is only feasible with an experimental strategy.

The second criteria defined for data collection was to ensure the strategy allowed for a degree of comparison between all three business process change initiatives, and also enables measurement of disruption. The experimental data collection strategy ensures this by using control and confounding variables in the experiment, which provides control over dependent and independent variables. Furthermore, this allows adequate measurement of disruption, since every business process change initiative entails a degree of disruption. In this research, the level of disruption is the dependent variable, and measurement could be done using time and observation of the participants and process, this is further emphasised in Chapter 6 Analysis and findings

The third criteria defined for data collection was to ensure the researcher has a degree of intervention over the factors of predictability and modularity. By delineating the participants into control and experimental groups, intervention on the stipulated factors became not only possible but also measurable and comparable.

The fourth criteria defined for data collection stipulated that the strategy provide a platform that captures the design and implementation elements of the three concepts (BPRC, BPI and BPR) of business process change. By using the experimental data collection strategy, the researcher is able to monitor the design and implementation phase.

Finally, the fifth criteria defined for data collection was to ensure the strategy’s feasibility within the context of a self-funded PhD; the implication specifically being time and resources (human and financial). By using an experimental strategy, the researcher can create a (lab-based) dynamic operating environment that enables adequate observation and comparison of business processes, within a limited timeframe and budget. Based on all these elements discussed, the experimental method was selected as the most justifiable data collection strategy (within the context of this research) that will enable a robust test of the validity of propositions derived from the literature. Other data collection techniques like, Grounded theory and ethnography were not considered because they did not meet any of the predefined criteria.

In conclusion, to select and justify the strategy for data collection, the five criteria necessary for this research to meet its objectives were evaluated in relation to four feasible research strategies and techniques. Of all four strategies, only the classical experimental strategy meets the five criteria described in this section and thus the most appropriate strategy for the purpose of this experiment. In Table 3.9, a highlight of the four strategies considered against each of the five defined criteria is illustrated. Using the letters “Y/N” to represent “Yes” or “No”, where “Y” indicates the strategy in question meets the corresponding criterion and “N” indicates the strategy in question does not meet the criterion. Of the four strategies, only the classical experiment strategy meets all five criteria necessary for fulfilling the objectives of this research.

As previously stated in Section 3.6.6, the experimental method requires a selected sample of participants that are split into two groups at random, a control group and an experimental group. At this point before any form of intervention is introduced to the experimental group, the dependent variables are measured, and then an intervention is exerted on the experimental but not the control group, at which point the dependent variable is measured again. This is explained in sufficient detail in 4.3.2 Final design and experiment.

Table 3.9 Evaluation of Research Strategy

Strategy	Y/N	Criteria for Research Design
Case Study	Y	Dynamic Operating Environment
	N	A Comparison between BPRC, BPI, BPR
	N	Enables a degree of intervention on Predictability and Modularity
	N	Test BPRC, BPI, BPR in relation to change
	Y	Contextual limitation of a PhD
Survey	Y	Dynamic Operating Environment
	Y	A Comparison between BPRC, BPI, BPR
	N	Enables a degree of intervention on Predictability and Modularity
	N	Test BPRC, BPI, BPR in relation to change
	Y	Contextual limitation of a PhD
Action Research	Y	Dynamic Operating Environment
	Y	A Comparison between BPRC, BPI, BPR
	Y	Enables a degree of intervention on Predictability and Modularity
	N	Test BPRC, BPI, BPR in relation to change
	N	Contextual limitation of a PhD
Classic Experiment	Y	Dynamic Operating Environment
	Y	A Comparison between BPRC, BPI, BPR
	Y	Enables a degree of intervention on Predictability and Modularity
	Y	Test BPRC, BPI, BPR in relation to change
	Y	Contextual limitation of a PhD

3.8. Summary of research methodology chapter

This chapter started with a discussion of the significance of the methodological choices made in this research; using the research onion adapted from Saunders *et al*., (2016) the researcher has explored the methodological choices available and selected the options that are justifiable and applicable to this research in particular. After reviewing all the choices available to management research; an observation was made that no particular choice was deemed wrong or right, but rather which is most appropriate and justifiable in the context of this research. In selecting all choices, the researcher has ensured that all choices are justifiable and appropriate in the context of the aims and objectives of this research in particular. See Figure 3.7 for an illustration of the methodological choices selected for this research with respect to Saunders research onion.

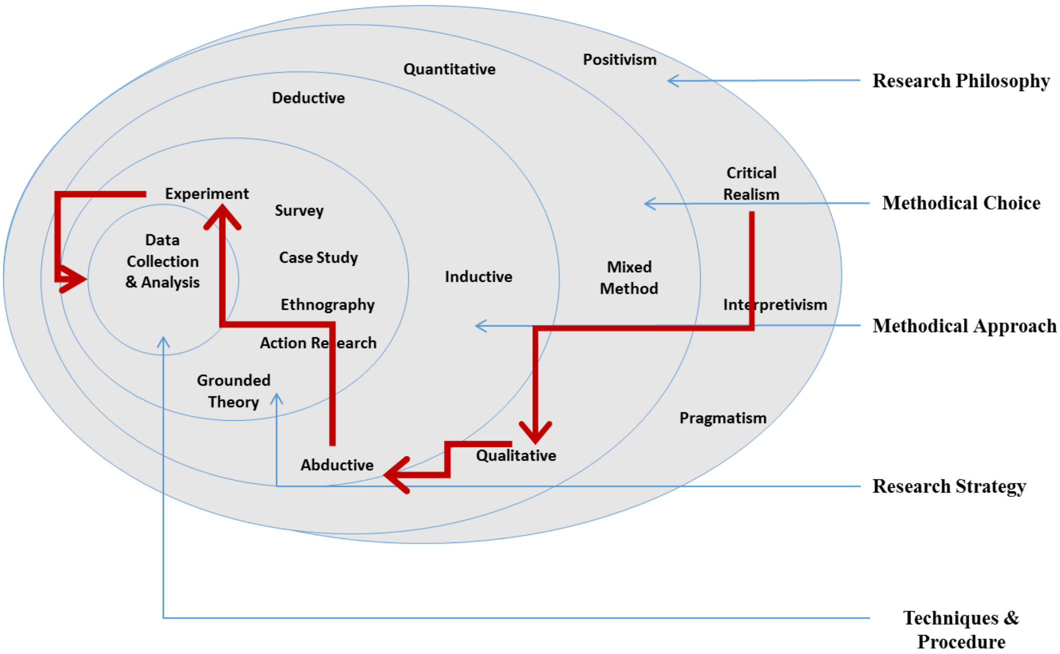


Figure 3.7 Methodological Map adapted from Saunders et al., (2016)

Chapter 4. Research Design

Research design refers to the overall strategy of a researcher; it is the framework for the collection and analysis of data; the design employed in a research process is informed by causal relationships between variables, understanding behaviour and meaning within a specific context, over a specific period of time (Bryman and Bell, 2015). Research design has been defined “as a plan that guides the investigator in the process of collecting, analysing, and interpreting observations. It is the logical model of proof that allows the researcher to draw inferences concerning causal relations among the variables under investigation” (Yin 2014: 28).

The significance of clearly defining the research objectives is critical because it is a guide to the research design choices made (Saunders *et al*., 2012). What this implies is that whilst it is important to define the research design before undertaking the research, the actual research also informs the decisions made in defining the research design. The award of PhD necessitates a novel contribution to knowledge; this can be achieved by connecting existing business process concepts to build or test theory. In the preceding chapter, the methodological options available to research of this nature was reviewed, based on this, review choices that will deliver a robust justification for the researcher’s preferences were made.

In this chapter, the researcher’s aim is to provide a justifiable research design strategy in relation to the research propositions derived from the literature review.

4.1. Broad research problem

The motivations for this research project came from understanding how business processes adapt and respond to a dynamic operating environment (factors such as globalisation, increasing consumer complexity and competition); due to its the far-reaching implication on business operations and organisational sustainability. Specifically, this led to explorative research of the business process literature to identify the gaps in knowledge from the context of dynamic capabilities and agility, from which a set of propositions emerged. In summary, these propositions advocate a complementary notion relating to the reconfigurability of business process (BPRC) in relation to other more conventional methods of business process change like re-engineering (BPR) and improvement (BPI). Furthermore, these propositions suggest that the notion of BPRC is underpinned by the tenets of predictability and modularity; which have been demonstrated to enhance reconfigurability within other contexts, thereby enabling transformational change with reduced disruption[2].

Thus, the objective of this research design is to create an experiment that would appropriately test the validity of the research propositions. Whilst Section 3.7.5 described the criteria necessary for selecting a data collection strategy, subsequent sections in this chapter describe the necessary criteria to be met by the chosen data collection strategy- experimental method. These criteria enhance the credibility and quality of the research design.

4.2. Criteria for assessing quality of research

Underpinning the study of research design is the matter of the quality of output from research; according to Raimond (1993), the use of criteria for assessing research quality will provide a degree of confidence in the output and conclusions from the research. The logical sequence of a research design indicates that tests can be used to examine the quality of research (Yin, 2014). Scientific research design needs to be reflected as such; meaning, it is necessary to use methods that prevent the researcher from applying personal subjective distinctions developed over time between the researcher and the subject material (Raimond, 1993; Saunders *et al*. 2016).

In establishing the quality of research design, four tests (construct validity, internal validity, external validity, and reliability) have been commonly used (Saunders *et al*. 2012; Yin, 2014). In Table 4.1, an itemised list of the four tests is detailed and a description of the applicability of these test to the research design. In the following sections, a description of the research design journey is detailed with respect to each of these tests.

Table 4.1 Criteria for assessing quality of research

Criteria	Meaning
Construct validity	Detects accurate operational measures for the concepts being studied
Internal validity	Seeks to ascertain causal relationships; this form of validity is suited to explanatory or causal studies and not explorative or descriptive research studies
External validity	Defines the domain of a study's findings
Reliability	Demonstrates the repeatability of the operations of a research study

4.2.1. Construct validity

The objective of construct validity is to ensure that the intended measures of the research are actually measured (Saunders *et al*., 2016). The term construct validity is normally used to describe constructs such as attitude scales, aptitude and personality tests.

Construct validity answers the question “How well can you generalise from your measurement questions to your construct?” (Saunders *et al*., 2012: 430). Construct validity is usually linked with positivist and quantitative research (Saunders *et al*. 2012). For example, in experimental research, it is critical that the measurements taken are relevant to the propositional claim, only then is the construct valid.

4.2.2. Internal validity

Internal validity is established when the research exhibits a causal relationship between two variables (Saunders *et al*., 2012; Yin 2014). Internal validity has been more closely associated with experimental and quasi-experimental research (Campbell and Stanley, 2015; Cook et al., 1979). For example, in experimental research, internal validity would be demonstrated when the research output can be linked statistically to an intervention (Saunders *et al*. 2012). In the instance where the outcome from research cannot be specifically attributed to an intervention but is due to some other reason; the research outcome would be deemed spurious. Saunders *et al* (2012) itemise six threats to internal validity as past or recent events, testing, instrumentation, mortality, maturation, and ambiguity about causal direction.

4.2.3. External validity

External validity relates to the challenge of knowing if the research output is generalizable beyond the immediate study (Yin, 2015). According to Saunders *et al*. (2012: 194) external validity is associated with the question: “can a study’s research findings be generalised to other relevant settings or groups?” So in essence, when the output from research can be replicated in a different context, statistical generalisability is observed.

4.2.4. Reliability

Reliability is demonstrated when data collection and analytical procedures produce consistent research output at different times by different researchers (Saunders *et al*. 2012). The objective of reliability is to eliminate or minimise errors and bias in a research study; it is significant to note that the essence is on performing the same procedures repeatedly and not on replicating the results (Yin, 2014).

In Section 4.4 Validating the Experimental Design, a detailed description of how the criteria for assessing the quality of research is used to validate the design of experiments used in this research.

4.3. Research design journey

In developing this experimental research design for data collection, the most significant limitations and influence were ensuring that the data collection procedure did not deviate from the objectives of the research and the parameters set out in Section 3.7.5.

The process of conducting experiments involves the use of hypotheses or propositions over research questions; these (hypotheses or propositions) are predictions of the relationship between variables (Saunders *et al*. 2012). The significance and implications of these variables to this research, in particular, are itemised in Table 4.2. There are two types of hypotheses that are opposed to each other: the null, and alternative hypotheses. The null hypothesis, if accepted, claims that there would be little or no interaction between the independent and dependent variables, thereby indicating a lack of relationship between variables. Whilst the alternative hypotheses, if accepted, claims that there will be a significant interaction between the independent and dependent variables, indicating a relationship between the variables and subsequently passing the "internal validity" test. However, it is important to note that the use of the term "hypothesis" in this section specifically explains the experimental process, in this research "propositions" and not "hypothesis", has been used.

The fundamental difference between a hypothesis and a proposition is in the form of measurement and the unit of data; the former is usually measured quantitatively, and the latter is usually measured qualitatively (Whetten, 1989). This is largely due to the type and interpretation of data; quantitative measure requires not just numeric, but statistical analysis of the data (Whetten, 1989). With regards to this research, propositions, rather than hypotheses have been derived from the literature because the content and concept of this research is qualitative, whilst some of the data collected were numeric, the data was not statistically analysed.

Table 4.2 Variables and Experimental Implications

Variable	Definition	Experimental Implication
Independent variable	Is being manipulated or changed to measure the effect on a dependent variable	Predictability and Modularity (enabled by standard interfaces) in Business Process Design
Dependent variable	May or may not change in response to changes in other variables; observed results or outcome is a consequence of manipulation of other variables	Level of Disruption and time taken
Mediating variable	Located between the independent and dependent variables	Reconfigurability
Moderator variable	The introduction of this variable will have an impact on the relationship between the independent and dependent variables	Changes initiated in a dynamic operating environment
Control variable	Variable to be kept constant in order to ensure there is no undue impact on the dependent and independent variables	Equal quantity of people Same objectives Same training and level of education and experience with business processes
Confounding variable	Extraneous but difficult to observe variables that can potentially undermine the outcomes from the independent and dependent variables; requires consideration to avoid spurious conclusions	Level of intelligence between participants Propensity towards games and exercises

The propositions derived from the literature suggest a positive relationship between the variables discussed i.e. higher levels of predictability and modularity will make business processes more reconfigurable and subsequently minimise disruption. Hence, the objective of the experiment is to test the validity of these propositions by investigating the relationship between variables. Table 4.2 provides a definition of the variables, as well as a description of how they pertain to this experiment.

The independent variables in this instance are predictability and modularity, whilst the dependent variables are the level of disruption and time taken. For example, the third proposition in

Table 2.9 states that *a more modular approach to business process design, based on predictable outcomes would enable transformational changes to occur rapidly and with reduced disruption,* which indicates that positive changes to the independent variable would lead to the changes in the dependent variable, where disruption is reduced.

The mediating variable acts as a facilitator of the entire experiment and explains the relationship between the independent and dependent variables, in this experiment the mediating variable is reconfigurability. The moderator variable is the instigative factor that initiates the relationship between the independent and dependent variables, for the purposes of this experiment, changes initiated in a dynamic operating environment represent the moderating variable.

The control and confounding variables ensure a degree of equality between the independent and dependent variables and also the control and experimental group.

4.3.1. Initial scenarios considered and lessons learned

In designing the experiment for data collection, two operational process scenarios were initially designed for carrying out the experiments and testing the validity of the propositions derived from literature. First, an order fulfilment process and second, a recruitment and selection process, in both instances the experiment failed to achieve the previously defined criteria necessary for data collection. The initial justification for selecting these two operational processes was to attempt to ensure the experiments reflect organisational business process characteristics. The remainder of this section provides a detailed description of the challenges and lesson learned.

In the first order fulfilment scenario, a control and experimental group were created, where both groups were tasked with modifying the current order fulfilment process in line with the organisation's new direction. Similarly, in the second recruitment and selection scenario, a control and an experimental group were tasked with modifying the recruitment and selection process of the organisation in relation to the company's new objectives. In both scenarios, the order fulfilment and recruitment and selection process; the participants were selected and randomly split into two groups forming the control and experimental groups as required in an experimental data collection strategy. Both groups were given identical background information: a beverage maker based in Europe was aiming to expand its operations outside the continent due to increased competition locally. To determine the validity of the propositions, the experiment had to measure the effect of the dependent variable on the independent variable. As indicated in Table 4.2 Variables and Experimental Implications), predictability and modularity were identified as independent variables, whilst the level of disruption and time taken were identified as the dependent variable. Therefore, the experimental groups were given enough information and training (independent variable) to enable predictability and modularity which the control group was not provided with. Subsequently, three changes were introduced at various points during the experiment, with each change increasing in complexity. The first change required a minor modification of the existing process, whilst the second change required several modifications and the third process required a top-down re-engineering of the process. The notion behind this was to offer a degree of comparison between BPI, BPR and BPRC. The experiments failed to fulfil the previously defined criteria necessary for data collection (see Section 3.7.5). Whilst a dynamic operating environment was achieved, and the researcher was able to integrate elements of predictability and modularity to the experiment, the experiment was unable to provide a degree of comparison between all the process change initiatives and failed the internal validity test. Furthermore, this experimental design failed the reliability criteria and was not able to capture the design and implementation of the business process; getting the participants to implement the real-life process that they had designed in a simulated environment was not feasible. Whilst designing a business process based on a real-life case study posed no significant challenge to the participants, it was discovered that implementing the process in an experiment was not practical for data collection and observation.

In a real-life organisational business process, each participant would have a degree of experience or training with regards to the work flowing through the process, whether it be an order fulfilment or recruitment and selection process. However, for the purposes of this experiment, training the participants on the order fulfilment process for a beverage maker would have created additional complexity and no added value to the purposes of this research.

The high-level nature of the scenario in this experiment created more complexity because the focus shifted from operational to strategic. Factors surrounding each process diverted emphasis from the core focus of the experiment-business processes. Participants were unduly influenced by other factors that could impact these business processes, and as such could not effectively design and implement the business process. From the outcome of these two experiments, it was apparent that in order to test the validity of the propositions and fulfil the necessary predefined criteria, the designed experiment would have to involve a task that is easily comprehensible and completely process based. This would ensure that the objective of the experiment is met, and all criteria fulfilled, enabling adequate data collection. Based on these attempts to design a real-life case study experiment that fulfils the demands of the previously stated criteria, and appropriately tests the validity of the propositions derived from literature, a research experiment was adapted from Womack and Jones, (1996), on the advantages of one-piece flow over batch production[6]. Their experiment was aimed at revealing the efficiency of one-piece flow over batch production using an experimental process of folding and placing the paper into envelopes to be stamped. This workshop styled experiment was chosen because it is procedural and easily comprehensible. Therefore, participants could get on with the task of designing and implementing the process

[6] One Piece Flow vs. Mass Production- https://www.youtube.com/watch?v=Dr67i5SdXiM

without the distraction of external factors as observed in previous experiments. Unlike in these previous experiments, the activity-based nature allows the participants to physically implement the experiment, which enables the researcher to adequately observe and analyse the design and implementation of each process. The subsequent sections contain a description of how this experiment was adapted to suit the objectives of this research.

4.3.2. Final design and experiment

The final design of the experiment used in this research was guided by the following factors: the classic experimental design; the predefined criteria necessary for data collection; the criteria for assessing research quality; the lessons learned from previous experiments; and, Womack and Jones, (1996) one-piece flow envelope experiment were all significant to the final design of this experiment. In Figure 4.1, the process of the design of the experiment is illustrated by the selection of participants prior to the experiment, and to the start and finally the end of the experiment.

The scope of this laboratory-based business process experiment was limited to designing the process (using post-it notes to map the process) and implementing the process, which entails physically undertaking the activities delineated in the designed process. The experiment was split into the following three phases:

- Scenario 1 entailed an initial process design and implementation.
- Scenario 2 featured the introduction of minor unplanned changes which required process improvement (BPI),
- Scenario 3 introduced major changes that would require re-engineering (BPR).

As stipulated in the requirements of a classic experiment, all participants selected had to be similar to avoid bias; meaning a similar level of education, knowledge and experience with regards to business processes. This was significant due to the varying levels of understanding of business processes potentially having an adverse effect on the relationship between the variables; for example, a participant with a limited understanding of business processes might spend more time than required to design a process and therefore misrepresent the results. The extra time taken to design a process could be incorrectly analysed as being a result of the unexpected changes to the task (disruption), whilst it may, in reality, be due to the participant's limited understanding of the task in question.

To mitigate this potential bias and ensure a similar understanding of business processes, all participants selected were postgraduates with similar levels of experience with business processes and also received a basic business process training. The training was on the effectiveness and efficiency of BPM to organisations, process mapping techniques, and the significance of a one-piece flow envelope experiment.

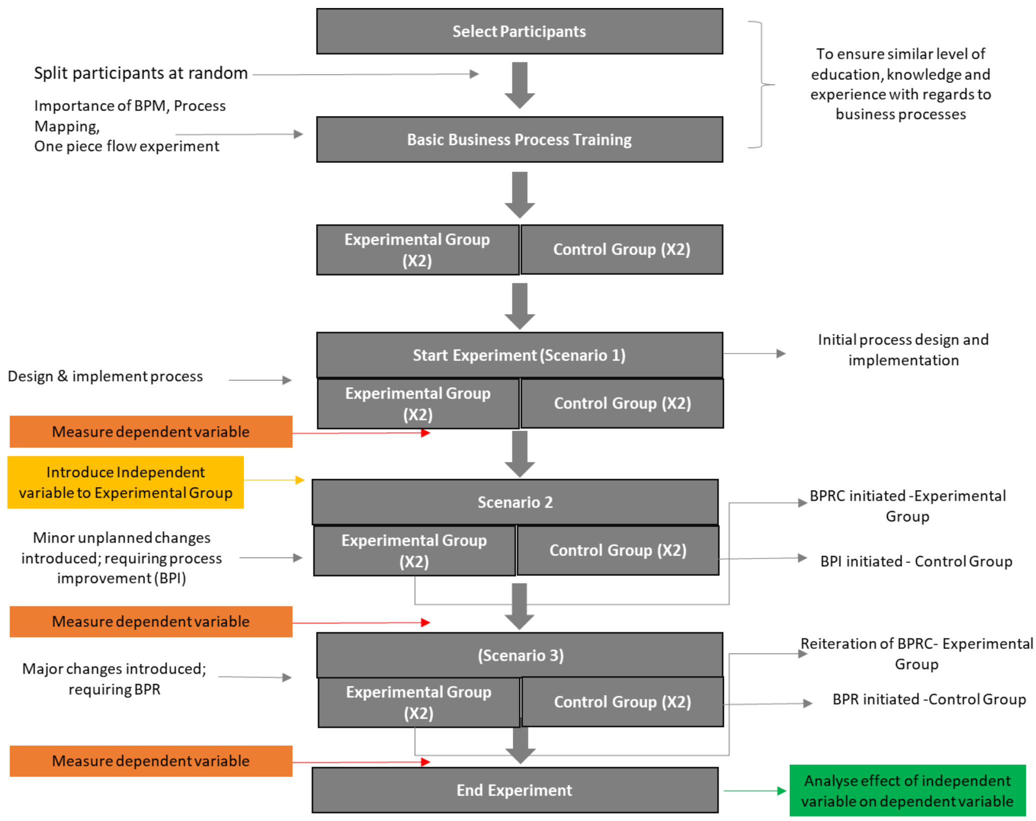


Figure 4.1 Design of Experiment

To illustrate the required level of detail regarding the tasks within a process, the participants watched two videos on the process of making a cup of tea[7] and another on the process of One-Piece Flow vs. Mass Production[8] using an envelope placing lean thinking simulation. The first video on the process of making a cup of tea was used to instruct the participants on process mapping techniques. By instructing each group to use the information gleaned from the video to design a process and map it using post-it notes, the researcher was able to ensure an appropriate level of understanding of process design and mapping. The second video on One Piece Flow vs. Mass Production was used to show participants the significance of an exercise like envelope sorting to business processes and industry operations.

The justification of the use of an envelope mail sorting workshop for this experiment, is its widespread use in analysing process flow in organisations. In analysing organisational productivity of businesses ranging from airlines and health care in service industries to construction and manufacturing operations, Womack and Jones, (2010), employ the use of a single-piece flow workshops. In their analysis, they explain the importance of flow in every business operation and the effect it has on waste. Therefore, there is justification for employing the use of a mail sorting one-piece flow in a process of this nature to illustrate a business process scenario. Furthermore, mail sorting is an actual process used in an organisation where bulk letters are received or sent from and to customers.

[7] How to make a cup of tea video- https://www.youtube.com/watch?v=MV2zpq9P2zo

For the first experiment, six Master's degree students were selected; based on the requirements of the classic Experimental design, these six were split at random to two groups; namely, the Control and Experimental Group. For the second experiment, eight PhD. degree students were selected, again based on the requirements of the classic experimental design, these eight participants were split at random into two equal groups of four; a control group and an experimental group.

After the selecting, training and splitting of the participants, each group undertook the experiments at different times in the same location; an information sheet describing a scenario from a mail sorting room was given to each group. It is important to state that all four groups conducted their experiments in isolation of the other groups.
Scenario 1 entailed an initial process design and implementation based on information provided to all participants, here all groups received the same information; see Figure 4.2 for the details on the content of the information sheet handed out to all the participants. After the information had been provided, each group was given five minutes to read and discuss the information received, and also ask questions for clarification. After which, as stipulated in the information sheet they were to design and map out a process using post-it notes provided, as well as assign specific tasks in the process to specific individuals within the group. This was done to make sure the process experiment was identical to organisational operational processes where roles and tasks were usually defined. Based on the training received, it was anticipated that each group would design the process map in a manner similar to a conveyor belt, where each task in the process is done by one person and passed on to another till the process is completed. In doing so, the first participant would select and pass on a paper to the second participant who would then fold the paper and pass on to the third participant whose task

was to select and place the folded paper into an envelope then pass on to the fourth participant who seals the envelope and stores it.

The objective of Scenario 1 was to observe and measure process efficiency and effectiveness of the experimental and control group, which subsequently enabled a degree of comparison between the two groups before any change was introduced.

Mailing Room Report

You have recently been appointed team lead of the mailroom sorting house at Primani and associates. Waste in the mail sorting process led to the need for a change in leadership of the team. Waste includes wrong stamps being put on envelopes and documents, delays in getting to post, poorly folded papers in envelopes and documents being stored wrongly. This waste has led to a lot of rework that is time consuming and unnecessary.

Tasks
The task involves folding and placing paper into envelopes, stamping the envelopes and sending them to be sorted.

The tasks have been split into two steps:

1. **Design the process (using post it notes)**
   - This entails creating a process map on the board of how you intend to physically carry out the task
   - The process should also include assigning specific people to specific tasks in the process
2. **Implement the process**
   - Follow the designed process and go about the task of sorting the mail into envelopes

NOTE
If at any time during the implementation of the process you deem it necessary to make a change to the process; you have to take the following steps:
STEP 1- Stop. Redesign the process on the board,
STEP 2- then go about implementing the process.
At all times the process being implemented must be a reflection of the process on the board.
It is important to again state that it is imperative that the tasks are carried out efficiently and effectively, time is of the essence.

Figure 4.2 Information for scenario 1 provided to experiment participants

For the implementation of the task, the participants were provided with stacks of plain A4 paper, along with C4, C5, C6 and DL envelopes (see Figure 4.6 for envelope shapes), and two storage boxes; depending on the process map on the board participants were generally expected to fold, place the paper in the envelope and finally place the envelope in the storage box. See Figure 4.3 for details of expected paper and envelope fold configuration. All envelopes came in window and non-window types.

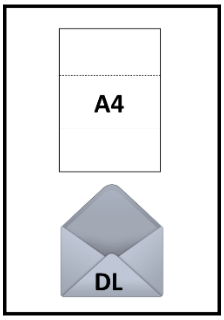


Figure 4.3 Fold Configuration - Scenario 1

In Scenario 1, all groups were observed by recording them on video and timed to check for efficiency and effectiveness; process cycle time was used as an indication of efficiency. The process cycle time was measured by the amount of time it took for each process run, which starts from when the paper is selected and ends when it has been folded, placed in the envelope and the envelope stored in the storage box. Effectiveness was defined in this scenario as successfully performing the task of selecting, folding, and placing the paper in the envelope and finally storing it in the storage box. In essence, the effectiveness of the process was determined by the average cycle time it took each group to complete the requirements of the process. At the end of Scenario 1, the process effectiveness and efficiency were measured for all groups.

Prior to the commencement of Scenario 2, the Independent variable was introduced. For the purpose of this research experiment, predictability and modularity (see Table 2.8 for definitions) were used as the independent variable. As stipulated in the classic experimental design the independent variable was introduced only to the experimental group. As such, predictability and modularity were only introduced to Experimental

Groups1B and 2B. Please see Table 4.3 for categorisation and label for each of the groups in the experiment.

Table 4.3 Group Categorisation and Labels

	1st Experiment	2nd Experiment
Control Group	1A	2A
Experimental Group	1B	2B

Therefore, the experimental groups were trained of the possibility of more changes similar to the one experienced in the previous scenario (without stating the specific nature of the change) and based on that, should design a modular process in anticipation of more unplanned changes. In addition to this training on predictability, the experimental group was also educated on modularity; by explaining that a process can be delineated into divisible modules that enable change. To further iterate this point, the experimental group was given a document (see Figure 4.6) that included possible modular configurations of folding paper and placing them in envelopes. Since the propositions suggest BPRC is underpinned by the tenets of predictability and modularity, which enhances reconfigurability and enables transformational change with minimal disruption[2], the introduction of predictability and modularity to the Experimental Group was justified.

In Scenario 2, minor unplanned changes were introduced to the process; the objective here was to observe and measure the impact of disruption brought about by these minor unplanned changes and to see the effect of process improvement (BPI) in relation to a reconfigurable process (BPRC). These minor changes necessitated a process improvement (BPI). To meet the requirements, the Control Group would initiate an improvement of the existing process, whilst the Experimental Group would be introduced to the concept of reconfigurability to enable and facilitate rapid responses to future changes. In Scenario 2, without any instruction and in addition to the plain A4 sized paper, A6 sized receipts (see Figure 4.5) was introduced to the pile of papers to be handed to both groups. Through a communique, both groups (experimental and control) would be duly informed of the need to change processes, see Figure 4.4 for details. This communique would necessitate a change of the existing process design and consequently the implementation of the process.

Mailing Room Report

Management has recently received a complaint from the Accounts department about the condition of the company receipts they have been receiving.

They complained that company receipts received by them have been folded and placed in DL envelopes, and the folding sometimes distorts the information on the receipt and makes it difficult to read the content, and also placing it in a DL envelope makes the process of filing clumsy

New requirement

Based on these complaints, management proposes that the team designs and implements a new process map that enables the Accounts team read and file the receipts without challenges

We suggest the A6 sized receipts be placed in C6 sized envelopes, this will ensure folding is not required and also enable the Accounts team store the receipts seamlessly

Signed

Management

Figure 4.4 Information for Scenario 2.

RECEIPT		Date	29/09/2015		No.123456
Received From	Strathclyde DMEM			**Amount £ 1234**	
Amount	One Thousand Two Hundred Thirty-Four and NO/100 -----------GBP				
For Payment of	Rent of James Weir Building				
From	01/01/2015	**to**	01/06/2015	Paid by	Cash
Received By	Primani & Associates				
	[Address]				Account Amt
	[Phone]				This Payment
					Balance Due

Figure 4.5 A6 sized receipts

In Scenario 3, major unplanned changes are introduced; the objective here was to further observe and measure the impact of disruption brought about by major changes in addition to those done in the earlier scenario. These changes required process re-engineering (BPR). However, by introducing the tenets of BPRC to the Experimental Group, Scenario 3 should also enable a comparison of BPRC and BPR in relation to disruption.

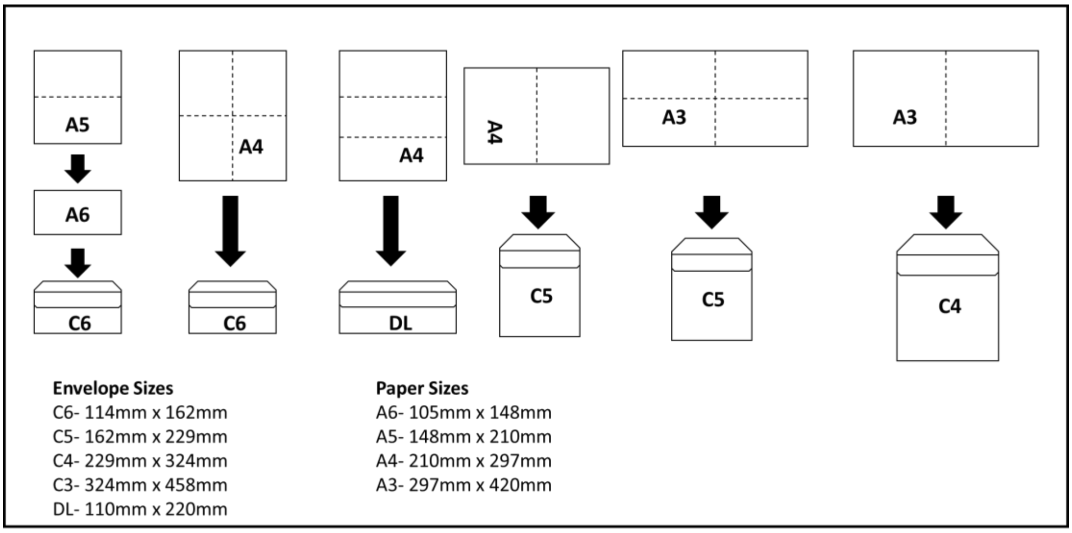


Figure 4.6 Modular Configuration of Paper to Envelope

In Scenario 3, without prior notice, specific changes were introduced; A5 sized Bill Statement and A4 sized Invoices were introduced, see Figure 4.7 and Figure 4.8 respectively for details. Furthermore, the two storage boxes were renamed as “File” and “Mail”, with the expectation that the Bill Statements and Invoices would be placed in the mailbox, whilst the receipts would be stored in the file box. With the control group, the assumption is that they would continue to implement the previously designed process map, even though the circumstances had changed.

They would subsequently be informed through a *communique* of the need to change operational processes, see Figure 4.9 for details. This communique would necessitate a re-engineering (BPR) of the existing process design and consequently the implementation of the process, leading to a degree of disruption. With regards to the experimental group; if there was a positive relationship between the independent variable (Predictability and Modularity) and the dependent variable (Level of Disruption), then these changes would have a little effect in comparison to the Control Group on existing process design and implementation. However, if there was a negative relationship between the independent variable and the dependent variable, the Experimental Group would experience similar levels of disruption as the Control Group due to these changes.

Primani & Associates
BILL STATEMENT

Bill To: James Philip
337 Glasgow Harbour
Glasgow. G117BH

Statement Date	30/05/2015
Statement #	[100]
Customer ID	[ABC123]

Remittance

To ensure proper credit, please enclose a copy of this statement with your check and remit to:

Primani & Associates
[Street Address]
[City, ST Zip]

Please write your Customer ID on your check.

Account Summary

Balance Due	**£250.00**
Payment Due Date	20/07/2015
Amount Enclosed	

Make all checks payable to
[Company Name]

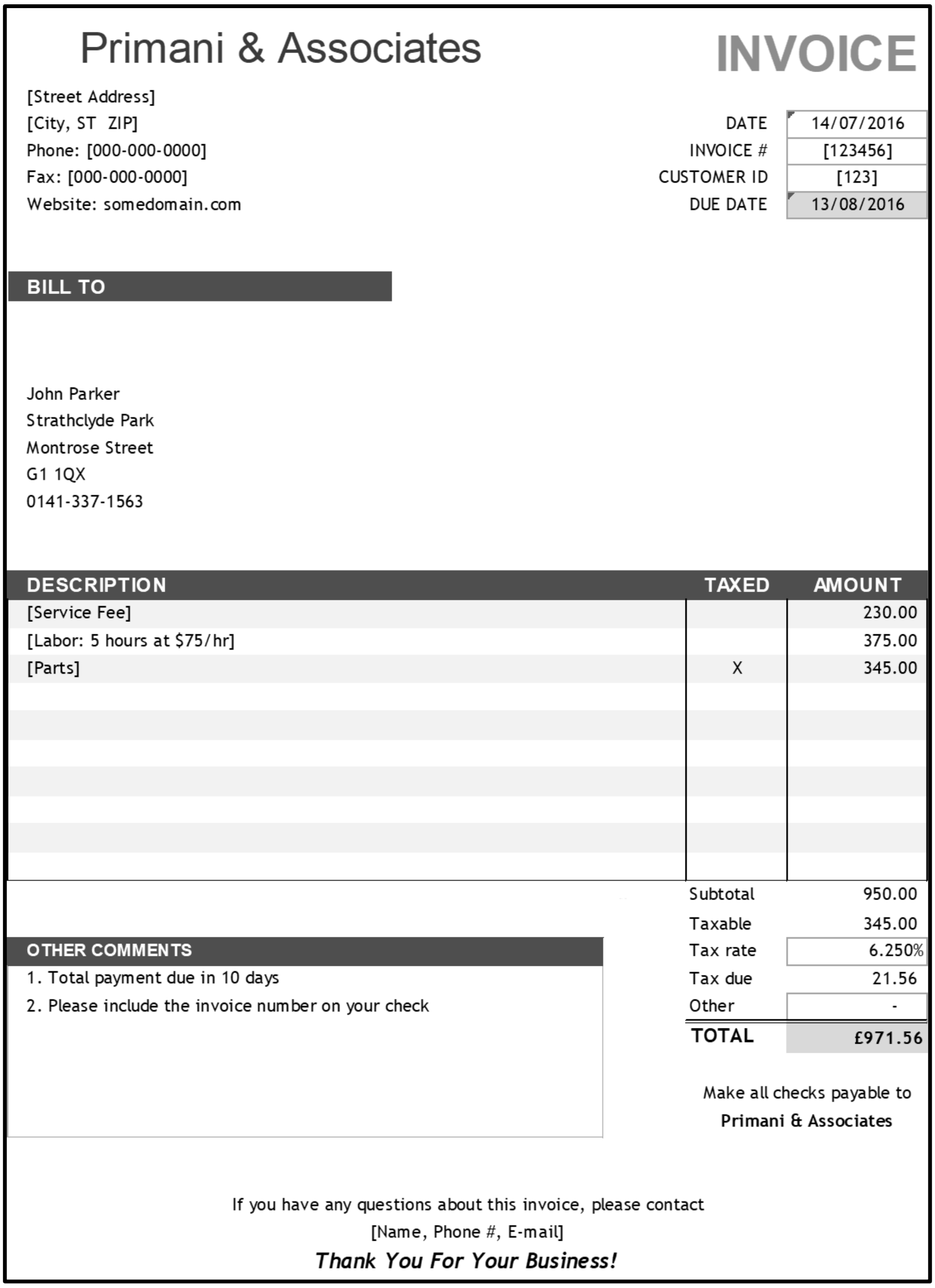
Account Activity

DATE	TYPE	INVOICE	DESCRIPTION	PAYMENT	AMOUNT	BALANCE
1/1/12			Balance Forward			£250.00
					Current Balance:	£250.00

If you have any questions about this invoice, please contact
[Name], [Street Address], [City, ST Zip]
Phone [000-000-0000], Fax [000-000-0000], [Email]

Thank You For Your Business!

Figure 4.7 A5 sized bill statement



Primani & Associates

INVOICE

[Street Address]
[City, ST ZIP]
Phone: [000-000-0000]
Fax: [000-000-0000]
Website: somedomain.com

DATE	14/07/2016
INVOICE #	[123456]
CUSTOMER ID	[123]
DUE DATE	13/08/2016

BILL TO

John Parker
Strathclyde Park
Montrose Street
G1 1QX
0141-337-1563

DESCRIPTION	TAXED	AMOUNT
[Service Fee]		230.00
[Labor: 5 hours at $75/hr]		375.00
[Parts]	X	345.00

Subtotal	950.00
Taxable	345.00
Tax rate	6.250%
Tax due	21.56
Other	-
TOTAL	**£971.56**

OTHER COMMENTS

1. Total payment due in 10 days
2. Please include the invoice number on your check

Make all checks payable to
Primani & Associates

If you have any questions about this invoice, please contact
[Name, Phone #, E-mail]
Thank You For Your Business!

Figure 4.8 A4 sized invoices

Mailing Room Report

Management has recently received a number of complaints regarding Bill Statements and Invoices not getting to customers promptly, consequently this means the organisation does not receive monies owed by customers on time.

Based on the new directive to not only send customer Bill Statements (A4 paper) and Invoices (A5) electronically but by letter, management suggests a couple of changes are required to the mailing process, namely:

1. The two storage boxes have been labelled as "File" and "Mail"; Receipts should be stored in the storage box labelled "File", Bill Statements and Invoices which are to be sent out to customers should be stored in the storage box labelled "Mail"
2. Bill Statements and Invoices should be placed in window envelopes; this would enable the postman deliver them to the customers promptly.

Signed

Management

Figure 4.9 Information for Scenario 3

4.4. Validating the Experimental Design

The validity of this research design is dependent on meeting the criteria for assessing the quality of the research and also in ensuring that the design meets the purpose of the intended experiment which was to test the propositions derived from literature. According to Saunders et al., (2016), four criteria are necessary for assessing the quality of research; construct validity, internal validity, external validity, and reliability.

With regards to the construct validity of this experiment, the objective was to ensure the intended measures were actually measured; the intended measure of this experiment was to test the propositions derived from literature.

The first proposition (*Existing knowledge of reconfigurability in product, manufacturing systems and software engineering can be transferred and/or replicated for business processes*), in the experiment, a feature of reconfigurability in product design was incorporated. As stated previously, reconfiguration in product design enables a degree of reconfigurability to the customer, where the product not only provides the customer with the ability to tailor/configure the specification of their intended purchase, it also enables upgrade (or reconfiguration) to various components as required (Jiang, 2002; Borja *et al*. 2000; Jose and Tollenaere 2005; Simpson 2004). In the experiment, this feature was indirectly integrated into the design of business processes by giving the experimental group a modular configuration of the possible paper to envelope fold (see, Figure 4.6), which subsequently enabled reconfigurability to the process when the need to change arises.

This leads to the second proposition (*A high degree of predictability, will enable a more modular approach to process design*). Predictability is the ability to anticipate future occurrences with a degree of confidence and modularity from the context of business processes is the described as the ability to independently design processes from smaller subsystems yet function together as a whole. Therefore, in the third scenario of the experiment, the configuration of paper to envelope size and information on the possibility of changes given to the experimental group enabled predictability which would subsequently lead to a modular design.

With regards to the third proposition (*A more modular approach to business process design, based on predictable outcomes would enable transformational changes to occur rapidly and with reduced disruption*), again in the third scenario, the amount and the significance of changes introduced would require a degree of process transformation and disruption. By integrating modularity and predictability into the design process for the Experimental and not the Control Group, a measurement of the impact they have on speed is achievable.

The fourth proposition (*Existing business process management methods, tools and techniques would not be appropriate, or even sufficient to enable the design of reconfigurable business processes*). On the one hand, existing traditional process design methods are used in response to the need for change, as done by the Control Group. On the other hand, the Experimental Group designs its process before the need for change, this enables a comparative analysis of the methods used in process design. Therefore, in traditional process change, the tools required are reactionary rather than proactive. In this experiment, the Control Group used traditional methods and tools of BPR and BPI, whilst the Experimental Group used complementary tools required to design reconfigurable processes.

With regards to the fifth proposition (*The amount of effort and ingenuity required to design reconfigurable business processes would be significantly more than other traditional forms of process design*), by observing and timing the reconfigurable design process on the Experimental Group in relation to the traditional process design process by the Control Group, a measurement of effort and ingenuity can be attained.

With regards to the internal validity of this experiment, the objective is to establish a causal relationship between two variables; this form of validity is especially significant in experimental research (Campbell and Stanley, 2015; Cook et al., 1979; Saunders et al., 2016; Yin, 2015). As stated in Section 4.3, this experiment involves the use of propositions that are based on predictions of the relationship between variables; in Table 4.2, a list of all the variables pertaining to this experiment are itemised. Since internal validity is only demonstrated when the outcome of the experiment is related to an intervention (i.e. independent variable) in the experiment, then the causal relationship between the variables has to be tested.

The relationship between variables and propositions are categorised in two forms; namely, null and alternative hypothesis, which for the purposes of this research, is referred to as a negative proposition or positive propositions. The negative proposition, if accepted, suggests no relationship between the independent and dependent variables, thereby indicating the propositions are invalid. Whilst a positive proposition; if accepted, suggests a relationship between the independent and dependent variables, thereby indicating that the propositions are valid.

Using the fourth proposition (*A more modular approach to business process design, based on predictable outcomes would enable transformational changes to occur rapidly and with reduced disruption*) in

Table 2.9 as an example, if an increase in the independent variable (modularity and predictability) leads to a reduction in the dependent variable (disruption), then a relationship between variables has been established. This internal validity gives credence to the experimental process and subsequently ensures the results of the experiment are not spurious.

With regards to the external validity of this experiment, the objective is to ensure the outcome of the research is generalizable or replicable in a different context. If the output from the research can be replicated in a different context, the research has achieved external validity. The elements selected for this experiment have been clearly defined; for example, the selection of people, environment and time, have been done randomly. Irrespective of the fact that the experiment was done within a university environment and the participants were all postgraduates, the challenge of participating in the experiment (folding documents and placing in envelopes) did not require any level of specific cognitive ability. As a result, the external validity of this research has been achieved.

With regards to the reliability of this experiment, the objective is to ensure that the output from the research is consistent in relation to the data collection method and analysis. In order to demonstrate the reliability of the research output, this experiment was replicated using the same data collection method in the same environment, with consistent output.

Chapter 5. Results of Experiments

This chapter provides a description of the results of the experiment, where the details of the results from the two experiments conducted are communicated. This section also provides additional information about how the experiments were conducted. The analysis of the results of the experiment are not contained in this section but the subsequent section (See Analysis and findings in Chapter 6). The discourse during the experiment is also not included in this section but has been added as an appendix[9].

In this research, two experiments were undertaken, the second was done to investigate replicability and to ultimately validate the propositions from research. As stated in previous sections, there were minor differences in the participants used in both experiments, for the first experiment, six Master's degree students were selected and for the second experiment, eight PhD. degree students were selected.

[9] Transcript from Control and Experimental groups are detailed in Appendix 3- Transcript from Control Group and Appendix 4- Transcript from Experimental Group

5.1. Description of results from first experiment

The results from the first experiment are illustrated in Figure 5.1, whilst Figure 5.8 illustrates the results from the second experiment, these two results along with other figures are discussed in detail in the subsequent sections. The first and second experiments contain two sets of results, which are the results of the Control and Experiment Group.

Each experiment contained three scenarios with eight phases. Each scenario represented a new set of instructions for the participants, and each phase represented a different set of tasks for the participants. In each phase the time taken by the groups was recorded, the phases have been colour coded to represent the different tasks taken place. The phases colour-coded in yellow represent the process design tasks, the phases colour-coded in green represent the implementation tasks of the process, and finally, the phases colour-coded in red represent the disruption tasks caused by the changes introduced.

The first scenario involved two phases. In Phase 1, an initial process design map for filling the envelopes was created by the participants, and subsequently, in Phase 2, the participants implemented this process map. In Phase 2, this process implementation was concurrently undertaken by both groups nine times as illustrated in Figure 5.1. The number of cycles (nine) selected was decided as appropriate by the researcher because it provided ample data for comparison; to ensure consistency, all phases of the experiment went through nine cycles.

The second scenario involved three phases. In Phase 3, a minor unplanned change was introduced to the process that necessitated a processual change due to the new required output. In this phase, the time taken by both groups to recognise the need for this processual change, and the effect it has on the groups was recorded. With regards to the Experimental Group, in addition to recognising the need for change, the independent variable was introduced as indicated in Table 4.2. The necessity of a reconfigurable process underpinned by modularity and predictability was intimated. In Phase 4, a record of the time taken by the Control Group to design (improve) the process (BPI) in order for it to meet the new requirements was recorded, whilst a record of the time taken by the Experimental Group to design a reconfigurable business process (BPRC) was also recorded.

In Phase 5, the new process design was subsequently implemented, and like in Phase 2, the implementation was done in nine concurrent process cycles by both groups.

The third scenario involved an additional three phases; Phase 6, Phase 7, and Phase 8 see Figure 5.1 and Figure 5.8 of the first and second experiments. In Phase 6, a major unplanned change was introduced that forces a radical processual change due to the new required output. A measurement of the time taken by the Control and Experimental Groups to address the need for this change, and the effect it had on the group was recorded. In Phase 7, the Control Group initiated a major redesign of the previous process, whilst the Experimental Group *reconfigured* the previous design from Phase 5. In the final phase (Phase 8), both groups implemented the new process design, again the time taken for nine process cycles implemented concurrently was recorded.

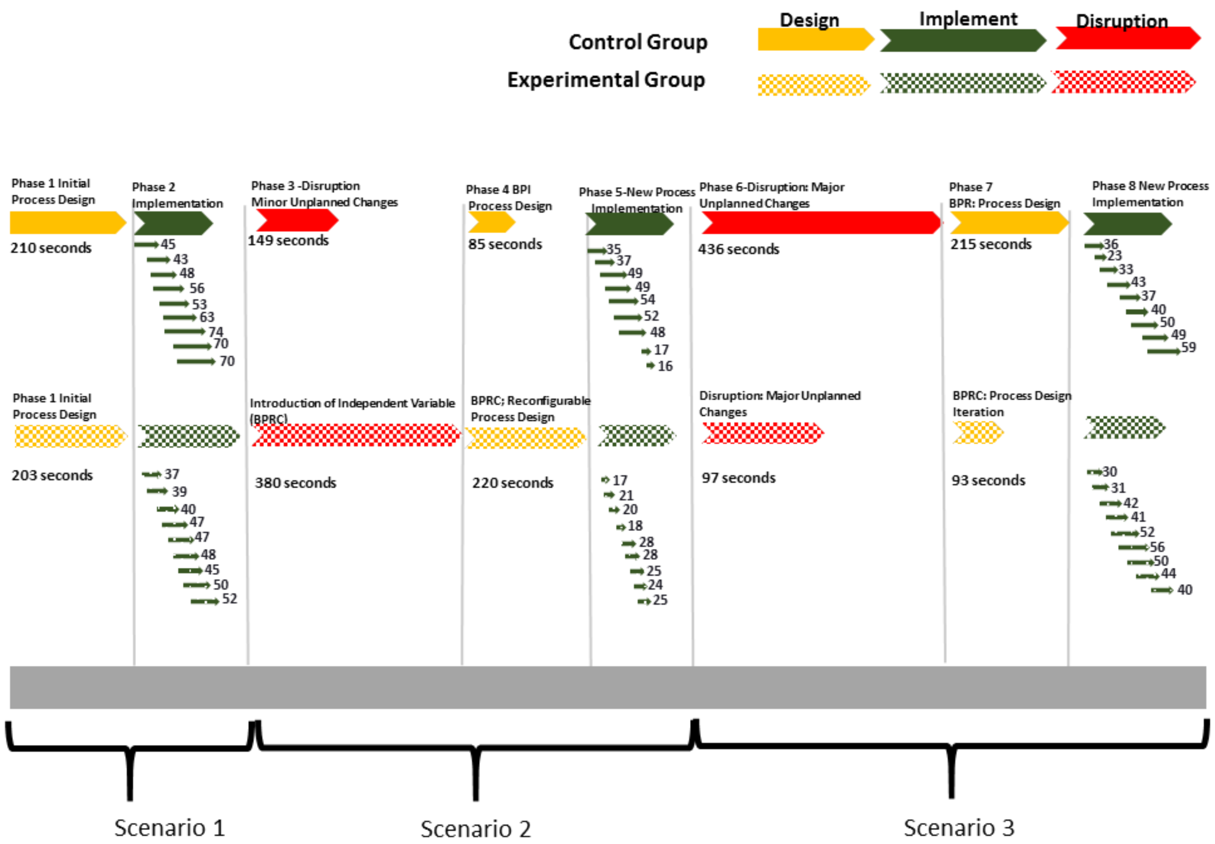


Figure 5.1 First Experiment

5.1.1. 1st Scenario - Initial Process Design and Implementation

In Phase 1 of Scenario 1, both groups received the same information with the task of designing and mapping a process from the information received, whilst in Phase 2, the mapped process was subsequently implemented. The implementation of the process entailed selecting a document, placing the document in an envelope (A4 paper into a choice of envelopes- no preference was given), sealing, stamping and storing each document received. In the process design phase of the first scenario, both teams were also required to assign specific tasks in the process to specific individuals in the group. The Control Group-1A took a time of 210 seconds to design and map the process, whilst the Experimental Group-1B took a time of 203 seconds to design and map the processes, see the process maps and division of tasks[10]. In this 1st scenario, the respondents in the Control Group-1A are influenced by the efficiency of the one-piece flow over batch production and have decided to design their process accordingly. After they decided on the one-piece flow, there was an initial discussion on effectiveness where one of the respondents said "Right, so we're folding it and stuffing it right here? And another responded: "Yes."

"Yes. Then you have to select the right envelope, like size, as well, how are we choosing which envelope they go in?"

"Based on the final folding configuration."

Hence, whilst the choice of one-piece flow was largely based on efficiency, that is the need to complete the task as quickly as possible, but also recognising the need for the tasks to be completed correctly. In their process design, they decided to include an

[10] Corresponding picture of actual process maps is in Figure 0.1

additional task- check orientation, to ensure the paper was folded and placed correctly into the envelope before sending out, see Figure 5.2.

Similar to the Control Group-1A, the Experimental Group-1B put more emphasis on efficiency that effectiveness, the video on one-piece flow over batch production has an influence on the need to use this process rather than batch production. But unlike the Control Group, they did not deem it necessary to include a task in the process that checked paper to envelope orientation, see Figure 5.2.

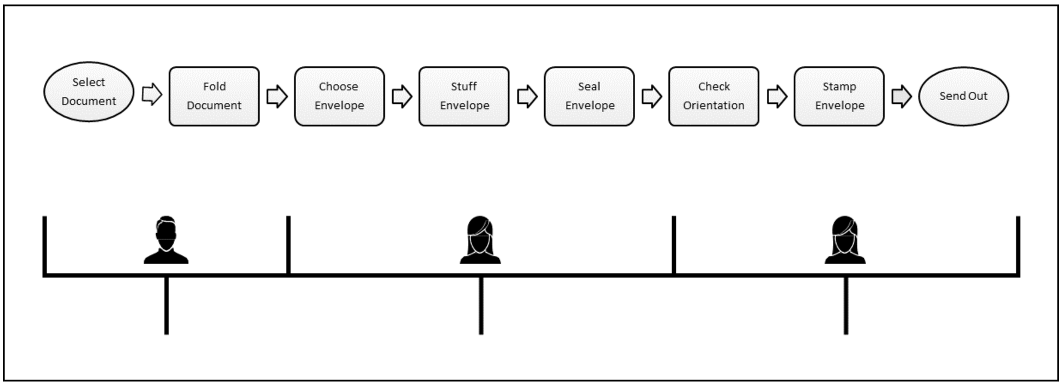


Figure 5.2 Control Group-1A Process Map- Scenario 1

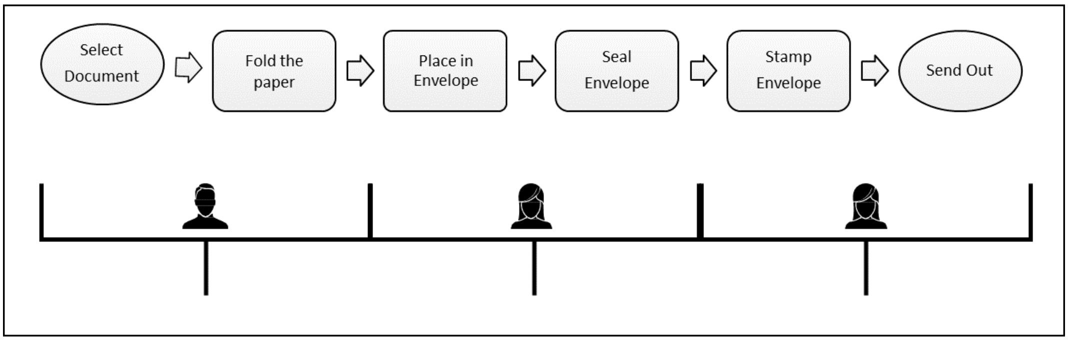


Figure 5.3 Experimental Group-1B Process Map - Scenario 1

In the implementation phase (Phase 2) of scenario 1, the Control Group and the Experimental Group executed the process nine times (i.e. the process went through nine cycles), the total time taken for the implementation was 158 seconds and 156 seconds respectively. The similarity in the total amount of time taken for implementation was expected due to the identical nature of the tasks to be undertaken by both groups. However, there was a degree of discrepancy in both groups; because the processes were executed concurrently, a sum of the individual implementation times for each cycle exceeds the total time taken during implementation. For example, the execution times for the Control Group-1A on each implementation in Scenario 1 were 45, 43, 48, 56, 53, 63, 74, 70, and 70, whilst the Experimental Group-1B implementation time for each execution were 37, 39, 40, 47, 47, 48, 45, 50, and 52. The total time taken by the Control Group-1A and the Experimental Group-1B to design, map and implement the process was 368 and 359 seconds respectively with an average cycle time of 40.8 and 39.8 seconds. See Figure 5.1 for details of each process cycle in relation to each task, phase and scenario.

5.1.2. 2nd Scenario -Introduction of BPI and BPRC

The second scenario involved three phases. In Phase 3, a minor unplanned change that disrupted the initial process design was introduced to the Control Group-1A and the Experimental Group-1B, this necessitated changes to the existing process. This minor unplanned change was achieved by introducing a different document (A6 sized receipts) in addition to the A4 sized document. The Control Group-1A and Experimental Group-1B responded by folding the receipt and placing it in an inappropriate envelope. At inspection, this error was noticed, and the groups were duly informed that a C6 envelope that allowed the document to be stored without folding would be required. In Phase 3, the time taken by the Control Group-1A and the Experimental Group-1B to identify and understand the cause of the disruption was 72 and 380 second respectively. The extended time of 380 seconds from the Experimental Group -1B was caused by the additional introduction of process reconfigurability, where the group was introduced to the possibilities of uncertainty and change. This subsequently led to the introduction of the independent variable (predictability and modularity) as a solution to mitigate future uncertainties. The time of 380 seconds includes the time it took them to understand the implications of reconfigurability and how it relates to the new changes introduced and the possibility of subsequent changes.

In Phase 4, to meet the new requirements caused by the minor unplanned changes, the Control and Experimental Groups, needed to change their current processes. The Control Group-1A, made an improvement (BPI) to their existing process design by including a decision gateway (decide on the fold, based on the size of the document received) in the process between receiving and selecting the envelope and folding the document, see Figure 5.4. The Control Group-1A took 85 seconds to improve the design of this process based on the new requirements.
The Independent Variable (Predictability and Modularity) was introduced to the Experimental Group-1B, where they were informed of the requirements and necessity of a reconfigurable process. This meant that they (Experimental Group- 1B) designed the process with an understanding that there may be future changes to the process, so the process was designed with a degree of prediction of these future changes by making the process more modular. This group decided that there were three feasible sets of documents that could come into this mail sorting room, Bills, Invoices and Receipts in three possible paper sizes (A4, A5, and A6), see Figure 5.5. They came to this conclusion, after analysing previous process cycles in Phase 2. The total time taken to design the reconfigurable process by the Experimental Group was 220 seconds. In Figure 5.5, the reconfigurable business process design was underpinned by predictability

and modularity. By predicting the possibility of changes in the types of documents received and their corresponding envelopes they were able to create modules within each task and based on the documents received the process path would be followed. The definite tasks have been indicated with bold lines and the modular paths with dotted lines. The corresponding picture of actual process maps as was created on the board during the experiment is depicted in Figure 0.2 and Figure 0.3 of Appendix 1.

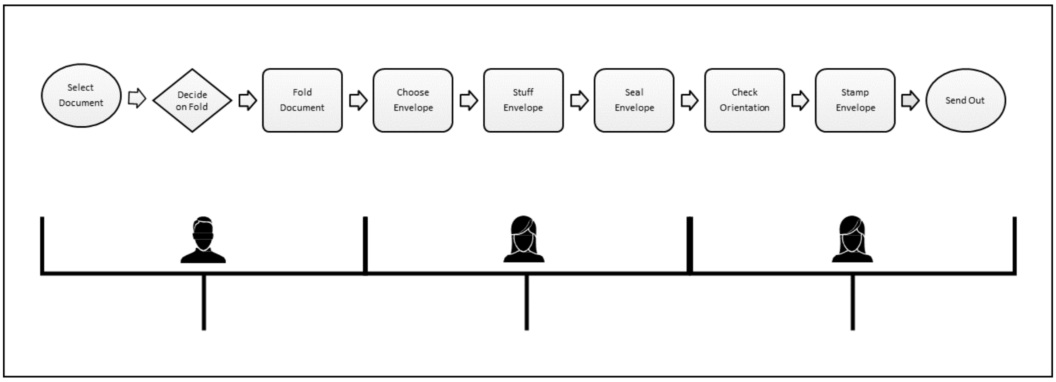


Figure 5.4 Control Group-1A, BPI- Process (Scenario 2)

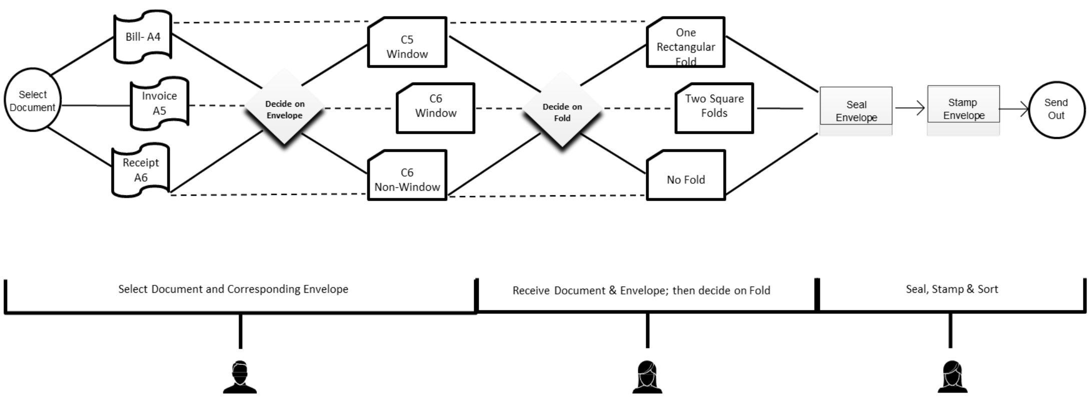


Figure 5.5 Experimental Group-1B, BPRC- Process (Scenario 2)

In Phase 5, both groups implemented their respective processes: The Control Group took a total of 201 seconds, whilst the Experimental Group took a total of 100 seconds. In a similar manner as in the previous implementation phase, the implementation was again executed nine times. During implementation, the Control Group took 77 seconds to rework some of the documents that went through the process but did not fulfil the current requirements. The individual cycle time for the Control Group in seconds was 35, 37, 49, 49, 54, 52, 48, 17, and 16, whilst the Experimental Group had individual cycle times of 17, 21, 20, 18, 28, 28, 25, 24, and 25 seconds. In this phase, there is a marked difference in individual cycle times and total time taken to implement the process that had been designed. The earlier design from both groups has had an effect on the implementation process. For example, the Control Group-1A spent almost 40% of their time on rework, meaning the existing process design did not adequately account for the changes in this scenario. However, whilst the participants of the Experimental Group-1B spent considerably more time on the design of the process it enabled them adequately implement the changes introduced in this scenario effectively.

5.1.3. 3rd Scenario-BPR and BPRC process iteration

In the third scenario, both groups again went through three phases. In Phase 6, major unplanned changes were introduced that caused significant disruption to the current processes and necessitated process changes to fulfil these new requirements. Without prior instruction (apart from the information given to the Experimental Group) in addition to the A4 sized plain papers and A6 sized Receipts, A5 sized Bill Statement and A4 sized Invoices were introduced, see Figure 4.7 and Figure 4.8 respectively for details. Furthermore, the two storage boxes were renamed as “File” and “Mail”, with the expectation (though they weren’t told to do so beforehand) that the receipts would be stored in the former and the Bill Statements and Invoices would be stored in the latter. It was also expected that the invoices and statements be folded in a way that ensured the names of the recipients were visible in the envelope window, a stipulation that was not required previously.

In Phase 6, the time taken by the Control and Experimental groups to familiarise themselves with the new requirements was 370 seconds and 97 seconds respectively, here both teams had to evaluate current processes in relation to new requirements and then make a decision on the necessary changes required. The number of changes introduced in this phase created a significant amount of disruption to the Control Group and less so to the Experimental Group as the time taken indicates. A discussion on the reasons for this is detailed in the analysis of the findings in Chapter 6.

In Phase 7, to meet these new requirements, the Control Group-1A re-engineered (BPR) their process, this process design took 215 seconds to complete. The radical overhaul of existing processes is referred to as BPR, this is usually done by examining existing process from the context of new requirements from the customer and creating a new process that meets this requirement. In this experiment, the changes introduced necessitated a new approach to the existing process. In this phase, the participants of the Control Group-1A had to evaluate the existing process from the context of the new requirements and made changes to ensure the process could meet this new requirement. Factors like the option to fold the document depending on the type of document received were introduced, also a decision on the orientation of the letter was also introduced in relation to the new requirements of the process. See Figure 5.6 for details, the corresponding picture of actual process map as was created on the board during the experiment is depicted in Figure 0.4 of Appendix 1.

Due to the elements of predictability and modularity that had been previously integrated into the process design of the Experimental Group, they did not need to completely redesign their process, rather, a few iterations to the existing process enabled them to meet the new requirements. This process iteration took 93 seconds, see Figure 5.1 for details of the time taken.

In Phase 8, both groups implemented their process designs, the total time taken for implementation by the Control and Experimental groups in this phase was 192 and 137 seconds respectively. During implementation, the Control Group took 66 seconds to rework some of the documents that went through the process but did not fulfil the current requirements. This was due to the failure of the team to integrate the new requirements for sorting out mail, where the invoices and statements were to be mailed out and the receipts filed. In Figure 5.6, after stamping envelope, there was no information included to either file or mail depending on the document received. Hence the group had to adapt the process to meet this new requirement. The individual cycle time for the Control Group in this phase was 36, 23, 33, 43, 37, 40, 50, 49, and 59 seconds, whilst the Experimental Group had individual cycle times of 30, 31, 42, 41, 52, 56, 50, 44, and 40 seconds, see Figure 5.7 for details. A discussion on the import of the individual cycle times is detailed in the analysis of the findings in Chapter 6.

Refer to Figure 5.8 Illustration of second experiment scenarios and phases. Section 5.2 which describes the outcome from the second experiment which was undertaken with a different set of participants.

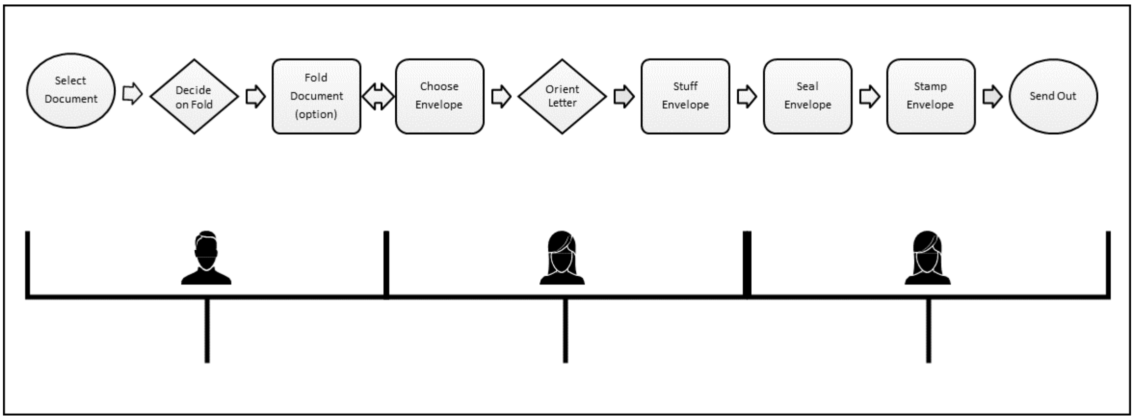


Figure 5.6 Control Group-1A, BPR- Process (Scenario 3)

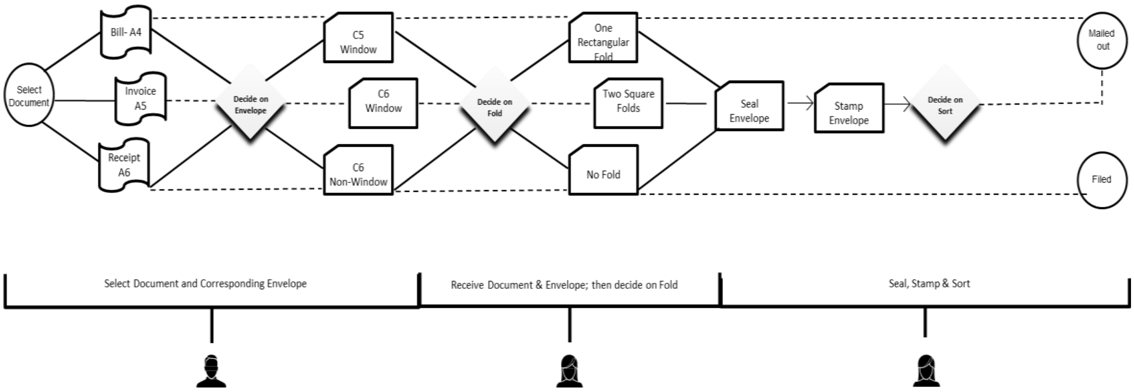


Figure 5.7 Experimental Group-1B BPRC- Process (Scenario 3)

5.2. Description of result from the second experiment

The results from the second experiment have been represented in Figure 5.8, these were done to substantiate the results of the prior experiment. As stated in Section 4.2.4, reliability is a key tenet of the validity of an experiment. In order to demonstrate the reliability of the output from the first experiment, a second experiment was carried using identical processes with the exception of the number of participants and the level of education of the participants. Like with the first experiment, each of these experiments contains three scenarios and eight phases; with each scenario representing a new set of instructions for the participants and in each phase a different set of tasks for the participants. In each phase, the time taken by the two groups was recorded. The phases and scenarios followed the same process as the first experiment, as described in Section 5.1. However, the main difference with the second experiment was the use of eight participants, rather than six used in the first experiment. It is also important to note that the participants in this instance were PhD. students unlike in the first experiment which had MSc students. Again, the participants have been selected at random into two groups, namely the Control and Experimental Group. The purpose of the experiment was to test the validity of the propositions derived from literature, which consequently tested the validity of the concept of business process reconfiguration in dynamic operating environments. However, to demonstrate the applicability of this notion of BPRC in different organisational settings, it was important to examine the concept from a different perspective. It was expected that the validity of the concept proposed in the literature would be applicable regardless of the change in the number and level of experience of the participants.

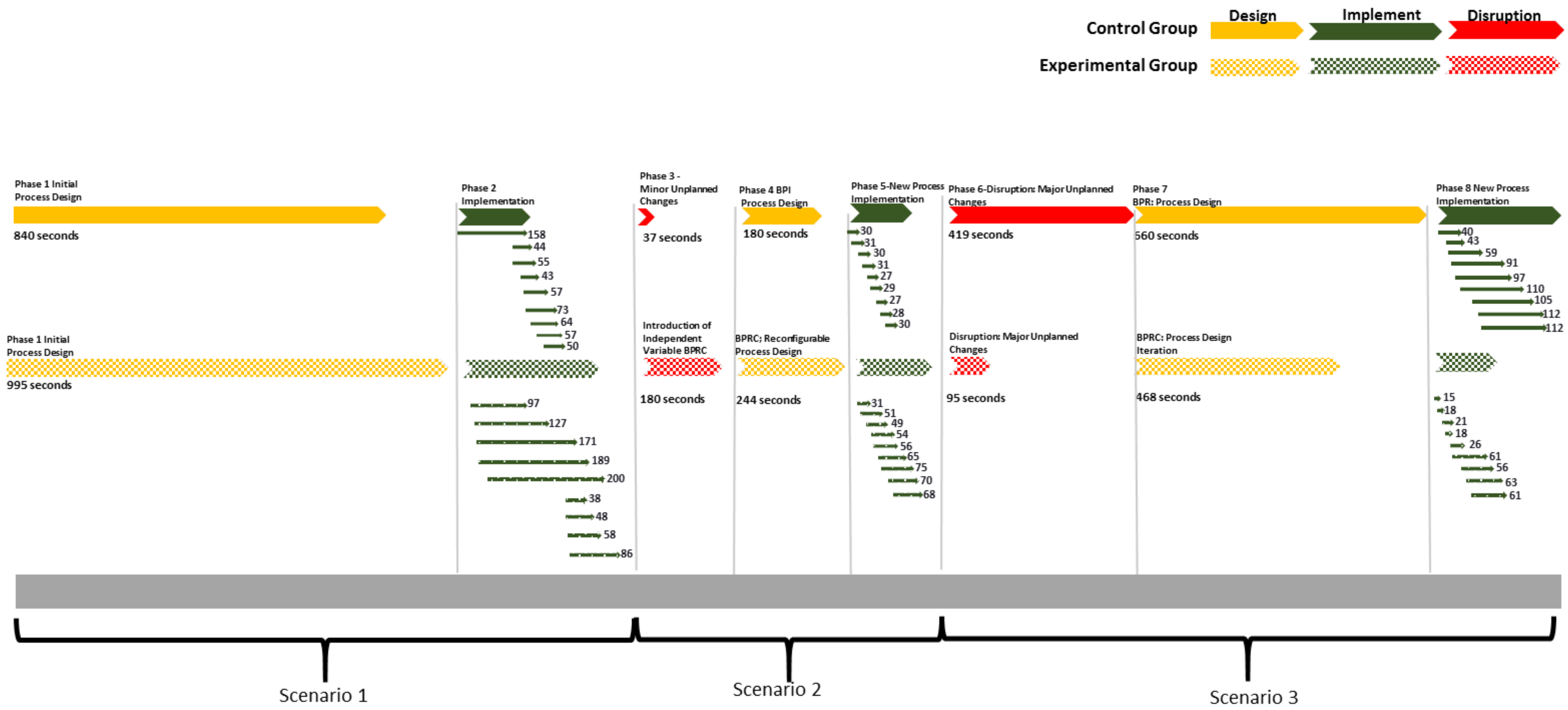


Figure 5.8 Illustration of second experiment scenarios and phases.

5.2.1. 1st Scenario- Initial Process Design and Implementation

As with the previous experiment, both groups received the same information (see Section 4.3.2), with the task of designing and mapping a process from the information received. However, in this experiment, the PhD students took significantly more time to design and implement the process than the MSc. Students in the first experiment. For example, in Phase 1 of Scenario 1, Control Group took a time of 840 seconds to design and map the process, whilst the Experimental Group initially took 768 seconds and later revisited the design and took an additional 227 seconds for a total time of 995 seconds to design and map the processes. In contrast with the first experiment, these two cohorts spent significantly more time deliberating and analysing the task.

In the implementation phase (Phase 2) of scenario 1, the Control Group and the Experimental Group went through nine concurrent process cycles. However, the Experimental Group initially struggled to come to terms with the requirements of the task and had to stop midway through the implementation to re-design their process i.e. go back into Phase 1. The time taken by the Control Group on each implementation in Scenario 1 were 158, 44, 55, 43, 57, 73, 64, 57, and 50, whilst the Experimental Group implementation times for each execution were 97, 127, 171, 189, 200, 38, 48, 58, and 86. From observation, both groups were more focused on the effectiveness, rather than efficiency of the tasks, hence more time spent designing and implementing the process. To reiterate, for the purpose of this experiment, effectiveness was defined as successfully performing the task of selecting, folding, and placing the paper in the envelope and finally storing it in the storage box. Whilst, the process cycle time was used as an indication of efficiency.

Furthermore, both groups (independently) decided on including quality checks within the process to ensure compliance with the requirements of the tasks. The Control Group in this instance decided on a flexible structure where three members of the group were simultaneously responsible for six of the seven tasks in the process, see Figure 5.9. The Experimental Group initially designed a process that was significantly inefficient as the implementation times of 97, 127, 171, and 189 reveals. After observing the inefficiencies in their process, they decided to improve the process by doubling the resources allocated to the first four tasks. Rather than have two people working independently and simultaneously on four tasks, they changed the process to allow two people to work concurrently and codependently, see initial process design in Figure 5.10 and the new process design in Figure 5.11.

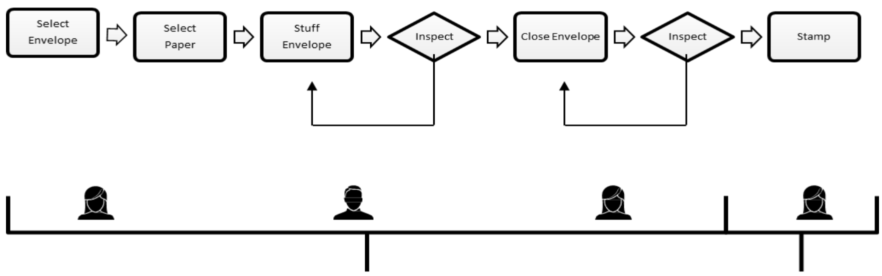


Figure 5.9 2nd Experiment- Control Group Process Map- Scenario 1

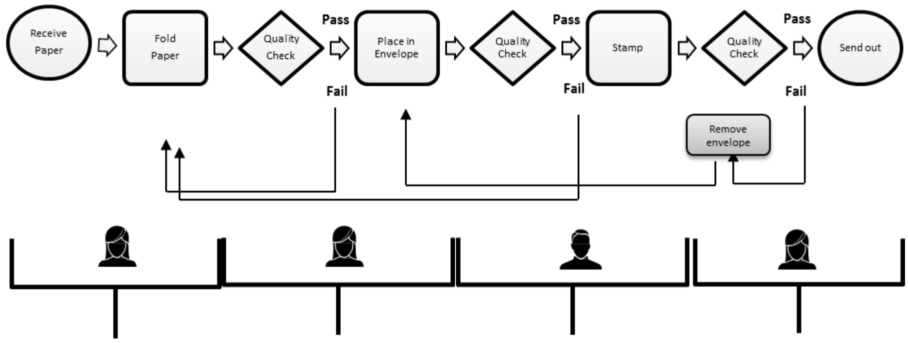


Figure 5.10 2nd Exp. Experimental Group Process Map- Scenario 1

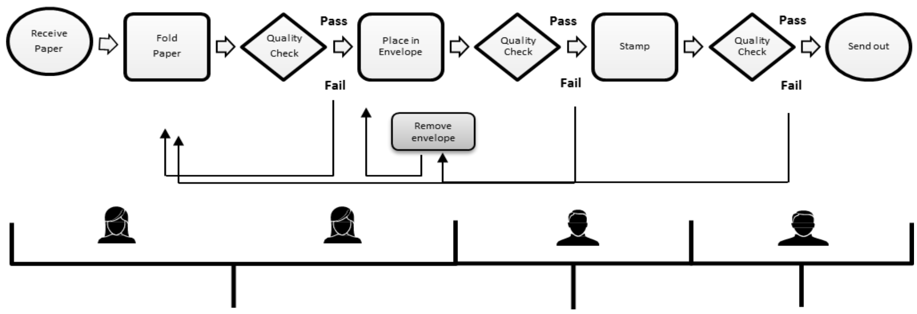


Figure 5.11 2nd Exp. Experimental Group 2nd Process Map- Scenario 1

5.2.2. 2nd Scenario -Introduction of BPI and BPRC (2nd Experiment)

The second scenario introduced minor unplanned changes to both groups to disrupt the initial process to necessitate a change.

In Phase 3, the time taken by the Control Group and the Experimental Group to identify and familiarise themselves with the cause of the disruption was 37 and 180 seconds respectively. The extended time of 180 seconds from the Experimental Group was due to the introduction of the independent variable (predictability and modularity, see Table 4.2).

In Phase 4, to meet the new requirements caused by the minor unplanned changes, the Control and the Experimental Group needed to change their initial process maps. The Control Group made an improvement (BPI) to their existing process design by including a new task in the process to inspect the document received in relation to the initial envelope selected. If they were a fit, the participant would proceed to place the paper in the envelope, and if not, another envelope would be selected, see Figure 5.12.
With regards to the Experimental Group in Phase 4, like in the first experiment, they also designed the process with the understanding of the possibility of future changes and what these changes could be, so the process was designed with a degree of predictability and modularity. Total time taken by the Control and the Experimental Group to design these processes were 180 and 224 seconds respectively.

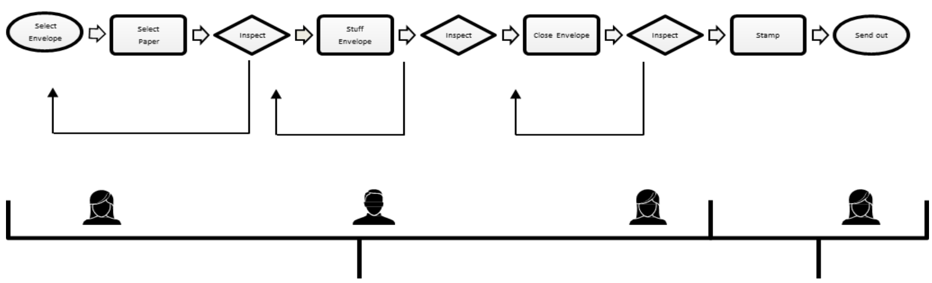


Figure 5.12 2nd Experiment Control Group BPI- Process (Scenario 2)

5.2.3. 3rd Scenario-BPR and BPRC Process Iteration (2nd Experiment)

In Phase 6 of Scenario 3, major unplanned changes were introduced that caused significant disruption and increased complexity to the current processes and necessitated changes to fulfil these new requirements. Without prior instruction (apart from the information given to the Experimental Group) in addition to the A4 sized plain papers and A6 sized Receipts; A5 sized Bill Statement and A4 sized Invoices were introduced, see Figure 4.7 and Figure 4.8 respectively for details. Furthermore, the two storage boxes were renamed as “File” and “Mail”, with the expectation that the Bill Statements and Invoices would be stored in the latter, whilst the Receipt is stored in the former. It was also expected that the invoices and statements be folded in a way that ensured the names of the recipients were visible in the folded envelope, a stipulation that was not required previously.

In Phase 6, the time taken by the Control and Experimental Group to come to terms with the new requirements was 204 seconds and 95 seconds respectively. Again, similar to the first experiment, the number of changes introduced in this phase created a significant amount of disruption to the Control Group and less so to the Experimental Group as the time taken indicates.

In Phase 7, to meet these new requirements, the Control Group re-engineered (BPR) their process, this process design took 660 seconds, whilst the Experimental Group took 468 seconds, again see Figure 5.8 for details.

Finally, in Phase 8, both groups implemented their process designs, during implementation. The Control Group took 215 seconds to rework some of the documents that went through the process but did not fulfil the current requirements, due to the failure of the team to integrate all of the new process requirements so the group had to improve the already re-engineered process. The individual cycle time for the Control Group in this phase was 40, 43, 59, 91, 97, 110, 105, 112, and 112 seconds, whilst the Experimental Group had individual cycle times of 15, 18, 21, 18, 26, 61, 56, 63, and 61 seconds.

Chapter 6. Analysis and findings

Using the five propositions derived from the literature, this notion was examined and the results in the preceding chapter are analysed in the subsequent sections of this chapter. The classical experimental method was used to test the validity of the propositions. In addition, the relationship between the six key variables is also determined. These are the: independent variable, dependent variable, mediating variable, moderator variable, control variable, and confounding variable, see Table 3.4 for a description of each variable.

In Figure 6.1, an illustration of the relationship between the independent, dependent, mediating and moderating variables with regards to the propositions in question is revealed.

The independent variable is described as the variable that could be manipulated or changed to create an effect on the dependent variable. In this instance, factors of predictability and modularity act as the independent variable; the propositions suggest that an increase in predictability and modularity of business process design will enable reconfigurability which will subsequently enable transformational process changes to occur rapidly and with reduced disruption.

The dependent variable is described as the variable that could change in response to changes to other variables; observed results or outcome is a consequence of manipulation of other variables. For this experiment, the dependent variable is represented by disruption (which is the degree of disturbance, interruptions and disorder caused to normal business operations as a result of change negatively impacting on cost, staff engagement, quality, and customer experience) as well as the time taken to respond to changes initiated.

The mediating variable is described as the variable that is located between the Independent and Dependent variables; it defines the relationship between both variables. For this experiment, the Mediating variable is Reconfigurability; the relationship between the Independent and the Dependent variable is underpinned by reconfigurability. This research argues that a more modular approach to business process design, based on predictable outcomes (independent variable) would enable transformational changes to occur rapidly and with reduced disruption (dependent variable). However, business process reconfigurability is the incorporation of a process design based on predictability and modularity, which has an impact on the level of disruption and time taken to respond to change.

The Moderating variable is described as the variable that has an impact on the relationship between the Independent and Dependent variables, it instigates the relationship between the Independent and Dependent variables. For this experiment, the Moderating variable is represented as the changes initiated in a dynamic operating environment. Only when change is initiated can measurement of the impact on the relationship between the Independent variable and the Dependent variable be made.

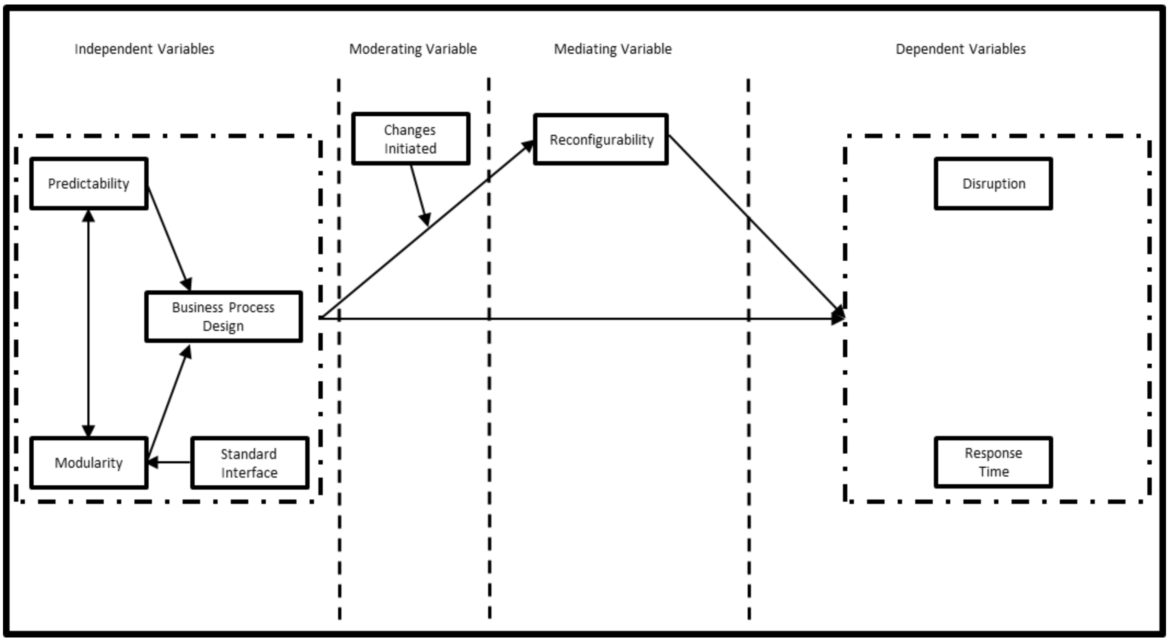


Figure 6.1 Relationship between Experimental Variables

The last two variables (Control and Confounding variable) are not depicted in Figure 6.1 because they are not directly related to the propositions in this experiment. The Control variable is described as a variable that should be kept constant in order to ensure there is no undue impact on the Dependent and Independent variables. Therefore, it was important that each experiment had an equal number of participants, the same objectives, and the same level of training, education and experience with business processes.

The Confounding variable is described as the extraneous, but difficult to observe variables that can potentially undermine the outcomes from the Independent and Dependent variables; requires consideration to avoid spurious conclusions. For this experiment, factors like the level of intelligence between participants, and their propensity towards games or workshops of this nature was considered. To diminish the effect of the Confounding variable, in each experiment, participants were selected based on their level of experience. For example, in the first experiment, all participants were post-graduate masters' students, whilst in the second experiment, they were all second-year PhD students. Using students at the same academic level on each experiment (i.e. the Control and Experimental groups) reduced the effect of having participants with widely differing levels of intelligence. Furthermore, by instructing all participants about the use of process mapping, the effect of some participants having more understanding of the experiment due to prior knowledge was effectively managed.

This classic experiment was done to examine the validity of the propositions derived from literature; in the subsequent sections of this thesis, each proposition is analysed in relation to the activities and results of the experiment.

6.1. 1st Proposition

Existing knowledge of reconfigurability in product manufacturing systems and software engineering can be transferred and/or replicated for business processes.

The first proposition derived from the review of the literature, suggests existing knowledge of reconfigurability in previously established disciplines like product manufacturing (specifically reconfigurable product design), and software engineering can be used in a business process scenario. Based on this premise, this research has delineated knowledge of factors critical to reconfigurability into three main concepts; design, predictability, and modularity (enabled by standard interfaces).

First, design; reconfigurability in product manufacturing and software engineering is achieved by the initial integration of the reconfigurable elements early in the design. Hence, the design is a critical enabler for reconfigurability that was explored from a processual perspective.

Second, predictability; in order to have a design that enables reconfigurability, a degree of anticipation of the factors that would contribute to the need for future changes becomes imperative, hence predictability was established as a critical element of reconfigurability.

Third, modularity (enabled by standard interfaces); to have modularity there is a requirement for modules to be able to be connected to each other, which subsequently requires an interface with a degree of standardisation that connects these modules. Hence, standard interfaces are critical to attaining modularity.

The feasibility of replicating knowledge of the impact of these factors on reconfigurability in product manufacturing systems and software engineering in the context of a business process was examined in the experiment.

In the experiment, Phases 3 and 4 (minor unplanned changes and subsequent process design) represented the integration of predictability and modularity enabled by standard interfaces into the business process design for the Experimental Group. In the experiments, the decision gateways act as standard interfaces between a set of tasks. The aggregation of these three concepts of predictability, modularity and the business process design represents the Independent Variable, which like in manufacturing and software engineering, these three concepts enable reconfigurability (see Figure 6.1).
To examine this proposition, predictability in the context of this experiment is determined by the degree of accuracy in anticipating future changes to the mail sorting process. In this instance, the participants of the experimental group predicted a variety of changes to the documents received and the types of envelopes that would be needed for each type of document. This prediction subsequently led to the introduction of a modular structure, where each phase of the process was delineated as a module with predefined inputs, constraints, resources and outputs. Figure 6.2 is an illustration of the BPRC design (done by the experimental group) highlighting the relationship between the modules, standard interfaces and tasks. The process tasks are actions that have been defined in advance and have predictable outcomes, however, in a dynamic operating environment, the unpredictability of the process is knowing (in advance) which task would be necessary to fulfil the objectives of the process. Hence, the need for a modular structure that is enhanced by predictability.

In the diagram, the experimental group delineated the process into three modules, with each containing tasks and are connected by standard interfaces. The first module contains all the tasks related to the selection of a document, which is subsequently followed by a standard interface on the decision to select an appropriate envelope. The second module contains all the tasks related to the selection of an envelope, which is subsequently followed by a standard interface on the decision to fold the envelope appropriately. The third module contains all the tasks related to the different possible combinations of folds required, which is subsequently followed by tasks to seal and stamp the envelope.

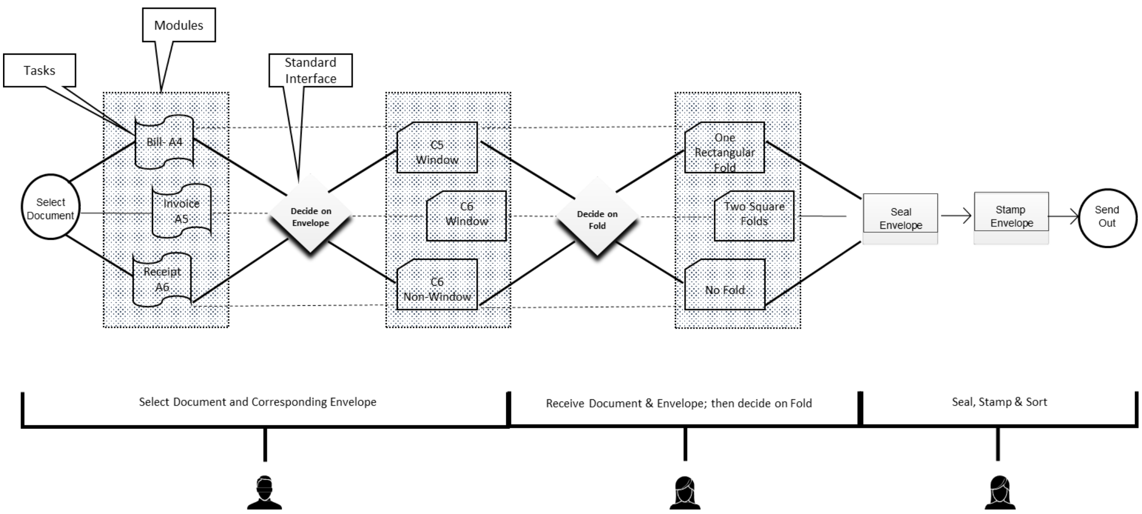


Figure 6.2 BPRC design with Modules, Standard Interface & Tasks

The Experimental Group created three modules by anticipating the possibility of three types of documents (Bill-A4, Invoice-A5, Receipt-A6) to be received. These three modules are enabled by a standard interface that connects all three to the next task in the process; the standard interface in this instance is the “decide on envelope” decision gateway. Therefore, by anticipating the possibility of three types of documents that could be received, and creating a modular process for each, the Experimental Group have integrated predictability and modularity to create a reconfigurable business process.

This demonstrates the validity of the first research proposition because existing knowledge of reconfigurability in product manufacturing systems and software engineering has been used in the context of a business process.

6.2. 2nd Proposition

A high degree of predictability will enable a more modular approach to process design.

The second proposition advocates a direct relationship between predictability and modularity, where a higher degree of predictability would enable a more modular approach to process design.

In order to examine the validity of this proposition, in the experiment, both groups (Control and Experimental) were required to make a number of changes to their business processes, which was done by introducing several different requirements to the output of the process. However, prior to this, the Experimental Group was educated on the significance of Predictability and Modularity in a dynamic operating environment, whilst the Control Group was not. This enabled the examination of the effect of predictability on modularity in a dynamic operating environment. Therefore; first, the validity of this proposition is based on the capability of the Experimental Group to create a more modular process design based on the information received which the Control Group did not. Second, the validity of this proposition also means the business process design from the Control Group would be less modular when they do not anticipate future changes. Consequently, it is necessary to determine what predictability and modularity are from the context of a business process design.

The definitions of both concepts become relevant to this discourse; predictability has been defined as the ability to anticipate future occurrences with a degree of confidence (Milliken, 1987; Ahsan and Musteen, 2011; De Meyer et al., 2002). Whilst a modular approach to process design necessitates building a complex process from smaller subsystems that can be designed independently yet function together as a whole (Baldwin and Clark 1997; Campagnolo and Camuffo 2009; Bask *et al*. 2010; Bask *et al*. 2011).

Based on the definition of predictability in the literature, this experiment interpreted predictability by the degree of anticipation of future changes to the mail sorting process founded on the information received. The biggest challenge with predicting future occurrence is uncertainty; which is described as the inability to determine the probability of a circumstance due to lack of cause and effect information (Ahsan and Musteen, 2011). Hence, predictability is dependent on mitigating uncertainty; in managing project uncertainty, De Meyer *et al*. (2002) developed four predictability profiles based on four degrees of uncertainty: variation, foreseen uncertainty, unforeseen uncertainty, and chaos. The implication being that whilst there are varying degrees of uncertainty, there are also varying degrees of predictability. The uncertainty in this experiment can be categorised under "foreseen uncertainty", which is described as perceptible circumstances that could influence a project/process even though there is no guarantee of these circumstances actually occurring. According to De Meyer *et al*. (2002, p. 62), to mitigate a foreseen circumstance "several alternative plans" may be required.

At the commencement of Scenario 2 of the experiment, the Experimental Group was given information regarding possible changes to the process output. This was done by talking with the group about the potential breadth of document types that a mail sorting room could receive, and also showing them possible paper to envelope fold configurations. By doing this, the Experimental Group predicted the possible input of three sizes of documents, which was A4, A6, and A5, based on this, they designed a process that could go through three alternative modular paths. See Figure 6.3 for illustration of the modular process, the red dotted lines represent the three modular paths in the process. Conversely, the Control Group which did not receive any information, and did not change the design of their process from the outset of Scenario 2.

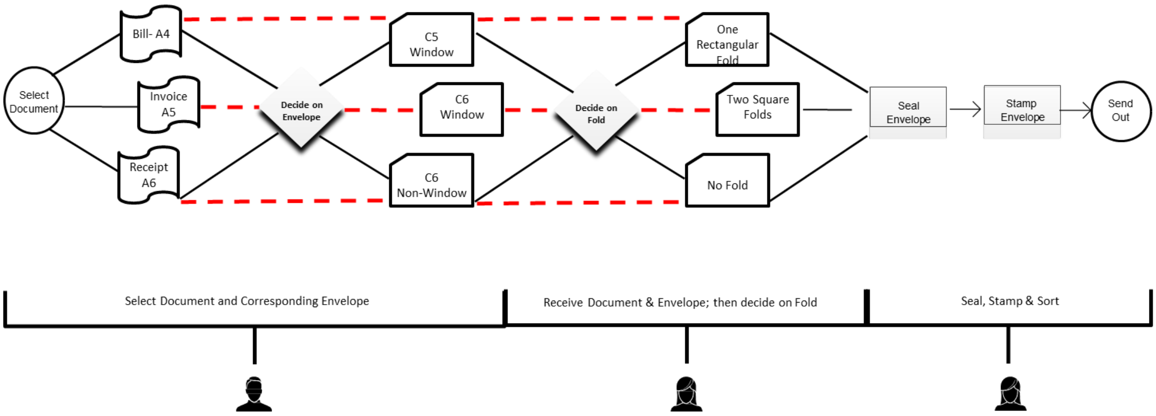


Figure 6.3 Modular Process- Experimental Group

In contrast with the Control Group (which did not receive any information regarding the possibility of future changes to the process), using the information afforded to them, the Experimental Group designed a process with three alternate paths. First, these alternate paths were created based on the anticipation of changes (predictability) to the process. Second, these alternate paths also demonstrated a modular approach to the design of their processes. Whilst this supports the validity of the 2nd Proposition from a predictability perspective, there is still the issue of modularity. From the processes designed by both groups, the issue of determining the difference in modularity remains.

From the context of evaluating this proposition in the experiment, the definition of modularity from literature did not provide ample clarity. The definition describes modularity as the ability to build complex products or designing processes from smaller subsystems that can be designed independently yet function together as a whole

(Baldwin and Clark 1997; Campagnolo and Camuffo 2009; Bask *et al*. 2010; Bask *et al*. 2011). For example, what metric should be used to evaluate the degree of complexity of the process, before deeming it modular? The definition also states that modular processes consist of smaller subsystems that can be designed independently yet function together as a whole (Baldwin and Clark 1997; Campagnolo and Camuffo 2009; Bask *et al*. 2010; Bask *et al*. 2011). The challenge with that definition is both processes designed by the Experimental and Control groups meet that criteria; they both consist of smaller subsystems (i.e. tasks) that were designed independently and could function as a whole. Depending on the degree of granularity, an argument could be made that because of the anatomy of a process (where tasks are connected towards the attainment of a particular purpose), there is a degree of modularity in every process. Therefore, whilst the existing definition is suitable in product manufacturing; for business processes, an understanding of the comparative degree of modularity is critical.

To understand modularity from the context of a process, further examination of the validity of this proposition is vital to be able to decipher the difference in the levels of modularity between the Control and Experimental groups. There is a distinctive difference when examining the processes designed by both groups. As stated previously in this section, both experimental groups created three alternate paths based on the anticipation of receiving three possible document sizes, whilst the control groups only created one path. Consequently, the fundamental difference between the two process designs is the number of interfaces within each process. In programming, the objective of standard interfaces is to facilitate the transfer of information from one platform to another, (Binoth et al., 2010). This enables integration between two different platforms, in this experiment, the decision gateway is the standard interface that enables the integration and transformation (interchangeability) of modules within the process. Therefore, the degree of modularity of a process can be determined by the percentage of interchangeable modules being transformed and the number of interfaces that enable the interchangeability and transformation of the module. Hence, from the context of a business process design:

modularity is reflected by the degree of interchangeability between modules, and the connectivity with other modules across the entire process.

In this instance, the process design from the Experimental Group had two interfaces ("Decide on envelope" and "Decide on fold"), and three modular paths going through the process, whilst the Control Group had one interface ("Decide on fold") and one modular path. This establishes the validity of the second research proposition because by using the information provided the Experimental Group were able to anticipate and create a more modular approach to the business process.

6.3. 3rd Proposition

A more modular approach to business process design, based on predictable outcomes would enable frequent transformational changes to occur rapidly and with reduced disruption.

The third proposition advocates the notion that a high degree of modularity (aided by predictability) in a business process would facilitate rapid transformational changes frequently, whilst reducing disruption to a minimum.

In the 2^{nd} Proposition, the notion that the Experimental Group created a more modular business process in comparison to the Control Group was established. Consequently, the validity of the third research proposition can be examined by comparing the execution and adaptability of both groups in the experiment. Therefore, the validity of this proposition is demonstrated by the Experimental Group's ability to rapidly transform as well as keep disruption to a minimum in comparison to the Control Group, i.e. comparing the more modular group with the less modular group.

To examine the validity of this research proposition, the following factors are pertinent. First, since the research proposition advocates that a more modular process will enable rapid transformational change, a means of ascertaining the speed of transformational change from the context of this experiment must be established. Second, since the research proposition advocates that a modular process would also reduce disruption, a means of evaluating the level of disruption in the context of this experiment must also be established. Finally, a comparison of the results of the experiment between the Experimental Group and Control Group is required.

As indicated in Figure 2.5, the need for business process transformation is emphasised when the scale of change and the level of disruption brought about by the change is high i.e. a dynamic operating environment. However, as stated previously this could either be done by means of a protracted process improvement (BPI) or by the more disruptive process of re-engineering (BPR).

In Phase 6 of both experiments, large-scale changes were introduced that necessitated transformation by both groups, i.e. for each group to continue to respond to the requirement of the process, a drastic reorganisation of the tasks associated with the process becomes imperative (Levy and Merry, 1986). Here, without prior instructions, A5 sized Bill Statement and A4 sized Invoices were introduced, furthermore, two storage boxes were renamed as “File” and “Mail”, with the expectation that the Bill Statements and Invoices would be stored in the latter, whilst the Receipt is stored in the former. These changes required a redesign of the current processes of the Control and Experimental Groups, for example, the invoices and statements needed to be folded in a way that ensured the names of the recipients were visible in the envelope, another stipulation that was not required previously. It is therefore evident that the processes from both groups required transformation.

The issue of speed becomes pertinent; as defined in this research, *Speed is a metric that measures the distance between the disruptive changes to a business process over the time taken to respond and adapt to the disruption.* In physics, speed is calculated as the distance covered over a period of time. Similarly, for the purposes of this research, speed is defined as a metric that measures the distance between the disruptive changes to a business process over the time taken to respond and adapt to the disruption. Therefore, distance is measured as the difference *in time* between changing from the current process (as is) to the future desired state of the process (to be). Based on this definition, a comparison can be made between the Control and the Experimental Group. In Phase 6 and Phase 7, the time taken by the Control and Experimental Group in both experiments to transform their processes in relation to the new requirements was 1564 seconds and 753 seconds respectively, see Table 6.1 Speed of Transformation for details. The time taken by the Control Group was more than twice that taken by the Experimental Group, based on this evidence, an argument can be made that whilst both processes experienced transformation, the modular process did so in significantly less time compared to the other process. On one hand, the control groups re-engineered their processes and in one instance had to do a rework of some of the documents due to the process output not meeting the requirements, see the difference between Figure 5.4 and changes made in Figure 5.6 (in the 1st experiment). On the other hand, the experimental groups only needed to reconfigure elements of their processes to meet the new requirements. In order to adequately understand the factors responsible for the speed of transformation between the Control and the Experimental Group, the issue of disruption needs to be examined.

Table 6.1 Speed of Transformation

	Phase 6- Major Disruption & Unplanned changes introduced	**Phase 7- Process Redesign (BPR & BPRC)**	**Total time Taken (secs)**
Control Group	First Experiment-370 Second Experiment- 419	First Experiment-215 Second Experiment- 560	**1564 seconds**
Experimental Group	First Experiment-97 Second Experiment- 95	First Experiment-93 Second Experiment- 468	**753 seconds**

As stated previously, disruption is the degree of receptivity and challenges caused by or experienced during the change, which includes the impact on cost, staff engagement, quality, and customer experience. The workshop was able to measure disruption in relation to staff engagement (participants), reduction in quality and customer experience (quantity of re-work needed after each scenario), and cost (time taken to design and implement process). In every metric, the degree of disruption is significantly lower in modular processes in relation to other processes. For example, with participant engagement in the Control Group; in the third scenario (43^{rd} minute) of the first experiment, visible signs of frustration become evident. The participants have folded arms and pursed lips due to the newly introduced changes. In the 49^{th} minute, more frustration is displayed due to these uncertainties, one of the respondents said, “I feel like management are really giving us a hard time on this because they didn’t stipulate a lot of these conditions”. On the other hand, in the Experimental Group; participants are having a discussion on predictability as they reconfigure the process, the following conversation ensued:

Minute 37:19- 38:00, participants discuss the dynamism of the process.

Participant 1: “Can we have like a dynamic step where it can be like the first part is like you know, decide, based upon envelope size, can the folder, does the folder know the envelope sizes?”

Participant 1: “We're just training on envelope size”

Participant 2: “That's not a specific process though”

Participant 1: “Well if you know all the envelope sizes, then you could decide whether you have to fold it or not”

An argument can be made that this conversation between the participants of the Experimental Group in the 38^{th} minute alludes to the significance of predictability in a modular process to minimising disruption.

Another element necessary to determine disruption is the issue of quality and customer experience, for the purpose of this experiment the quantity of re-work needed after each scenario was evaluated. In Phase 5 and Phase 8; the Control Group spent 77 and 55 seconds respectively on rework, whilst the Experimental Group got it right first time.

By evaluating the results from both experiments, the results suggest that the modular approach to business processes based on predictable outcomes would facilitate transformational changes quicker and subsequently more frequently whilst keeping disruption lower than a less modular process. Hence, the validity of the 3rd Proposition is established.

6.4. 4th Proposition

Existing business process management change methods would not be appropriate, or even sufficient to enable the design of reconfigurable business processes.

This proposition advocates the techniques used to create existing process management change initiatives like BPR and BPI would not be applicable for designing reconfigurable business processes. To examine the validity of this proposition, the following factors need to be considered. First, the required method for process management (improvement and re-engineering) design, as well as those required for reconfigurable business processes, require validation. Second, the effect of these methods in relation to process management and reconfigurable business process design also needs validation. Finally, by comparing both methods used in the experiment, an examination can be undertaken to determine the applicability of traditional process management design methods on reconfigurable business process design.

As stated in Section 2.4.3, there are a plethora of tools and techniques currently used by practitioners as well as advocated in the literature for business process change, examples include IDEF, process simulation and force field analysis (Balaban et al., 2011; Kettinger et al., 1997; Kettinger and Grover, 1995b). A commonality with all these process change tools, is they are based on a reactive methodology rather than a proactive one. In a survey of 25 process change initiatives, an analysis of all the tools and methods used were summarised in these phases; envision a goal, then initiate proceedings to actualise the goal by analysing, redesigning and reconstructing *existing* processes (Adesola and Baines, 2005; Kettinger et al., 1997).

In both experiments, the Control Group followed a similar method. In Phase 3 and Phase 6, minor and major unplanned changes to the input and expected output were introduced respectively, this was done to create disruption and to necessitate a processual change. Similar to business process change practised in industry, in Phase 3 and Phase 6 (minor and major changes introduced), the Control Groups in the first and second experiments recognised the need for change and decided on the direction of that change. This was done by analysing existing processes and deciding the necessary changes to the process that would enable the process output to meet the new direction. In Phase 4 and Phase 7 (process improvement and process re-engineered), the Control Group went on to redesign the process that would be subsequently be implemented in Phase 5 and Phase 8 respectively.

Like in previous process change methods documented from industry, the processual changes in both experiments from the Control Group follow a similar pattern. Here, a dynamic operating environment necessitated changes that led both control groups to envision and initiate proceedings by redesigning and reconstructing the business process with regards to the existing process.

Regarding the Experimental Groups in both experiments, the influence of predictability and modularity necessitated a different method of process change in a dynamic operating environment. In Phase 3, after the introduction of minor unplanned changes to the input and expected output, like with the Control Group, the need for processual change was recognised. Unlike the Control Group, the Experimental Group was introduced to the concept of a dynamic operating environment and the importance of modularity and predictability. Based on this information, the Experimental Groups designed a reconfigurable process with a degree of predictability and modularity. In essence, a modular process was designed in anticipation of future changes, hence in Phase 7, where major unplanned changes were introduced, rather than a complete redesign, a re-configuration of the process was done. The feasibility of this re-configuration was based on the degree of accuracy in anticipating future changes. Traditional process change methods used by the Control Group requires changes to a process every time new factors arise that influence its operations, whilst this is relevant in an inert operating environment, in a dynamic operating environment, where changes occur frequently the ability to respond quickly is paramount. To further emphasise, the combined time taken in both experiments by the Control Group in Phase 3 (only minor unplanned changes) and Phase 4 (process redesign) to identify the need for change and design a process that could adequately respond to this need was 186 and 265 seconds respectively. For the Experimental Group, when minor changes were introduced (i.e. Phase 3) the combined time taken in both experiments to identify the need for change and design a re-configurable process (Phase 4) based on predictability and modularity was 556 and 464 seconds respectively. In this instance, where the changes to the operating environment were minor, a reconfigurable process took significantly more time and effort than was needed to meet the requirements of the process goals.

In Phase 6 (major unplanned changes introduced), the combined time taken in both experiments by the Control Group to identify the need for change and redesign a process (Phase 7) that could adequately respond to this need was 855 and 755 seconds respectively. For the Experimental Group, when major changes were introduced in Phase 6, the combined time taken in both experiments to identify the need for change and to re-configure the previously designed process was 193 and 561 seconds respectively, see Table 6.2.

By evaluating the results from both experiments, the evidence reveals that the effectiveness of the business process change method chosen is dependent on how dynamic the operating environment is. When minor changes (Phase 3 and 4) were introduced, the design of reconfigurable processes took more time and was less effective in comparison to traditional process change methods. When multiple major changes (Phase 6 and 7) were introduced, the design of reconfigurable processes took less time and was more effective in comparison to traditional process change methods. The reason for this disparity being; traditional process change is based on being reactive, whilst reconfigurable process change is based on predictability and modularity, therefore more suitable to dynamic operating environments. Hence, the validity of the 4th Proposition is established, but only under the conditions of a dynamic operating environment.

	Minor Unplanned Changes			*Major Unplanned Changes*		
		Control Group	Exp. Group		Control Group	Exp. Group
1st Experiment	**Phase 3**	149	380	**Phase 6**	436	97
	Phase 4	85	220	**Phase 7**	215	93
Total Time Taken-		**234**	**600**	***Total Time Taken-***	**651**	**190**
2nd Experiment	**Phase 3**	37	180	**Phase 6**	419	95
	Phase 4	180	244	**Phase 7**	560	468
Total Time Taken-		**217**	**424**		**979**	**563**

Table 6.2 Time Taken with Minor & Major Changes

6.5. 5th Proposition

The amount of effort and ingenuity required to design reconfigurable business processes would be significantly more than other traditional forms of process design.

Following on from the theme of the previous proposition, the 5^{th} proposition posits that the volume of work and exertion required to design reconfigurable business processes significantly exceeds what would be required in traditional forms of process design.

To examine the validity of this proposition, a comparison of the amount of effort and ingenuity required to design reconfigurable business processes and what would be required in traditional forms of process design needs to be established. Conversely, to do so adequately, a method for evaluating process design effort and ingenuity in the context of this experiment must be determined.

In the context of this experiment, the effort has been evaluated by comparing the time taken by the Control and Experimental groups to design their corresponding tasks and also by observing both groups in order to determine the challenges faced.

To evaluate the effort used in process design, the time taken in the first and second experiment by the Control and Experimental Group was compared. Both experiments included three phases of process design, Phase 1 (initial process design), and Phase 4 had a BPI Process Design for the Control Group as well as a reconfigurable process design for the Experimental Group. Finally, in Phase 7, the Control Group had a BPR process design whilst the Experimental Group again had a reconfigurable process design (BPRC), see Table 6.3 for details. In Phase 1, both groups were asked to create an initial process design for the tasks they were about to undertake. In the 1^{st} experiment, it took the Control Group and the Experimental Group 210 seconds and 203 seconds respectively, whilst in the 2^{nd} experiment, it took them 840 seconds and 995 seconds respectively, both control and experiment groups took similar amount of time to design the process. Furthermore, we observed that both groups took the task of an initial process design comparatively easily with the exception of the Experimental Group (in the 2nd experiment), who seemed to stall before deciding on how best to design the process. At the start of the 31st minute after reading the information sheet, the experimental group waited for about 60 seconds before proceeding with the task at the urging of the conductor of the experiment.

Since no change had been introduced at this stage of the (1st) experiment, the emphasis is on Phase 4 and Phase 7. As documented in Table 6.3, the total time taken in Phase 4 and Phase 7 by the Control and Experimental group in the first experiment was 300 and 313 seconds respectively. In Phase 4, the groups were given different tasks, the Control Group were tasked with designing an improved process that could adequately react to the changes introduced. Whilst, the Experimental Group was introduced to the concept of modularity and predictability in their process design as an alternative to BPI. This involved re-examining the existing process, delineating each task, anticipating potential changes that could have an impact on the process and then creating a reconfigurable process design. In Phase 4 of the first experiment, the Control Group took 85 seconds whilst the Experimental Group took 220 seconds.

Similarly, in the second experiment, the Control Group took 180 seconds whilst the Experimental Group took 244 seconds in Phase 4. This result provided a clear indication of the difference between traditional process improvement design and a reconfigurable process design, again see Table 6.3 for details. From the time taken in Phase 4 to design the respective processes, there is evidence that the initial design of reconfigurable processes requires significantly more time.

In Phase 7, the groups were again given different tasks, the Control Group was tasked with designing a re-engineered process, which required a total overhaul of the existing process to adequately react to the number of new changes introduced. Conversely, because the Experimental Group had created a reconfigurable process in Phase 4, the impact of the new changes introduced only necessitated a re-configuration (and not a re-engineer) of the existing process design. In Phase 7 of the first experiment, the Control Group took 215 seconds whilst the Experimental Group took 93 seconds. In Phase 7 of the second experiment, the Control Group took 560 seconds whilst the Experimental Group took 468 seconds, see Table 6.3.

Table 6.3 Process Design time by Control & Exp. Group

			Control Group	*Experimental Group*
1st Experiment	Phase 1	Initial Process Design	210 Seconds	203 Seconds
	Phase 4	BPI Process Design Reconfigurable Process design	85 Seconds	220 Seconds
	Phase 7	BPR Process Design Process Reconfiguration	215 seconds	93 Seconds
Total Time Taken Control Group in Phase 4 and Phase 7 - 300 Seconds ***Total Time Taken Experimental Group in Phase 4 and Phase 7- 313 Seconds***				
2nd Experiment	Phase 1	Initial Process Design	840 Seconds	995 Seconds
	Phase 4	BPI Process Design Reconfigurable Process design	180 Seconds	244 Seconds
	Phase 7	BPR Process Design Process Reconfiguration	560 Seconds	468 Seconds
Total Time Taken Control Group in Phase 4 and Phase 7 - 740 Seconds ***Total Time Taken Experimental Group in Phase 4 and Phase 7- 712 Seconds***				

From the results of the experiment, the following factors are revealed. First, there is no substantial difference in the total effort put in by the Control and Experimental Groups, in Phase 4 and Phase 7. In the first experiment, the Control and Experimental Group took a total time of 300 seconds and 313 seconds respectively in Phase 4 and Phase 7, whilst in the second experiment, the Control and Experimental Group took a total time of 740 and 712 seconds respectively.

However, an itemised view of each of Phase 4 and Phase 7 of the experiments indicates there is a substantial difference. An argument could be made that the experimental group would be taking consistently less time to reconfigure their process than the control group take to re-engineer their process. If this is the case, the total time over repeated changes would be substantially different in total effort between control and experimental groups. Second; on further inspection, an observation can be made that the effort taken in the initial stages of the introduction of the disruptive changes (Phase 4) to the process, far exceeds the effort expended in traditional improvement methods (i.e. BPI and BPR). For example, in Phase 4 of the first experiment, the reconfigurable process design took 220 seconds whilst the process improvement design took 85 seconds, again in the second experiment, it took the reconfigurable process design 244 seconds and the process improvement design 180 seconds. By integrating the elements of predictability and modularity into the process design, a reconfigurable process design is configured to not only adapt to the need for change but also anticipate the need for change in the future and creating a process that is robust enough to respond when that need arises. This takes significantly more effort than designing a traditional improvement process.

Lastly, in Phase 7 of the first and second experiment, where more disruptive elements were introduced to the process, less effort is taken by the Experimental Group than the Control Group. By reconfiguring the existing process, rather than re-engineering the process, the Control Group had significantly more tasks to perform and subsequently more effort than the Experimental Group. For example, in Phase 7 of the first experiment, the Control group took 215 seconds compared to 93 seconds by the Experimental group. Similarly, in Phase 7 of the second experiment, the Control group took 560 seconds compared to 480 seconds by the Experimental group. This clearly demonstrates that less effort and time is expended in subsequent reconfigurable process design compared to process re-engineering design.

The implication of these results on the 5th Proposition being, whilst Reconfigurable Business Process design requires significantly more effort at the initial stages of a disruptive change (in comparison with traditional process design), subsequent disruptions to the process will require less effort. In summation, whilst the results validate this proposition, it is important to note that the initial design effort expended in the creation of reconfigurable business processes enables a more robust and yet efficient transformational process.

6.6. Key output from Propositions

In this section, a summary of the key constructs, definitions and the key output from each proposition have been tabulated, see Table 6.4 below.

Propositions	*Key Constructs & Definitions*	*Evidence*	*Conclusion*
P1. Existing knowledge of reconfigurability in product manufacturing systems and software engineering can be transferred and/or replicated for business processes	Reconfigurability is the ability to consistently change and rearrange the sub-components of a system in an efficient and effective way (Bondalapati and Prasanna, 2002; Setchi and Lagos, 2004)	By taking existing knowledge of reconfigurability in product manufacturing systems and software engineering and using them in the context of a business process, this proposition established the significance of design, predictability and modularity (enabled by standard interfaces) to process reconfigurability. See Section 6.1 for details.	Fully Supported
P2. A high degree of predictability will enable a more modular approach to process design	Predictability is the ability to anticipate future occurrences with a degree of confidence (Milliken, 1987; Ahsan and Musteen, 2011; De Meyer et al. 2002). Modularity is reflected by the relationship between the connectivity of tasks within a module, and the connectivity across the module boundary.	A higher degree of predictability was established by the experimental group's process design. By anticipating future changes to the process, they designed three alternate modular process paths. See Figure 6.3 for process design and Section 6.2 (2nd Proposition) The new definition of modularity was established.	Fully Supported
P3. A more modular approach to business process design, based on predictable outcomes would enable frequent transformational changes to occur rapidly and with reduced disruption	Business process transformation is emphasised when the scale of change and the level of disruption brought about by the change is high i.e. a dynamic operating environment (Levy and Merry, 1986). Disruption is the degree of receptivity and challenges caused by or experienced during the change, which includes the impact on cost, staff engagement, quality, and customer experience.	The experiment was able to measure disruption in relation to staff engagement (participants), quality and customer experience (quantity of re-work needed after each scenario), and cost (time taken to design and implement process). In every metric, the degree of disruption is significantly lower in modular processes in relation to other processes. See Section 6.3 for details.	Fully Supported
P4. Existing business process management change methods would not be appropriate, or even sufficient to enable the design of reconfigurable business processes	Process Management design is based on a reactive methodology rather than a proactive one whilst Reconfigurable process design methods are proactive rather than reactive.	By evaluating the results from both experiments, the evidence reveals that the effectiveness of the business process change method chosen is dependent on how dynamic the operating environment is. When minor changes (Phase 3 and 4) were introduced, the design of reconfigurable processes took more time and was less effective in comparison to traditional process change methods. When a multiple number of major changes (Phase 6 and 7) were introduced, the design of reconfigurable processes took less time and was more effective in comparison to traditional process change methods. See Section 6.4 for details.	Partially Supported
P5. The amount of effort and ingenuity required to design reconfigurable business processes would be significantly more than other traditional forms of process design	Process Management design effort has been evaluated, by comparing the time taken, number of re-work done by the Control and Experimental groups to execute their corresponding tasks and also by observing both groups in order to determine the challenges faced	In the initial stages of disruption, reconfigurable business process design requires significantly more effort than traditional forms of process design. In the later stage of disruption, reconfiguration takes less effort compared to traditional forms of process change, however, it is important to note that less effort in the later stages is enabled by the effort expended in the earlier stages when the reconfigurable process was initially designed. See Section 6.5 for details.	Partially Supported

Table 6.4 Key output from propositions.

Chapter 7. Discussion

The significant contribution of this thesis is the ***influence*** of predictability and modularity on reconfigurability of business processes in a dynamic operating environment. The challenge of managing change in a dynamic operating environment is especially significant due to the effect of making large-scale changes frequently. The disruption caused by this need to constantly respond to the dynamics of the industry has left organisations in flux, which has management repercussions. By designing a reconfigurable process underpinned by predictability and modularity, the ability to change rapidly and frequently with minimal disruption is enhanced.

Two identical processes were created, they both start out stable but get increasingly dynamic, where there was no influence of predictability and modularity in the first (Control) process, and in the other (Experimental) process there was. This enabled the researcher to examine the influence of predictability and modularity in a stable and dynamic operating environments. From the results of the experiments, there is evidence that predictability and modularity have an influence on the ability of a process to be reconfigurable which subsequently enables frequent transformational changes. By repeating this experiment and getting identical results to the first, the research not only established the influence of predictability and modularity but also the repeatability of the experiment used. Another observation is the effect of reconfigurability on stable processes, here, the research indicates that the value derived from the process of designing reconfigurable processes is not evident in the interim but realised after subsequent iterations of the process.

Whilst the results from the research demonstrates a novel contribution to change management, the impact on theory is not evident. In the subsequent sections, a discourse of how the findings in this research relate to theory is espoused.

The concept of theory has its origins in diverse disciplines (like psychology, sociology and even organisational sciences) dating back over a century (Dewey, 1896; Ferris et al., 2012; James, 1975). Despite the longevity of this discourse, there are very few agreed definitions of theory, instead what we have is variations in theory definitions resulting from their different contexts – being agreed within contexts but differing across contexts. This is particularly problematic because, without the necessary theoretical underpinnings, empirical research is unfounded. In fact, without the development of theory, the ability to understand phenomena (which is essential to the creation of knowledge) is significantly undermined (Strong et al., 1999). In order to have an understanding of theory, several definitions of theory have been adapted from Ferris et al., (2012), see Table 7.1 below.

Definition	**Keyword/Phrase**	**Reference**
‘‘A statement of relations among concepts within a set of boundary assumptions and constraints. It is no more than a linguistic device used to organize a complex empirical world’’	Statement of relations of concepts Boundary assumptions	(Bacharach, 1989, p. 496).
‘‘The attempt of man to model some theoretical aspect of the real world’’	Model of theory	(Dubin, 1976, p. 26).
‘‘The formation of testable hypotheses’’	Formation Testable hypotheses	(Gorelick, 2011, p. 1).
‘‘Theory is a statement of concepts and their interrelationships that shows how and/or why a phenomenon occurs’’	Statement of concepts Interrelationships How and why of a phenomenon	(Corley and Gioia, 2011, p. 12)
“Theory represents a systematic explanatory statement about the relationships among a set of constructs, with accompanying logic and assumptions”	Systematic explanatory statement Logical relationships of constructs Assumptions	(Ferris et al., 2012, p. 96)

Table 7.1 Definitions of theory

From the definitions in the table, the following observations are made. First, theory is the description of phenomena i.e. actions, natural or social behaviour; specifically, a theory is an organisation of constructs, concepts and variables. Second, there is a relationship between the constructs or concepts which collectively present a coherent and logical explanation of the phenomena. Third, theory has to be within the context of certain assumptions and boundaries (Bacharach, 1989). Based on this understanding, it can be ascertained that a theory is not a description of events, but rather an explanation of phenomena that enables repetition and predictability within the confines of the assumptions that pertain to the phenomena of interest. With this explanation, an exploration of theory from the perspective of processes is provided.

7.1. Theory and process classifications

Using the framework from Poole et al., (2000), a description of the relationship between processes and theory is espoused. Accordingly, three concepts of theory from the context of organisational change research are described; first, logical explanation of the causal relationship between variables (variance theory), second, as a category of concepts or variables, and third, as an explanation of the sequential order of change.

A logical explanation of causal relationships between variables refers largely to the input-output model of process change. Here, the emphasis is on describing the effect of inputs on the output of a process, this could also be described as the effect of an independent variable on a dependent variable. An example often cited in experimental research is the increase in sales volume of a particular product (dependent variable), when a promotion is introduced (independent variable). In the experiment in this research, a causal relationship between the dependent and independent variables was established, where a more modular process (built on predictability) reduced the level of disruption to the process in a dynamic operating environment.

In their discourse, van de Ven and Huber, (1990) describe the causal process explanation as lacking detail of the process and is dependent on idealistic assumptions about the nature of events. To avoid this, an observation of the activities that enable the causal relationship between the dependent and independent variable needs to be done, which involves opening the proverbial black box see Figure 7.1 (Poole et al., 2000).

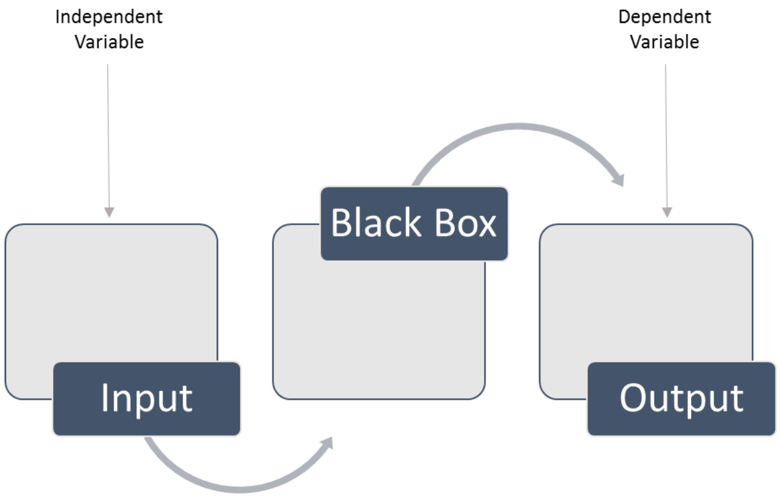


Figure 7.1 Variance Theory

Category of concepts describes the theory of process from the perspective of workflows, individual and organisational tasks, it relates to the conventional description of business processes. Here, the emphasis is on the details of the tasks that occur between the input and output (i.e. the black box). The irreducible purpose of processual analysis remains to account for and explain the what, and why of the links between context, processes and outcomes. From literature, the significance of the processual view is demonstrated in the study of process from a cross-functional perspective, the interconnectedness also enables processual investigation of performance (Dawson, 1996; van de Ven and Huber, 1990). Furthermore, processual theory provides a contextual explanation for the tasks in a process.

According to Poole et al., (2000), the sequential order of change represents the holistic view of change in events over a particular period of time. Whilst, the category of concepts relates to the activities that occur within a process, the sequential order of change is focused on the historical nature of an entire process and the changes that have occurred in that time.

7.2. Theoretical Contribution

The theoretical contribution of this research is predicated on an understanding and classification of theory. From the literature on theory discussed in Section 7.1, the significant contribution to knowledge of this research is espoused. As stated previously the significant contribution to knowledge of this thesis is the ***influence*** of predictability and modularity on reconfigurability of business processes in a dynamic operating environment. To develop the theoretical contribution from this research, a description of the phenomena, a relationship of the concepts and the boundaries they are set in are explained.

A theoretical description of the phenomena is focused on changes to business processes; business process changes necessitate a degree of disruption, this could either be significant or minor depending on the scale or complexity of the change. The introduction of predictability and modularity into the business process design creates a reconfigurable business process that is better able to facilitate rapid transformational changes with reduced disruption.

The relationship between the concepts in this phenomena is illustrated in Figure 6.1 (relationship between variables). Predictability and Modularity in the process design act as independent variables whilst disruption and response time (to change) are the dependent variables. Consequently, reconfigurability acts as the mediating variable that defines the relationship between the independent and the dependent variable. A predictable and modular process creates a reconfigurable process that enables reduced disruption and faster response times. In this instance, the moderating variable (which is responsible for instigating the relationship between the independent and dependent variable) relates to changes initiated in a dynamic operating environment. This leads to the issue of the boundaries that pertain to this theory.

The theory proposed in this research is based on the context and boundary of a dynamic operating environment. Analysis from the experiment indicates that the value derived from predictability and modularity in a latent operating environment (where changes are infrequent and minor as opposed to a dynamic operating environment) is not evident in the interim but realised after subsequent iterations of the process. The amount of time and effort required to integrate predictability and modularity to the business process design to create a reconfigurable process is not justified when there is no need for reconfiguration. Hence, this theory is confined to the boundaries of a dynamic operating environment, where change to the business process is more frequent, and/or major.

Three classes of process theory were described in the preceding section (7.1), logical explanation of causal relationships between variables (variance theory), process theory as a category of concepts or variables, and as an explanation of the sequential order of change. The process theory derived from the contribution in this research relates more closely and can be classified as the *category of concepts* and not variance theory or as an explanation of the sequential order of change. Conversely, because variance theory relates to the transactional view of process change, which is focused on the explanation of cause and effect of inputs to outputs; hence, an assumption could be made that the contribution from this research relates to this classification. This assumption is based on the impact of the inputs of modularity and predictability in a process design on (the output of) disruption and time to respond. However, on further examination, modularity and predictability deal with the individual task’s responsiveness to change which subsequently impacts the output. In this research, the level of disruption and response time are not outputs of a process but rather help to assess the ability of the process to respond effectively and efficiently to change in a dynamic operating environment. The sequential order of change is focused on the historical nature of an entire process and the changes that have occurred in that time, which does not relate to the contributions made in this research. As with the category of concepts, the research is not focused on a holistic view of the process but rather the interactions and interconnectedness of the tasks and its subsequent impact on process change in a dynamic operating environment.

7.3. Contribution to Practice

The academic discourse of business processes primarily originated from an attempt to understand, measure and improve business performance in industry; hence any contribution should be discussed in the context of industry practice. In this section, a discussion on the contributions of this research and its subsequent implication on industry practice are espoused.

Business processes encapsulate the flow of work from inputs to output in any given operation, taking into consideration the resources and constraints of the process (Bititci et al., 2011b; Bititci and Muir, 1997). Consequently, the focus of business process design is to create the most efficient and effective workflow, specifically it involves using the least amount of resources to achieve a business goal. Accordingly, the concept of reengineering and improvement of business processes was instigated by the need to have more effective and efficient processes that work towards business goals (Hammer, 1990; Hammer and Champy, 1993; Harrington, 1991). However, in a dynamic operating environment, where reconfigurable processes enable rapid responses and reduced disruption, a re-examination of what effectiveness and efficiency entail becomes essential to business practice.

In a dynamic operating environment where there are consistent changes to customer preferences and market conditions, the ability to respond to these changes is not only desirable but an essential component for effective business operations. Similarly, whilst using the least amount of resources to achieve a business objective is efficient, changes to the business operations that dictate a new process design every time is not. Therefore, effective design of business processes should be robust enough to enable changes to the existing process without the need for redesign, due to the disruption it would cause. The contribution from this research is necessary; a reconfigurable process created by integrating the concept of predictability and modularity will enable rapid changes with reduced disruption. This will initiate a different approach to process modelling, to create a reconfigurable process, an anticipation of future occurrences with a degree of confidence has to be done as well as an analysis on the interconnectedness of tasks within the process.

7.4. Contribution to Academic Body of Knowledge

This research was motivated by the dynamic nature of the modern-day operating environment, which instigated an explorative study on its relationship with business processes (Chen & Miller, 2012a; D'Aveni *et al*., 2010; Ndofor *et al*., 2011). Accordingly, the business process was selected as the single unit of analysis on this discourse because of its interconnectedness with tasks, roles, and people working towards a business goal (Earl, 1994; Earl and Khan, 1994). Existing study on business processes had hardly advanced from the remit of either process re-engineering and its proponents (Davenport, 1993; Davenport and Short, 1990; Hammer, 1990, 2014) or its critiques (Deakins and Makgill, 1997; Harrington, 1998; Mumford and Hendricks, 1996; Vakola and Rezgui, 2000). Other discussions on business processes have been focused on continuous improvement (Coronado and Antony, 2002; Hendricks and Singhal, 1997; Womack and Jones, 1996; Stoddard and Jarvenpaa, 1995; Zairi and Sinclair, 1995). Adapting principles from existing bodies of knowledge like dynamic capabilities, agility, and software reconfiguration, the contributions from this research expands existing knowledge of business process literature. The acknowledgement of the impact of agility on business processes was subsequently conveyed in a conference publication on the interrelationship between agility and business processes[11] (Osagie and Bititci, 2013).

To remain sustainable in a dynamic operating environment, organisations require the ability to change quickly and frequently by adapting and responding rapidly and

[11] (Osagie and Bititci, 2013) Business Process Agility as a Strategic Capability

efficiently (Benner, 2009; Braunscheidel and Suresh, 2009). The contributions from this research demonstrated this by introducing concepts like predictability and modularity to create reconfigurable business processes that facilitate rapid transformation with minimal disruption. This led to the introduction of the notion of business process reconfiguration (BPRC)[12] as a complement to traditional process change methods like BPI and BPR (Osagie and Bititci, 2014). Finally, the most significant contribution of this thesis to the academic body of knowledge is the ***influence*** of predictability and modularity on reconfigurability of business processes in a dynamic operating environment.

[12] (Osagie and Bititci, 2014) Organisational agility & the business process conundrum: Is reconfiguration the answer?

Chapter 8. Conclusion

The aim of this research was to investigate whether predictability and a modular to business process construct can complement existing business process change initiatives like BPR and BPI in a dynamic operating environment. Since dynamic capabilities and agility advocate the ability of an organisation to respond with speed, a couple of questions emerge on the implication of these attributes to the business process. To this aim, the following *literature review* questions were asked.

- With regards to rapid changes in a dynamic operating environment, what are the current gaps in knowledge of business process management and,
- What opportunities would a study of business processes in a dynamic operating environment yield?

To extend the current knowledge on BPM with regards to responding rapidly in a dynamic operating environment, two bodies of literature were examined from the context of business processes; Dynamic Capabilities and Agility. A critical review of these two bodies of literature in relation to business processes informed the concept of reconfigurability as a key tenet that could enable business processes to respond rapidly in a dynamic operating environment.

This research was initiated on the premise of exploring the gaps in knowledge of business processes in a dynamic operating environment. The notion was established that in the last three decades, the perspective of business process change has hardly changed from either re-engineering (BPR) or Improvement (BPI). It was noted that the rate of change today has created a dynamic operating environment within which the need to rapidly respond has been significantly amplified. To this notion, an explorative discourse was initiated in the literature on the basis of the two literature review questions, a review of the literature based on these questions led to the development of five research propositions. The findings from this research are discussed from the context of the questions asked at the onset of the literature review and the propositions derived. Furthermore, a discussion on the theoretical implications of the findings in this research as well as the impact on managerial practice are discussed. To answer these questions, a three-phased literature review was undertaken; where a review of dynamic capabilities and agility was undertaken.

This first phase of the review identified five core themes (sensing, responding, reconfiguring, speed and disruption) as critical to business process change in a dynamic operating environment. The first phase of the review also identified these themes as being critical to the discourse on business process change in a dynamic operating environment.

The second phase of the review recognised the existence of “transforming” processes and “transformed” processes and their relationship with the five core themes (sensing, responding, reconfiguring, speed and disruption). In the experiment, Phase 1, Phase 4 and Phase 7 are examples of transforming processes because in this phase the emphasis was on sensing the need for change as well as designing a solution to that change. Conversely, Phase 2, Phase 5 and Phase 8 are an example of transformed processes; in these phases, the emphasis was in responding and executing the previously established process design. Organisational processes with capabilities like sensing, responding, and reconfiguring are transforming processes as their function is to transform the operational and support processes. Thus, in the context of operational and support processes, the concept of reconfigurability was critical.

To identify how business processes could be more reconfigurable, in the third phase of the review, the concept of reconfigurability was examined from previously established disciplines like product design and software engineering. The outcome of this review led to the identification of predictability, modularity, and standard interfaces as critical components to reconfigurability. This subsequently led to the introduction of five testable research propositions to further investigate the feasibility of the reconfigurable business process. Particularly, empirical research into the business process reconfiguration was required to facilitate an applicable approach to reconfiguration in the context of business process change. In summary, the review of the literature provided three distinct contributions.

First, whilst current business process change methods (BPR and BPI) are relevant as agents of radical and incremental change respectively, the disruption attributed to BPR and the inability of BPI to ensure large-scale transformation would inhibit the possibility of rapid transformational changes occurring frequently. Consequently, by exploring the business process management literature from the lenses of dynamic capability and agility, the review identified a gap in knowledge that gave rise to the feasibility of reconfigurable business processes as a means to facilitate rapid transformational changes.

Second, this review presented a research agenda (in the form of propositions) for developing the contribution to the knowledge of the possibility of reconfigurable business processes as a means to more rapid transformational change. See Table 2.9 for details.

Third, by introducing the notion of business process reconfiguration, it created a platform for extending the scholastic investigation on the topic of business processes. The validity of the notion of reconfigurable business process was subsequently investigated with far reaching implication on academic research and industry practice. The discussion in this section is framed by the five propositions.

1st Proposition

Existing knowledge of reconfigurability in product manufacturing systems and software engineering can be transferred and/or replicated for business processes.

The validity of the first proposition was determined by examining the applicability of knowledge in product manufacturing systems and software engineering to business process change in a dynamic operating environment. From which, factors like predictability, modularity and standard interfaces emerged as essential to the design of business process reconfigurability. In essence, the validity of this proposition was tested by examining the feasibility of creating a reconfigurable business process using the concepts of predictability and modularity (enabled by standard interfaces). See Section 6.1 for details.

2nd Proposition

A high degree of predictability will enable a more modular approach to process design.

The validity of the second proposition was established by comparing the difference in modularity between the two process designs from the control and experimental group. From the experiment, a new definition of modularity was introduced. Existing definitions of modularity from the product design literature describes modularity from the perspective of the module, that is as an independent sub-component of a product. Whilst that is correct, it does not adequately articulate the task complexity of a business process due to the anatomy of a process (where tasks are connected towards the attainment of a particular purpose), there is a degree of modularity in every process. Consequently, whilst the existing definition is suitable in product manufacturing; from the perspective of business process design, an understanding of the comparative degree of modularity was critical. From a business process design perspective, *the degree of modularity is reflected by the relationship between the connectivity of tasks within a module, and the connectivity across the module boundary.*

Therefore, the experimental group were able to demonstrate predictability by anticipating future changes to the process which subsequently led to the creation of a more modular process in comparison to the control group. Specifically; based on this anticipation, the experimental group created a modular process with three possible alternate process paths. See Figure 6.3 for process design and Section 6.2 (2nd Proposition) for details.

3rd Proposition

A more modular approach to business process design, based on predictable outcomes would enable transformational changes to occur rapidly and with reduced disruption.

A primary factor necessary to examine the validity of this proposition was to compare the level of disruption between both processes experiencing transformational change. To do this, a criterion for determining the level of disruption was paramount. The experiment was able to measure disruption in relation to staff engagement (participants), quality and customer experience (quantity of re-work needed after each scenario), and cost (time taken to design and implement process change). In every metric, the degree of disruption was lower in modular processes compared to the other processes. See Section 6.3 for details.

4th Proposition

Existing business process management change methods would not be appropriate, or even sufficient to enable the design of reconfigurable business processes.

An evaluation of the results from both experiments revealed a significant difference in the impact of reconfigurable business processes in comparison to traditional business process change methods. Traditional business process management change methods are based on a reactive methodology, where change is initiated as a result of disruptions to the existing process. From the experiments, an observation can be made that this reactive methodology is more adequate in circumstances where disruption to existing processes is minimal. For example, when minor changes were introduced (Phase 3 and 4 of the experiment), the design of reconfigurable processes took more time and was less effective in comparison to traditional process change methods.
Reconfigurable process change methods are based on a proactive methodology, where changes to the process are initiated in anticipation of disruption rather than in response to one. From the experiments, an observation can be made that this proactive process is more adequate in circumstances where disruption is high, i.e. a dynamic operating environment. For example, when a multiple number of major changes were introduced (Phase 6 and 7 of the experiment), the design of reconfigurable processes took less time

and was more effective in comparison to traditional process change methods. See Section 6.4 for details.

5th Proposition

The amount of effort required to design reconfigurable business processes would be significantly more than other traditional forms of process design.

In the experiment, three factors have been used to evaluate the amount of effort expended in process design; whether reconfigurable or traditional process design. First factor was the time taken to design the process, by comparing the time taken in both forms of process design, there is evidence of significant differences in the time taken depending on the level of disruption to the process. The second factor relates to the execution of the process rather than the design, where the volume of rework that needed to be done after the process had been concluded, was compared between both processes. The third factor is a general observation of the experiment and the challenges faced by both groups. These three factors helped determine the level of effort attributed to reconfigurable and traditional process design, however, it further revealed that the level of effort required was dependent on the stage of the process design. In the initial stages of disruption, reconfigurable business process design required more effort than traditional forms of process design. In the later stage of disruption, reconfiguration takes less effort compared to traditional forms of process change, however, it is important to note that less effort in the later stages is enabled by the effort expended in the earlier stages when the reconfigurable process was initially designed. See Section 6.5 for details.

8.1. Limitations & Future Research Direction

The principal limitation of the findings from this research relates to the operational environment. The influence of predictability and modularity is only evident in a dynamic operating environment; furthermore, the necessity to anticipate and change in an inert operating environment is minimal.

A second limitation of this research relates to the experimental research method used. Whilst the obvious benefits of the experimental research method are repeatability and determining causal relationships, it achieves this through the use of controlled environments that do not necessarily depict real-life scenarios. In experimental research, all variables are tightly controlled by the researcher and minimise the effect of other factors that may or may not have an influence on the outcome of the experiment. In Section **3.6**, a detailed description of all the possible research strategies and techniques for this experiment was written and the justification for using the experimental method. The resource limitations of a PhD. research and the propositions from the literature indicated the use of experiments rather than other research methods.

To build on the contributions from this research, a couple of factors should be considered; for example, the use of other research methods other than an experimental method. A case study approach in a process-oriented organisation in an industry experiencing dynamic change would be suitable. The conditions for this sort of research could either be as a single case (organisation) with multiple processes, where the researcher is a full-time employee of the company, or a multiple case (more than one organisation), to check for repeatability of outcome which is discussed in more detail in Section **3.6.2.**

Furthermore, a limitation of this experimental method was managing confounding variable; an extraneous but difficult to observe variable that can potentially undermine the outcomes from the independent and dependent variables. In this research, the confounding variables were identified as the level of intelligence between participants, the propensity of the some of the participants towards games and exercises of this nature. To manage the former, the research ensured participants were of the same academic level in each of the experiments; and to manage the latter, all participants underwent an identical training on business processes and the mail sorting process. Though, the issue of varying levels of proclivity towards exercises like this was minimised it was not completely eliminated which may have had an effect on some participants ability to carry out the tasks more effectively than others. A more robust method of managing this in future can be using participants of an actual mail sorting room in a mail sorting experiment outside of their regular working operation. In such a circumstance, an experimental environment where control is essential would still be available, but the issue of confounding variable would no longer be present because all participants are already very familiar with the exercise would not require training. Another research method that would be applicable is an action-styled research; where the researcher goes through an iterative and participative process of applying the findings from this research in an organisation looking to overcome the challenges of a dynamic operating environment. Documenting the results of this action styled research would provide more insight into reconfigurable business processes.

The contribution from this research, as well as the design of reconfigurable business processes, are predicated on the impact of predictability and modularity. Future research could be done on establishing a repeatable method of being predictable and modular from the context of any business process. If being predictable is the ability to anticipate future occurrences with a degree of confidence, a repeatable method of doing so needs to be established. However, it is important to note that any such method would contain a degree of assumptions, whilst not perfect, it would still be useful. An example of this would be a sales forecast which involves minimising the difference between actual and (predicted) results and setting up contingency plans for managing this distance. Conversely, in a reconfigurable business process, these contingency plans could be designed to create a modular process.

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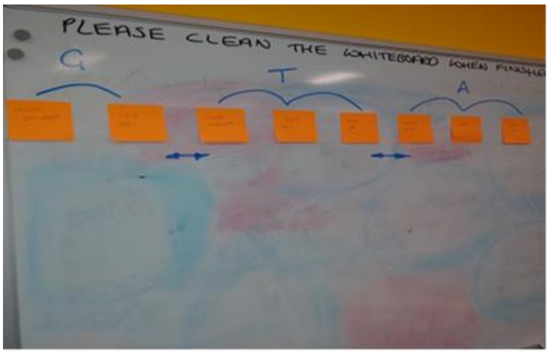
Appendix

In this chapter, pictures and transcripts from the experiment that have either been recreated or explained in the main text of this thesis are provided for context and clarity. Appendix 1 in Section 0 contains all the pictures of the process diagrams from the experiment, whilst Appendix 2 has the transcripts from the experiment.

Appendix 1

Figure 0.1 contains the pictures from the Control Group 1A and Experimental Group 1B from the first experiment, depicted in Figure 5.2 Control Group-1A Process Map-Scenario 1. The initial process design from both groups had similar designs



Control Group Scenario 1

Experimental Group Scenario 1

Figure 0.1 Pictures for Figure 5.2 and Figure 5.3

Appendix 2

Figure 0.2 and Figure 0.3 are the pictures from Scenario 2 of the Control Group 1A and Experimental Group 1B from the first experiment, where the first initial change was introduced.

In Phase 4, to meet the new requirements caused by the minor unplanned changes, the both groups required changes to their process design. The Control Group-1A, made an improvement (BPI) to their existing process design by including a decision gateway (decide on the fold, based on the size of the document received) in the process between receiving and selecting the envelope and folding the document, see Figure 5.4. The Control Group-1A took 85 seconds to improve the design of this process based on the new requirements.
The Independent Variable (Predictability and Modularity) was introduced to the Experimental Group-1B, where they were informed of the requirements and necessity of a reconfigurable process. This meant that they (Experimental Group- 1B) designed the process with an understanding that there may be future changes to the process, so the process was designed with a degree of prediction of these future changes by making the process more modular. This group decided that there were three feasible sets of documents that could come into this mail sorting room, Bills, Invoices and Receipts in three possible paper sizes (A4, A5, and A6), see Figure 5.5

Figure 0.2 Picture for Figure 5.4 Control Group-1A, BPI- Process (Scenario 2)

Figure 0.3 Picture for Figure 5.5 Experimental Group-1B, BPRC- Process (Scenario 2)

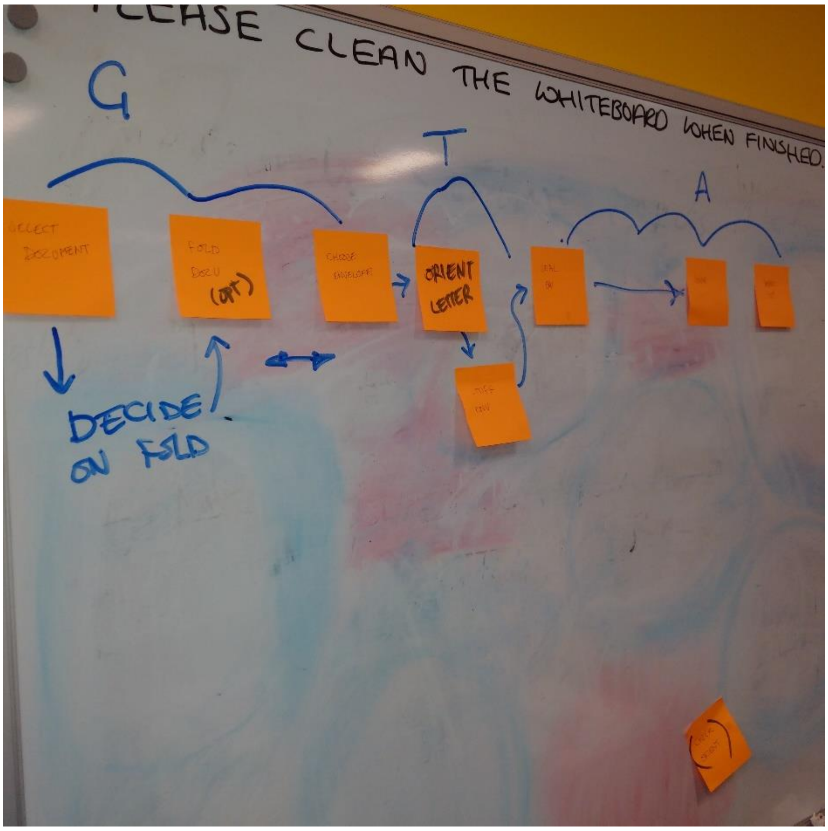


Figure 0.4 Picture for Figure 5.6 Control Group-1A, BPR- Process (Scenario 3)

Appendix 3- Transcript from Control Group

Transcription of Audio file: MOV008.mp3

IO: = Isimemeh Osagie

RM: = Respondent Males (And. Gra. and Tho. - The three Participants)

VIDEO: = Voice from video footage

Initial discussion-00:00:00:00

IO: In a real business scenario, every task will count towards the final outcome or output of a process, like every task that needs to be done with an awareness of the final outcome, and so I want us to look at what it is we do and look at the detail. And you guys are taping us, because what will happen is, after we watch the video, I want you guys to use post its, yes? Post-IT.

RM: I do not have a pen

IO: Okay, never mind. Have mine

IO: Yes, that's fine. So, yes, so basically what we're going to do is watch the video, and then I want you guys to map the process of that, yes, and just say, okay, this is how it will go, you know if I were to do this, if you were to design it for, if you had to say, create how to make a cup of tea for your own coffee shop, and you're going to focus first, and you want to follow every process to make this cup of tea, how would you do it? So, you put a template for them to run with.

RM: Yes.

IO: So, I'll just show you this, we'll see how it all goes. I don't think there is sound

First training on Process Mapping

VIDEO: How to make a cup of tea, by Frank McHale. To make a cup of tea, you need the following materials: These include a kettle, a cup and spoon, some water, a tea bag, some milk, and some sugar.

Step 1: fill the kettle. Now switch the kettle on.

Step 2: place the tea bag in the cup and wait for the kettle to boil.

Step 3: once the kettle boils, add the water to the cup and leave to brew.

Step 4: Remove the tea bag and add milk.

Step 5: If required, add sugar and stir.

Finally,

Step 6: Taste, cheers.

RM: It's good acting

Participants mapping making a cup of tea process- 00:05:00:00

IO: Okay, so, what it is, in the process, if you notice for every task there, is not denoted by the steps mention, why don't you guys try and map this process out, you map this process out, so on each paper, you just write each step or each task, how its process would go, so that somebody else can see it and be able to replicate it with similar results

RM: Okay.

RM: Do we have a process for optimising opening the packet.

IO: [Laughter]

RM: So...

IO: So, what you want to do is just write, not just, do it as a team, do it as a team.

IO: [Laughter] that's another process.

RM: Who has got the neatest hand writing?

RM: Okay fill the gap. Do we need to paste?

RM: Yes.

RM: To map

RM: Well no first there's no,

IO: The resources, let's leave the resources out, let's just how the process, the steps or activities to make the team, assuming you had all the resources necessary.

RM: Okay.

IO: So, you just write it down and well paste it on the wall from the first to the last process.

RM: Yes.

RM: Could you put every single step.

RM: Okay, number 2, bag and cup.

RM: Wait for kettle.

IO: You can make it each activity, each task on each post it, so each task on each post it.

RM: Okay, I'll re-write the next one.

RM: Put wait for kettle on the next one?

RM: Yes, you re-write those two.

RM: Okay so now water in cup,

RM: Water in cup.

RM: The next one, leave to brew.

RM: Leave to brew.

RM: The next one, remove bag.

RM: Remove bag.

RM: Then add milk.

RM: then add milk. Yes.

RM: and then, add sugar,

RM: add sugar.

RM: Yes.

RM: because stirring

RM: Yes, then stir.

RM: You only need to stir if you added sugar?

RM: Or maybe, I don't know.

RM: I don't know, but the final one is drink.

RM: If we're going to go,

RM: This would then after, to remove bag, add milk,

RM: All right.

RM: Add sugar, stir, drink.

IO: Okay, so is that it?

RM: I'd say so.

IO: So, what have you got

RM: We could say we could wait for the kettle to boil, but this, I mean,

IO: Okay.

RM: How, exactly,

IO: How details to go,

RM: the details.

IO: That's a good question, you see, the thing is, in a process, when you're mapping out a process, you have to go as detailed as making sure that you don't ever relate anything that will not have an effect on your output. Now output is to make a cup of tea. If you say fill the kettle, turn on the kettle, and so you don't want it to boil, if the water doesn't boil, would that have an effect on the output?

RM: Yes.

IO: So that's a significant aspect that should be included.

RM: For this are we trying to do our people process or customisable process?

IO: Well at this moment in time, the issues, this is just a first phase of just educating you guys about process mapping. At this moment in time [I want you to focus on making sure] every process is repeatable, regardless of whether it's customised or not, well that, well it's a good question, a fair question, so for me, you have to turn on the tap, which was not, that's another thing. If we observe this, he writes, he talks about each step, but there are more steps that he doesn't mention.

RM: That's true.

IO: There are more steps he doesn't mention in numbers. Like I said for instance, you have to turn on the tap. Which is important, then fill the kettle, the plug the kettle, to put the teabag in the cup, wait for the kettle to boil, pour boiling water into the cup. Well you took care of that. Leave to brew, but the step 8, leave to brew, remove the bag, add milk, add sugar, so that's two or three steps, I had 12 steps, you guys had 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, so that's about a step out, but I like how you guys observed all the things that were necessary. Okay, now, going to what we want to do, I just want us to go, I just want us to test that and see how it works. So, what I'm going to do is,

Second training on process efficiency and the significance of process workshops like these- 00:10:00:00

I'm going to show you another process okay, and this time, you will not only design the process, that's what here (referring to what is on the board), [but you would] design the process map, and implement it, okay?

RM: Yes, we can implement it because we're only making a cup of tea, okay.

RM: teabag?

IO: No [not making a cup of tea], this process is something that has been used, it's quite long video, but it's to show, it's an example to show people how processes work and how we use things like this to develop understanding of our processes and how they work in reality.

VIDEO: so, what we're going to do in this video is I'm going to kind of redo a simulation that I first did back in around 2008 and this first simulation was actually the first video that I ever made in my life. I was actually sitting at my kitchen table, about 1am, and I had some Home Depot light strapped to a step ladder, that was my lighting, and kitchen cabinets, I nearly burnt my house down I think, that night. Anyhow I somehow got that video put together and I uploaded it back then to Google Video, if anybody remembers that, and I embedded it on my blog back then, which was OSS academy and the comments kind of just blew up, and people just went crazy. Some people were like almost attacking me, they were angry, they were thinking I was playing some kind of trick, or something like that, there was no tricks. It was just one-piece flow versus bad productions, so obviously we got a little bit better at making videos so we're not in my kitchen.

IO: I'm going to just pause it and say something. You see with process mapping and implementing processes, it's important that the processes are efficient and effective. So here he's trying to describe the most efficient way to do something, so to run processes. So, one-piece flow is saying for instance, a car manufacturer wants to create the process of going through the conveyor belt, the car fits the tyres, the engine the windscreen and so on… the car goes. I don't know if anybody knows, or has observed that process before, the way car goes through the conveyor, that's an example of a one-piece flow. A batch production would be where if fitted all the tyres first, and then go back and fit all the engines, they go back and fit all the doors, and they go back and fit all the chassis, you know that kind of thing, so that would be batch production, do every single activity once, instead of 1, 2, 3, 4, 5, 6, 7, 8, 9, 10. Yes, doing 1, 1, 1, 1, 1, 2, 2, 2, 2, you know that's so, he's trying to show which is more efficient, that's what this video is about, so, I'll just continue.

VIDEO: Yes, so I want to redo that simulation here and the first thing I would encourage everyone to do is to watch this video, but then, go ahead and try this for yourselves and I'm doing this by myself, but you can actually do this simulation easily with say three people. One person could be the folding station, the folding of the paper. The next person could be the stuffing of the envelopes, and then perhaps a third person could seal and stamp the envelopes. So, there's many different ways of doing this, but since I'm by myself, I'm going to do it on my own. So, I've got 10 pieces of paper. This is just standard paper from our printer, and I've got 10 envelopes, and I've got my good mechanic stamper. I'm not actually going to stamp it, because Lesley would, in our office, would yell at me if I wasted envelopes, so, what I'm going to do is get my little stop watch and my iPhone dialled in. I think maybe Greg will put a little timer in the bottom of the video here or something, but let's see how this goes. So round 1 is mass production, are you ready? Here we go. All right, so, first thing, we're going to start folding. And what I'm going to do, I'm going to do my very best, so nobody thinks I'm playing any games to work at the same pace, no matter if I'm doing mass production or one-piece flow. Now this simulation was first, I learned about this in the book Lean Thinking, Dr James Womack first wrote about how he asked his daughters what they thought the best way would be to go about stuffing envelopes with some marketing material he wanted to send out, and they kind of naturally moved towards this kind of, that production mindset, and I think if anyone has ever been married and had to do the wedding invitations, the chances are really good that you did what I'm doing now, which is someone folded and someone did all the stuffing, and someone did all the stamping and so forth. So, it's, I don't know, for whatever reason, mass production is very comfortable to us, and we're drawn to it for some reason. People talk about the early farmers how they used to have to kind of store up wheat and grain for the long Winter,

00:15:00:00

and that was kind of ingrained in our thought process right, you know, that idea anyhow, so you can see you’ve got lots of inventory, wasted inventory, kind of piling up here in front of me. Right, so all 10 pieces are folded, now what I'm going to do is I'm going to stuff all 10 envelopes. Now here's the crazy thing, what happens if I had made a kind of a folding mistake on all of the pieces of paper, and I didn't discover it until after stuffing step? Well I would have had a bunch of defects, again, so that's another kind of draw back or negative to mass production, kind of high-quality problems, or can high quality problems. Okay, there's 10, now after this, we're going to go ahead and I'm going to seal all of the envelopes.

RM: I don't think he succeeded there.

VIDEO: So, they're all sealed, now what we got to do is we've got to stamp them all. Simulate the stamping process. Double check I've got the right orientation I guess it doesn't matter, right. All right. 3:42 is our magic time here, so go ahead and write that down, we'll put it up on the screen here but 3:42 is the mass production time to beat. So, let's see what happens. So, kind of move this off to the side, let's get setup for the one-piece flow. So everything is going to be the same, so what I'm going to do here, is I'm going to pick up a piece of paper, I'm going to fold it, I'm going to stuff it, I'm going to seal it, I'm going to go stamp it, and that will be done, and I'm going to move through all 10 pieces that same way, okay? So, let's see, let's go. All right. Folding the first piece, put it in the envelope. Stuffed it, seal it, stamp it. First piece done in about 17 seconds or so. Fold,

RM: You didn't check the envelopes, to see the orientation.

RM: My guess is then you just seal it.

RM: I know, I know, still,

VIDEO: Now there are, as we mentioned in several videos, prerequisites to one-piece flow, you've got to have a stable process. If you are producing tons of defects, one piece flow is going to very challenging, I mean the good thing is you'll immediately identify those issues, and kind of be forced to deal with them, so that can be a good thing, but it can be uncomfortable and painful, if you don't have stable processes. Okay. I was thinking like Motley Crew would be kind of cool.

VIDEO: For the music of this video. I wish I knew some jokes.

VIDEO: Actually, I know one joke. I'm going to tell a joke while I'm doing one-piece flow just to prove how awesome it is.

00:20:00:00

So, a horse walks into the bar. The bartender looks at the horse, and says why the long face? You get it? Long face?

RM: I don't get it.

VIDEO: All right, 2:56. So we went from, what was it Greg? We had 3:42, to 2:56, so it's quite an improvement, and what I would really encourage you to do with your teams, is to watch this together and do it, do the simulation yourself, do it yourself, do it with a team.

IO: Now obviously I'm not going to reinvent the wheel and make you guys do this all over again, but I just wanted to give you guys an appreciation of this sort of workshop and its effect on actual business process design efforts. Right now, what we're going to do is an exercise similar to what we have just watched. So, what I have here is various envelopes, envelope types, and I'm going to open one of them, before we start. Now what's going to happen is, we're going to go through the same sort of process where you have documents, and you would need to put them in the right, put them in envelopes, you know put them in the envelopes, seal stamp, you know the same thing you did basically

RM: Why was it faster?

IO: Sorry?

RM: Why was it faster with one-piece flow?

IO: The thing is you eat a lot of time, let me just put it back on, you eat a lot of time,

VIDEO: Something like that, and then brainstorming why do you think the one-piece was faster?

VIDEO: When you look at the one piece flow, the methodology, that first piece of paper that I'm folding, well I never put it down, whereas in the mass production, I folded that first piece of paper, put it down and then it sat in the same pile, and then eventually I picked that paper up again, and then I stuffed it, and then I set it down. Eventually I came back around to it, I picked that piece of paper up again, and the envelope, this time I sealed it and then I sat it down, and then finally after the other ones were done, I picked that piece of paper up again and the envelope, and stamped it, and so what we're doing with all this touching of that same piece of paper, so that's just one of the many reasons why this one is faster, but I would encourage you to get with your teams, do the simulation, and then really brainstorm, see if you can figure out why it's faster.

IO: Okay, so you should observe that process, if you were to map this process like you did, how would you map it, if you mapped this process, this exercise you did, if you had to map it over both these, of the map?

RM: Well which one? The mass production or the one piece?

RM: The one piece.

IO: The one piece.

RM: Pick up the paper, fold the paper. Pick up the envelope, stuff the envelope, pick up the stamp, sorry, seal, yes, pick up the stamp.

RM: Pish, pash, posh.

RM: That's that.

RM: Envelope, pick up stamp, then stamp.

RM: Yes, right.

RM: Stamp and then

IO: go through this

The Exercise begins-00:25:00:00

IO: Okay, so based on what is read, could you go about designing a process?

RM: Okay.

IO: So, designing a process from the board yes?

RM: So first off

RM: Right, so,

RM: Okay.

RM: Right, fold document.

RM: Right, so we're folding it and stuffing it right here?

RM: Yes.

RM: Yes. Then you have to select the right envelope, like size, as well.

RM: How are we choosing which envelope they go in?

RM: Based on the final folding configuration.

RM: How do you spell envelopes?

RM: Yes.

RM: So, we select the right envelope.

RM: Right, stuff envelope.

RM: So, my question is do we seal the envelope.

RM: We have to assign someone to each task

RM: right?

RM: Actually, if it's a different person, we need to check and then, unless it's the same person they still have to be sealed, and then stamped, and then,

RM: Should we have a couple of pass, like a passing step as well, two passing steps as well, pass to?

RM: Yes.

RM: Yes, so we're going to be putting them in,

RM: Yes, pass, and then the last step is send them to be served.

RM: Right following stamping we send them to sorry

RM: Right.

IO: So, is that the process design then?

RM: Are we happy with that that that's going to work every time we give it the desired output?

RM: Anything that is missing that could cause catastrophic failure, if not, explain to someone the process

RM: I would say that person one would be responsible for this.

IO: Okay, so could you put the name of the person? So, who is appropriate, who is the right person?

RM: Have you got folding skills Graham?

RM: I think so.

RM: I kind of want to do the stamp.

RM: All right, Grant.

RM: So, somebody else.

RM: I'll let you take it. It's not my birthday today, so I won't be as spoilt.

RM: Those three there.

RM: Does each person, can they only do the process once? Can Grant re-join the process at a later point?

IO: It just means he would be the last one.

RM: And then those ones there would be Andrew.

RM: Yes.

RM: How does that seem?

RM: Will it work mind?

RM: so, stuff and seal, right?

RM: Do you think?

RM: transition point.

RM: Okay sure.

00:30:00:00

RM: What you got, right so if you sat in there, it's very easy for you then to seal it, that's all, whereas if you stuffed it and then you pass it on and you need to take it, and as you said and seal it,

RM: Well we could always try this and then, it's basically done

RM: We can.

IO: When you've done with the design please let me know then we can start the implementation

RM: We need to check, what we call bottlenecks in the process

IO: So, the first thing I'll do is, I'm just going to give you the documents, I'm just going to give you back, yes, I'm just going to give you back who am I feeding this to, the first person?

RM: I'm the first person.

RM: Grant is starting.

IO: Okay.

RM: And I need to get in front of me as well.

RM: Right.

IO: Okay, so, go ahead.

RM: Just start?

RM: We need to fold

IO: It just has to be appropriate.

RM: Bottlenecks appearing already.

IO: So, you've chosen the envelope, as we said. You're stuffing the envelope.

RM: What do I have to do?

RM: You know I'm sealing again.

RM: Yes, and are these getting mailed or filed?

RM: All right, there's bottlenecks appearing.

RM: I've got

RM: For instance, and not just feed it straight to me.

RM: That's true.

RM: Are you

RM: Unless we could have two people stamping, and like one person folding up?

IO: Okay.

RM: fold it like a quarter sheet.

RM: Do I have one of mine?

RM: There's one more in the back.

RM: the whole thing will take

RM: I know

RM: Sorry that's true, we could have

RM: Oh, there's some, distribution of stuff

RM: I'm putting them in at all different orientations.

RM: Yes.

RM: Yes, the envelope.

RM: So, I'm finding this quite relaxing

RM: Certainly, that's a lot easier at the start.

IO: Okay, well let's just stop for a second. Now I changed this document that I was giving you. Initially when I was giving you paper, you folded it into three, and you put it in an envelope, but there are many envelopes here, you could have chosen the C4, and put it straight in and not needed to fold, and that would be more efficient.

00:35:00:00

So, you either cut one side of the process… I didn't actually tell you specifically that you needed to use that particular envelope, the DL envelope, when you chose to use it anyway. It wasn't the most efficient process. You know so if you are taking this paper and just put it into a C4, and then fold it in bits, and maybe it will be a lot faster. Then I changed it to a small receipt, a C6, a small E6 paper, and I changed it, and you still folded it, and with the receipt for filing, most times, the receipts for filing, you don't need to, you don't need to fold it, to let you put it into the envelope, because it goes into the envelope, it's the most efficient envelope that requires that.

RM: Yes, I was under the assumption that it was sensitive data.

IO: [Laughter]

RM: It should be folded,

RM: Also, is it not cheaper to send a smaller envelope compared to bigger ones, they cost less as well?

IO: Well, you could argue that as well, you would argue that, but whichever way, you are both correct, justify it, however what you're going to say now is, what I'm going to say now is this, looking at these documents now, I would say, if this was a business process I would say, these are folded, these are fine, how many, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, these are fine, they are good for filing. And I look at these and say, well okay, you folded them, there's no reason for them to be folded, so I'll send it back to you, you get what I mean?

RM: Yes.

IO: Okay, so I'll do this, if I wanted to send you receipts, how would you redesign the process? You can no longer fold it any more, into, I don't want this folded, so I'm going to give you back as rework, I don't want this folded, so you need to rework this. What I'm going to do is, when I'm going through the process, if I look at anything here, I will be examining things here, but you're putting it either in the middle, and if they require rework, I'll stop and put it to one side, and I'll give it to you guys. Now you guys have to redesign the process to fit it in the way that you don't have rework.

RM: Can we have like a dynamic step where it can be like the first part is like you know, decide, based upon envelope size, can the folder, does the folder know the envelope sizes?

IO: Well, if you're clear on the process, that is if you amend the process in that way,

RM: Okay.

RM: Yes, to be honest that,

RM: We need a folder to be able to

RM: We're just training on envelope size.

RM: Yes.

RM: No, just like training on envelope size would encompass anything.

RM: That's not a specific process though.

RM: Well if you know all the envelope sizes, then you could decide whether you have to fold it or not.

RM: I don't know.

RM: I know what you mean, but I think the specific person, when you get the document, you would say, am I going to fold this?

RM: Yes.

RM: We've got to add that step in there, and then it becomes optional, if there are receipts that need to be folded. I mean as it, yes, I mean I would, yes, I would do it, yes, don't fold them unless necessary.

RM: In that case, only if the piece of paper is bigger than A4.

RM: If we haven't got any paper bigger than A4, then couldn't you just put everything in

RM: But then it's not like,

RM: But then we could eliminate the select envelopes then.

RM: But then there's the issue that maybe, for instance yes, because we have cost, is that true, that, and they don't fit, like snuggle in there.

IO: So, are we ready? So, the process, I'm just going to show you a picture of that process, because so you can process.

RM: Yes.

RM: Okay.

IO: Good.

RM: Right.

IO: Well first of all, this should be reworked.

RM: What? I might just, I'm only…

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RM: Can we re-use the envelopes?

RM: Yes, it does.

RM: We need to seal it.

RM: Yes, we did.

RM: You're not supposed to seal it, because it's chaos if you seal it.

RM: on your top left here.

IO: Okay.

RM: Electronic veil.

RM: What about if we could export our production based [???]

RM: Yes, there's a major process issue right there.

RM: Exactly.

RM: It's also the envelope design, that's a more of a key issue.

RM: Yes, because of the wee [small] ones have the sort of side to help you guide the paper.

RM: I'll tell you an issue with the process, which is that if you stack them like this, you're getting last in and first out, rather than first in and first out.

RM: Yes.

IO: Okay, now, I'll just inspect this and see what it gives us, and we'll see if there's any call to change it. Okay, so these we know we've got these right initially. Now, these, these are bills, and usually when you receive a bill, the person's name should be reflected on the window when you receive a bill, when you receive a bill statement.

RM: That wasn't stipulated.

RM: Yes.

RM: So, is that C5?

RM: One of these.

RM: No, it's C5 in Scotland.

IO: Now this is, that's an invoice, and this is a bill as well, and this is, they should be reflected on the envelopes. So that's a new requirement. So, let's just see, these ones require rework, and I'm going to take away these two envelopes, because they can't go, because they can't go into our sorting room, they can't go into our window.

RM: And that's an issue, out with the

RM: So, we need a new step, right?

RM: Yes.

RM: Because, so we've got,

IO: Before we go, are you sure what you want to do now, does it reflect the process map you have designed?

RM: No, we need to, we need to,

RM: a new step would be something like,

RM: A check.

RM: A check document or you know the document type, check document type.

RM: Yes.

RM: So, use the envelope based on whether it's a bill or,

RM: Yes.

RM: So, whether it needs a window.

RM: Yes.

RM: And then these will go in here.

RM: We've got to choose an envelope already there, but we just need to refine this process, this step, right?

RM: Well I, I mean assuming that the man folding the document can also see what kind of document it is, so like a bill or,

RM: I have to tell you what kind,

RM: Yes.

RM: Because he's holding.

RM: Yes.

RM: Yes, so how could we rework this?

00:45:00:00

RM: And we have these piles?

RM: Right we have these piles, we can see, so I can then put on top, or decide the pile that you,

RM: That's a step.

RM: Place in correct pile or something. So, if I have these laid out like this, so that's just

RM: Is it that we need another step in here that's like,

RM: So maybe if I did select envelope and pass that across?

RM: There it goes like this.

RM: Also, I would change this to I'm doing it.

RM: Yes.

RM: And is there anything else you added?

RM: Because it's got to face the window.

RM: Yes, okay.

RM: And it has to be able to

RM: The rotating reference frame and in the plane

RM: Are we saying that Grant's going to choose the envelope?

RM: Yes.

RM: So, you're going to pass me the envelope on the thing?

RM: Yes, I'm going to pass you the envelope

RM: Okay, so you're just doing,

RM: I'm just the filler.

RM: This is like a major process redesign.

RM: You're a stuffer.

RM: You're just a big old stuffer.

RM: We could do it, if you want.

IO: Of course, yes, take your time. You can wipe the whole board and start fresh, it doesn't matter.

RM: Well just do it on the right-hand side.

RM: Is that clear enough? It's clear enough to us, RM: Yes, I know that.

IO: Right, am I getting this right. Grant is going to select document.

RM: Yes.

IO: Fold, choose envelope, decide on fold rather, choose the envelope, then you're going to orient and stuff, and you will seal, check orient.

RM: I don't, check orientation that's now, I think your process shows up you know?

RM: Yes.

RM: So, this is like no longer, because I've already, I just sealed it, so I know where they are.

IO: So, you can take it out then.

RM: So, we're basically going to eliminate this process step, because I am

RM: Yes.

RM: A bit like the man in the video.

RM: Yes.

RM: I feel like management are really confusing us on this, because they didn't stipulate a lot of the conditions.

RM: [Laughter]

RM: Yes.

IO: Okay, are you ready?

RM: Yes.

IO: Okay you have to start doing the first rework.

RM: There you go,

RM: Yes, I think he's offered a

RM: So, these are getting mailed then I guess?

RM: No,

RM: Is that a wee bill and a big bill?

RM: Yes, they're all bills.

RM: Would it be more effective, if I did that?

RM: everything, like using

RM: That's basically what we're working towards, isn't it?

RM: Well we're kind of.

RM: I mean you know

RM: What if I just did bills, and you did invoices, and Grant did like things with that?

RM: It needs to be more dynamic assisted, it should be just now, like if, what is that?

RM: All right, so this one should be folded, is that what we decided?

RM: That one just goes in a blank envelope.

RM: Right.

RM: And gets filed.

RM: Right.

RM: probably taking these,

RM: Yes.

RM: When I'm done.

RM: I'm scared of getting a paper cut.

00:50:00:00

RM: You're just scared of hard work, that's your problem.

RM: This guy John Barker has not paid up.

RM: Make a little skull and cross?

RM: You know I'm trying to

RM: In what way?

RM: We should split up.

RM: Yes.

RM: Bottlenecks are appearing every different step.

RM: They need to mark, just, it's awkward to get them in there, in those envelopes.

RM: Because every time, so if you have a table and there's a lot of bills, you get, Grant, because he doesn't need to fold them. Or if they've got receipts, but if there was a lot of like three-fold letters, foreground, because he would need to fold them all.

RM: And yes, as the video said, you know there's no bottlenecks when you're working on your own, because,

RM: yourself.

RM: So, should we start and do a complete process redesign?

RM: I don't know because I would say if there was a bottleneck then there should be some flexibility.

RM: more dynamic.

RM: Yes, one or three can come in, like if I fold something, and see that Thomas has got three still to put in envelopes, then I've selected the envelope, I may as well put it in the envelope and pass it through to you.

RM: That's true, maybe something like that?

RM: Yes, so as I said

RM: Because the trouble is if we're all working this out, then if there was no bills, I wouldn't have anything to do, if I was doing bills.

RM: Well assuming that we're not working on separate all the letters are appearing in a pile and we're just taking it on the top of the pile.

RM: So, we could say,

IO: So, what's the bottleneck that you've discovered here?

RM: It depends on the inputs from each,

IO: Okay.

RM: From each step, so if there's lots of bills, then the bottleneck might be at the very beginning, because of all the folding needs to be done. If it's just receipts, then the bottleneck is more likely to be between the folding and stuffing stage.

IO: Okay.

RM: But then again, it depends on the envelope type, because these A5 envelopes are easy to stuff, because you don't have to, the wing is already double fold.

IO: Right.

RM: Okay.

IO: I'll just move through these and see if we've got that right. So, this is an invoice, bill, invoice, invoice, invoice, bill, bill, bill, invoice, invoice, invoice, invoice, invoice, invoice, invoice, and these are the receipts here. Okay so it already work out what it's supposed to, that's kind of like the end of the process, so what the thing is, what I was trying to show you, in the video we watched, you could see that the essence was on efficiency. Now here, in today's world, efficiency is still very important, but we want a new thing that comes up now, a new thing that is more prevalent in the industry, is not that you don't have to be efficient, you still have to be efficient, whereas coping and managing the dynamism of the environment, when things change, how do you cope with it? You see so what you guys did was you had to go back to the total redesign, I heard somebody say, we have to totally re-engineer the process. They use terms like dynamic, so you need dynamic assistance, basically something that can handle this change. You know so the idea is, if I'd given you, if I'd told you, initially, you would be receiving different document types, you were going to receive a different document types,

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and probably you'd need to, you'd need to understand where those documents are going, you know and basically spent more time you know investigating, asking me things like, what kind of documents are coming, where are they going, how, what envelopes do they fit into? That would have saved you a little designing time, so the essence is that the time we spend redesigning processes could actually be spent in investigating possible future scenarios.

RM: Yes, sure.

IO: So that's the whole essence of the program. But we can still be efficient and effective, if we had more modular processes, or even shift things around easily, like that's what you described here, that's what you did at the end, if you had to create a modular process. Because when you start to decide, that's a modular process, when you say, okay this step here, these are three models you've designed. The three models here, and you call Grant, Thomas, and yourself Andrew. So, what you've done here is, when you make decisions, like okay, based on this input, what module fits? So, you change the module, like a level, you change the module and if you were to have more modular processes, we're able, we're more able to cope with change. You see now, you've done it right, you have to spend time redesigning it, but everything has come up completely perfect, yes?

RM: Yes, that's good for me.

IO: Thanks a lot guys, I really, really appreciate it.

RM: It's interesting.

RM: A good wee brainteaser.

00:56:57:10

Appendix 4- Transcript from Experimental Group

Transcription of Audio file: MOV009.mp3

IO: = Isimemeh Osagie

RM: = Respondent Male (Chr.)

RF: = Respondent Female (Tif. and Ste.)

Initial discussion-00:00:00:00

IO: I know you guys are not business students, but processes are prevalent in any industry or sector, it has inputs, outputs, and resources and controls, processes follow the same routes, that inputs, outputs, resources and controls, it's the same thing. To explain a little further I will show you two processes. I'll show you the first one, and you guys will try and implement it, try and map the process. Mapping the process, what we will do is taking every task that is relevant to the output, every taks that is relevant to the outputs of the process, put it, writing it on post its, each thing a post it, putting 1, 2, 3, 4, 5, until you get to the end. So, we'll just show you the first process, yes. The first process I want you to do, it's very simple, something we've all done at one point in our lives.

First training on Process Mapping

VIDEO: How to make a cup of tea, by Frank McHale. To make your cup of tea, you need the following...

IO: So, you can take some notes because we will be mapping the process after what is said.

VIDEO: …

RM: I didn't bring any paper.

IO: There's paper there. Do you want me to start it again?

RF: Yes please.

IO: Okay.

VIDEO: How to make a cup of tea, by Frank McHale. To make your cup of tea, you need the following materials: These include a kettle, a cup and spoon, some water, a tea bag, some milk, and some sugar.

Step 1: fill the kettle. Now switch the kettle on.

Step 2: place the tea bag in the cup and wait for the kettle to boil.

Step 3: once the kettle boils, add the water to the cup and leave to brew.

Step 4: Remove the tea bag and add milk.

Step 5: If required, add sugar and stir.

Finally,

Step 6: Taste, cheers.

IO: So, what did you guys think about it?

RF: It would be a true example.

IO: [Laughter] okay, do you think you can have a go at it, at mapping the process, as a group? Like basically say each activity they do. If you notice something, he goes through six steps, but there seem to be more taskd other than the six steps, did you notice that?

RF: Yes.

Participants mapping making a cup of tea process- 00:05:00:00

IO: Now your real business process, that's really significant, because every task that will relate to the output of a process, needs to be detailed or defined. If not, there will be friction in a business process, if someone were to follow a set of instructions.

RF: Yes.

RF: Okay.

IO: Yes, so map the process out, and setting how each activity will go, like from the beginning, from the first one, you can say the start process will be, turn on the tap, take the kettle, you know that kind of thing.

RF: Yes.

IO: So, each post it note, so one step for each post it note.

RF: So, we just need to summarise?

IO: No, not summarise,

RF: Put the step.

IO: Implement a process map of exactly what happened.

RF: Okay.

RF: We have to do it on a group?

IO: Yes, as a group.

RM: You are alright working?

RM: Yes.

RM: Is this a bit of problem guys?

RF: I think, what was the first step?

RF: Prepare the ingredients.

IO: Take away getting the ingredients, take away the resources,

RF: Okay.

IO: Just the tasks.

RF: Okay.

RM: When he said fill the kettle with water,

RF: We need to open the tap on the kettle.

RM: You have to plug the kettle in first though?

RF: How can you plug it first; you have to fill it in with water.

RM: But then you get the bottom bit that's like plugged in, and then you get the other bit that's not.

RF: So, take the kettle, put it under the tap, open the top,

RM: Yes, turn on the tap.

RF: So, one activity for,

IO: For each thing, yes, put your one activity for each one, just for clarity, one activity for each post it.

RF: Take the kettle.

IO: You can use this, why don't you use this, [handing over post-it paraphernalia]

RF: Okay, take the kettle, and then?

RM: Open the lid of the kettle?

RF: Open the lid.

RF: Open the,

RM: Unless you want to that he fills it up to the spout. It's not good to fill a kettle, so you shouldn't do that.

RF: the kettle.

RF: Transport the kettle behind the, in the same, RF: the kettle under the sink, right?

RM: Tap.

RF: Tap, like this?

RM: Yes.

RF: Make sure that the water is cold enough.

RM: You've got to boil it.

RF: No, because if it's boiled, when it's warmer, you get a low-quality tea. When you boil, when you use extremely cold, you get high quality. Do I need to teach to a Brit the basics of making a tea?

RF: Are we doing a presenter?

RF: And then?

RF: Open the kettle, put the kettle under the sink.

RM: Fill the kettle, yes? But not too much, because the environment.

RF: Fill the kettle with water.

RF: You can specify the temperature.

RM: So, it said to make a cup of tea, not a good cup of tea.

RF: Do you want to make a good tea, or a bad tea, my friend?

RF: Fill the kettle with water.

RM: Turn the tap off.

RF: Turn the tap off.

RF: Transport the kettle in a safe area of the kitchen.

RF: The kettle.

RF: My God, it's going to take,

IO: it's good to be detailed, but then again you have to find a balance. You know you can't start saying things like, walk two steps to the tap. So just try and make it detailed, but not,

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but not ridiculously detailed.

RF: Put the kettle on?

RM: Yes.

RM: Put teabag in cup.

RF: Take first, no?

RM: Yes.

RF: Take the teabag,

RF: Select the teabag.

RF: Why?

RF: I have six types of, selection is the one process.

RF: Select the teabag.

RF: According to your mood, emotional circumstance.

[Laughter]

RF: Place teabag in a cup.

RM: Wait for the kettle to boil?

RF: What if we switch the phases? First, we put the water, and then the teabag. It is more efficient, for a better taste of tea.

RM: No, it's already done, put it in, this is the way we do it, right?

RF: Wait for the tea kettle to boil?

RM: Yes.

RF: And then?

RM: And then add boiled water to the cup.

RF: Check the time you need to wait for a perfect taste.

RF: No, you need to take the kettle first.

RM: It's implied, I think.

RF: Fill the cup, and then leave,

RF: Leave it to brew?

RF: Leave the tea to brew.

IO: The flow has to be correct.

RF: Take,

RF: The individual steps guide, not at all, so what do you have to make like this, going down?

RM: But what are your issues with

RF: I don't make tea like this okay?

IO: It's just based on what we've seen actually, not how, well okay, go on, go on. No, no, it's fine, there is no right or wrong answer, there's no right or wrong answer [just map out what you have seen, not your preference for making tea].

RF: Remove the teabag first?

RF: That's now what he did.

RM: All right, fair enough, remove teabag.

IO: Let's do what he did.

RF: Remove teabag. He didn't stir it.

RF: You stir it.

RF: You get fired when you work in a company.

RF: Maybe I don't want to work in a company.

RF: Remove teabag. Put teabag,

RF: He didn't do that,

RF: in the food recycle, and not in the mixed recycle.

RF: In the bin.

RF: And remove teabag and then take milk?

RM: Yes.

RF: Take a bottle of milk, what do you call it?

RM: Jug.

RF: A jug. Add milk to the cup of tea.

RF: And if required, sugar.

RF: Take sugar. Let's take the sugar, add sugar.

RM: Stir.

RF: That's optional.

RM: Well that's optional as well.

RF: Then?

IO: Okay.

00:15:00:00

RF: complete process.

IO: Okay.

RF: Here we go.

IO: Okay, wonderful. What it is, you guys have done this very, very well and you've put in a lot of detail… So let's how many steps are there, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23. So you had about 11 steps more than I did. Now that's, there's nothing wrong with it, in the real process, this is actually better this way, because the more steps the more clarity. However, in every process, what will happen is, different tasks for instance will be assigned to different people, and different modules. Like you can say in this, we can say, if there were different modules, if you were dividing this into sections, I'm sure there will be sections okay, take the kettle, put the lid of the kettle, turn on the tap, fill the kettle, turn the tap off, put the kettle back, switch the kettle on, this would probably be one step, one who resolved to do the kettle and water.

RF: Yes.

IO: Yes?

RF: Yes.

Second training on process efficiency and the significance of process workshops like these- 00:18:00:00

IO: Then you say, select the tea you desire, take the teabag, place the teabag, wait for, this will be another module, this will be, because it's one activity, or activities together. Then you say wait for kettle to boil, add water, leave to brew, because this should be another module, there's two. Leave to brew takes so maybe about four different sections here or modules. Now we'll play another video, which is more, because the exercise we're going to do, as you can probably see, is envelopes with papers. What it is, is that, I'll put on a video for you guys, I want to extract appreciation for this process. Because it might look like all fun and games, but these things are actually used for real processes to improve real processes, and I'll show you, it is a bit long, but if we can just watch it. The man is quite funny, I think.

VIDEO: …

IO: What this, let me just explain what this video is about. This video is about showing the difference between a one-piece flow and mass production. Now I don't know if any of you have a manufacturing background, but I will just explain. A one-piece flow is like a car going through a conveyor belt at maybe Toyota. Now what the conveyor belt will start with I think the chassis, then you fitted the tires, so I'm just saying randomly, so fitted chassis, chassis fitted the tire, fitted the doors, you know and just go around the conveyor belt, and the car comes out the one end. If they have 100 cars, that's how they will all go, all the 100 cars will go that way. That example is a one-piece flow. So, one piece is going at the same time, yes?

RF: Yes.

IO: A batch process would be, 100 tires, fixing 100 tires, tire, tire, tire, tire, tire, tire, tire, 100 tires, then, start again, doors, doors, doors, doors, doors, doors, doors, 100 doors. Do you, does that make sense to you?

RF: Yes.

IO: Okay, so that's what he's trying to explain, the benefits of one, because processes have to be efficient and effective. Effective means it does what it's supposed to do. Efficiency means it does, there's no waste in the process. Okay, so he's trying to show the benefit of one over the other. One-piece flow, and mass customisation. So, after we watch this, and he's using envelopes and papers as an example, as an analogy.

VIDEO: so, what we're going to do in this video is I'm going to kind of redo a simulation that I first did back in around 2008 and this first simulation was actually the first video that I ever made in my life. I was actually sitting at my kitchen table, it was about 1am, and I had some Home Depot light strapped to a step ladder, that was my lighting, and kitchen cabinets, I nearly burnt my house down I think, that night. Anyhow I somehow got that video put together and I uploaded it back then to Google Video, if anybody remembers that, and I embedded it on my blog back then, which was OSS academy and the comments kind of just blew up, and people just went crazy. Some people were like almost attacking me, they were angry, they were thinking I was playing some kind of trick, or something like that, there was no tricks. It was just one-piece flow versus bad productions, so obviously we got a little bit better at making videos so we're not in my kitchen. so, I want to re-do that simulation here and the first thing I would encourage everyone to do is to watch this video, but then, go ahead and try this yourselves and I'm doing this by myself, but you can actually do this simulation easily with say three people. One person could be the folding station, the folding of the paper. The next person could be the stuffing of the envelopes,

00:20:00:00

and then perhaps a third person could seal and stamp the envelopes. So, there's many different ways of doing this, but since I'm by myself, I'm going to do it on my own. So, I've got 10 pieces of paper. This is just standard paper from our printer, and I've got 10 envelopes, and I've got my good mechanic stamper. I'm not actually going to stamp it, because Lesley would, in our office, would yell at me if I wasted these envelopes, so, what I'm going to do is get my little stop watch and my iPhone dialled in. I think maybe Greg will put a little timer at the bottom of the video here or something, but let's see how this goes. So round 1 is mass production, are you ready? Here we go. All right, so, first thing, we're going to start folding. And what I'm going to do, I'm going to do my very best, so nobody thinks I'm playing any games to work at the same pace, no matter if I'm doing mass production or one-piece flow. Now this simulation was first, I learned about this in the book Lean Thinking, Dr James Womack first wrote about how he asked his daughters what they thought the best way would be to go about stuffing envelopes with some marketing material he wanted to send out, and they kind of naturally moved towards this kind of, that production mindset, and I think if anyone has ever been married and had to do the wedding invitations, the chances are really good that you did what I'm doing now, which is someone folded and someone did all the stuffing, and someone did all the stamping and so forth. So, it's, I don't know, for whatever reason, mass production is very comfortable to us, and we're drawn to it for some reason.

People talk about the early farmers how they used to have to kind of store up wheat and grain for the long Winter, and that was kind of ingrained in our thought process right, you know, that idea anyhow, so you can see you've got lots of inventory, wasted inventory, kind of piling up here in front of me. Right, so all 10 pieces are folded, now what I'm going to do is I'm going to stuff all 10 envelopes. Now here's the crazy thing, what happens if I had made a kind of a folding mistake on all of the pieces of paper, and I didn't discover it until after stuffing step? Well I would have had a bunch of defects, again, so that's another kind of draw back or negative to mass production, kind of high-quality problems, or can high quality problems. Okay, there's 10, now after this, we're going to go ahead and I'm going to seal all of the envelopes.

RM: Is he doing it?

RF: Yes.

IO: Just use that as an example, because he doesn't actually take the envelope for everyone. It's like that's the time it would have taken to seal it.

VIDEO: All right, so they're all sealed, now what we got to do is we've got to stamp them all. Simulate the stamping process. Double check I've got the right orientation I guess it doesn't matter, right. All right. 3:42 is our magic time here, so go ahead and write that down, we'll put it up on the screen here but 3:42 is the mass production time to beat. So, let's see what happens. So, kind of move this off to the side, let's get setup for the one-piece flow. So everything is going to be the same, so what I'm going to do here, is I'm going to pick up a piece of paper, I'm going to fold it, I'm going to stuff it, I'm going to seal it, I'm going to go stamp it, and that will be done, and I'm going to move through all 10 pieces that same way, okay? So,

00:25:00:00

IO: Do you guys see what he's trying to do here, he's trying to show the two differences okay. I know it's quite boring, but just bear with me.

VIDEO: All right. Folding the first piece, put it in the envelope. Stuffed it, seal it, stamp it. First piece done in about 17 seconds or so. Fold, okay, now there are, as we mentioned in several of the academy videos, prerequisites to one-piece flow, you've got to have a stable process. If you are producing tons of defects, one piece flow is going to very challenging, I mean it will be, for one the good thing is you'll immediately identify those issues, and kind of be forced to deal with them, so that can be a good thing, but it can be uncomfortable and painful, if you don't have stable processes. Okay. Now I was telling Greg, I was thinking like Motley Crew would be kind of cool for the music of this video. I wish I knew some jokes. Actually, I know one joke. I'm going to tell a joke while I'm doing one-piece flow just to prove how awesome it is. So, a horse walks into the bar.

IO: I'm going to press mute.

VIDEO: The bartender looks at the horse, and says why the long face? You get it? Long face? My first edition was I'm almost done. That's one.

RF: It looks slower.

IO: Yes, he works slower doing the one-piece flow, yes.

RF: He's taking faster.

VIDEO: All right, 2:56.

IO: So almost a minute difference. Did you expect that?

RF: No.

IO: You actually thought the batch process would be faster would be faster, yes?

RF: Yes.

IO: And it just shows you how these illustrations can help you actually effect real business processes that are important. You know this video, the knowledge of this was known, or somehow suspected before, very hard to quantify, but now this will show that the one piece flow, and other things he also mentioned, you notice about defects, about defects, you know how if you do a, if you do batch production, what happens is your defects, your defects they tend to pile up at the wrong time, so if something is wrong, you have done 100 wrong things, as to just one, and also inventory, you know you keep a lot of inventory because you're doing 100 things at once and things like that, so this really helps, and the focus of this is efficiency. Yes? It's efficiency. Now it's important to be very efficient, not to waste, waste the process time, and cost basically to. So, what I wanted to do is, watching that, if we can design that process, if we can design that process and put it on the board, is it possible for us to design that process? That process, not in as much detail as you went this one, but just the process of what he did.

RF: Okay.

IO: You know what, that process. I'll explain a few things. So, you can go ahead, as a group.

RM: I don't understand that.

00:30:00:00

IO: The one-piece process flow,

RF: So, batch production.

IO: No, just the one-piece process flow.

RF: Yes.

IO: let me just play this to the end [where the video explains the reasons why one-piece was more efficient and effective].

VIDEO: So, we went from, what was it Greg? We had 3:42, to 2:56, so it's quite an improvement, and what I would really encourage you to do with your teams, is to watch this together and then do it, do the simulation yourself, do it yourself, do it with a team of three people, something like that, and then brainstorm why you think the one piece flow was faster, and it always will be faster. And I'll give you a little hint. When you look at the one piece flow methodology, that first piece of paper that I'm folding, well I never put it down, whereas in the mass production, I folded that first piece of paper, put it down and then it sat in the same pile, and then eventually I picked that paper up again, and then I stuffed it, and then I sat it back down. Eventually I came back around to it, I picked that piece of paper up again, and the envelope, this time I sealed it and then I sat it down, and then finally after the other ones were done, I picked that piece of paper up again and the envelope, and stamped it, and so what we're doing with all this touching of that same piece of paper, and so that's just one of the many reasons why this one is faster, but I would encourage you to get with your teams, do the …

The Exercise begins- 00:31:00:00

IO: So, you can get what he did basically? So, what I want you guys just to do is just to design the process and also assign one person that would, one, sorry one, assign a person for each task. So, if one person is going to be folding, one person is going to be stamping, one person is going to be sealing, you know that kind of thing. Okay, so what we'll do is, this time, unlike the cup of tea where we couldn't make a cup of tea, this time we'll design the process, and the process we design we'll implement it. Okay? So, RM: Paper.

RF: And then?

RM: Well place paper in the envelope. Stuff paper.

RF: In your language.

RM: I'm just going with looking at the telly.

RF: So, these are going on the board as well? Is it, shall I put it on the board?

IO: Yes please, if you would.

RF: Orientation is right.

RF: Excuse me.

RF: And then seal envelope.

RF: And then?

RF: Stuff envelope.

RF: And then?

RM: Stuff.

IO: So now, if you had to do this now, how would you assign it to the three of you? Just choose and I'll just assign it.

RF: Do it like.

IO: So just write as well, write on the board, who is going to be doing what. So, all you could do is, yes, just write on the board who,

RF: Step one, step two, step three.

IO: Okay, right who is going to be doing, who is going to be responsible, each person, right just so we can put the first letter of your name or something.

RF: Okay.

IO: Or who is going to be doing each one.

RF: I guess, for the first one.

IO: Okay, so we're going to go right now and

RF: Okay.

IO: Okay, so you have a choice of envelopes.

00:35:00:00

Okay, so I will start, yes?

RF: Okay.

IO: Start.

RF: Okay, I've not seen this style for 20 years, since my father was working

IO: Also, you can start.

RF: According to increased efficiency you should get closer to the chain number two.

RM: Sorry, what was that?

RF: Chain number one, you should get closer to chain number two, because of the efficiency in the pass work.

RM: is it?

RF: It's not folded.

RF: Sorry.

RM: Do I need to at this end of the table?

RF: Gosh I could see all

RF: Thank you.

RF: But you didn't consider that this type requires… should have been assigned to

RF: Yes, that's true.

RF: That's why it's too late, it's out mistake, and there for the future.

RM: And blaming someone, that's the most important part, is blaming someone.

RF: Chr. what have you done?

RF: It's never my fault.

IO: Now, I want to ask something. How did you choose that envelope? That choice of envelopes, yes, I didn't tell you to choose that one.

RF: Yes.

IO: But you chose it anyway.

RM: It's the same

IO: But wouldn't it be easier or more efficient to use this envelope, because then you wouldn't have to fold it.

RF: Yes, I was thinking about that, like why don't we use that envelope?

IO: Yes, just put it in, no need to fold.

RF: Yes, but then,

IO: Well.

RF: They can compare it.

00:40:00:00

IO: Okay, that's the one thing I was trying to say. You see, what it is, is, I want to give you guys this now, I want you to read this. This is a scenario, a scenario, just take a minute to read this. I'll explain. So, what will happen is after you read it, I want you to design the process on the as well.

Okay? I need to start giving you, oh sorry, you guys, can you design a process? Or do you think this same process will be necessary for it? Do you think you need to change this process, or you think this process will be necessary to fulfil that task? The process now, every process you design, has to be the process that you actually follow, because in an industry business process scenario what will happen is every time you want to make a change to the process, you have to change it, yes?

RF: Yes.

IO: So, is this process, do you think this process will suit that task?

RM: It's maybe okay, but they changed the,

IO: Forget about resources, I'll be giving you the resources, so, yes?

RM: What kind of, what size of paper are we getting?

IO: Okay, I'll be giving you that as well.

RF: Dividing the task according to the time consumed and getting like my task required nothing, [???]

IO: Okay, so you see what it is, well let's have a go at it, and you'll see how I explain it.

RF: Okay.

RM: So, will we keep the same people, or will we change the people?

IO: What do you think?

RF: No, we change like step two probably just place paper in envelope.

RM: Step three, seal and stamp.

RF: Seal and stamp.

RF: So basically, we make step one, step two and step three, okay.

RF: The name?

RF: Not it's okay.

RF: Just the name?

RF: No,

IO: Then you put the names in front of them on top there.

RF: And it seems to specialise in the one, we should keep, decide to, RM: Are we going to have one type of envelope or are we going to have various types of envelopes in there?

RF: Okay so,

IO: Forget about resources, don't worry about resources, don't worry about resources for now, but let's take a picture of this one. Okay, so let's write that down and test it.

RM: what size of the envelope can this go into?

IO: Stop.

RF: But we have to follow,

IO: You said fold the paper? You're not folding, then secondly you didn't put select the envelope, you had to look through to select, so that's required there, that's what so you have to redesign the process, if you you're going to do, yes?

RF: Okay. So, we can take the folded paper away.

RM: Is that allowed?

IO: Yes of course.

RF: We can take the, yes.

IO: So, what will be there?

RF: So, place paper in envelope would be, would be his job. I will seal the envelope and you will stamp it.

RM: So, you take a piece of paper, select which envelope, then you optionally fold it. Take the paper, select envelope is the second one.

RF: Oh yes, select the envelope, there's another one, there is another one.

RF: Why some of them

RF: Because of paper.

RF: You're a fast thinker, fast thinker.

RF: Yes ma'am. And then place paper in envelope.

RM: You need an optional one that says fold, in case he gives us a paper that needs to go in the skinny one.

RF: And we don't use that one.

RM: Oh, okay.

00:45:00:00

RF: So, place paper in envelope, seal envelope, yes. There you go. Yes?

RM: Okay.

IO: Right now, I want you to do two things. Sorry, I gave you a document, and in the document, if you noticed, I wrote something down, that the is either mailed or sorted. So, there's a mail or a file

RF: Hold on.

RM: [Laughter]

RF: If you select the envelope and I place paper in envelope, where will we take the envelope?

RF: By selecting,

RF: Okay, you gave it to me, okay.

IO: Okay, so you're ready?

RF: No.

RM: Yes.

RF: I'm doubting.

RF: The destination.

RF: We don't use that.

IO: Are you ready?

RF: The envelopes just here?

IO: But they put it in boxes.

RF: Can you put these boxes next to me?

IO: Yes, you can.

RF: It increases the efficiency of the process. That's a real nature work environment in most, what is this?

IO: Okay, ready when you are.

RF: There is a difference between file and name?

IO: Yes.

RF: Sorry, sorry, excuse me.

RF: Oh my God, hold on.

RF: Wait.

RM: This is why because of people like you Tif.

RM: [Laughter]

RF: So lots

RF: I don't even know.

IO: Okay.

RF: Excuse me.

IO: Let's see, for instance, I'm going to inspect the things that you've done. Now just after the process the outputs, we inspect the outputs. Now there's a bill coming in here and there's a receipt, yes? Two things here, one, this A4 papers are bills, yes? And in bills, most times, most bills, or most time they're not, the right thing to do will actually be to make sure the name is showing on the envelope, like when you receive your statement, the name should show on the envelope, so that everyone can see it. With window panes like that, but you didn't select, to show the names.

RM: Oh.

IO: Okay, that's one. So, it's true that all this will require a rework, yes? Then here, there's an invoice as well, and the invoice also has names, so I'm, here, it's a window envelope, and nobody yes? So, the windows should show, at least the name should show in the window when you put it in, so it should be folded in a way that we can, well I'll assume this will require a rework as well. Now,

RF: You didn't mention the requirements.

IO: Okay, I'm coming, but then, the receipts, you have to fold it in here, because they filing cabinet, because we're not sending the receipts out, now you make a very interesting point. You said that I didn't mention the requirements?

RF: Yes.

00:50:00:00

IO: If you watched initially, what that video showed us was, the video showed us how processes need to be efficient, yes?

RF: Yes.

IO: What the video didn't show us, was that in today's world, more than just efficiency, we also need to be adaptive, because change is coming so much, there's so many changes that come, that we're not expecting, that we need to handle. And how we handle this, how we build processes to handle this, is how most companies provide faster and more adaptive systems, so what they do is they create processes, that can handle change, so that what happens when you make those changes, when they are going to make those changes, where those changes come from externally, they're able to adapt their processes to them. So, two things that we think are essential to making sure the processes work efficiently, and handle change, are predictability and modularity. The processes need to be modular. If I receive this, what do I do? And the processes need to be somewhat predictable, in order to be modular, you need to be able to anticipate change, so there's some changes I'm going to submit, and you should be able to design your processes in a way that you can anticipate that change. Now the point is the time taken to anticipate, study and decide oh okay, first of all we're taking that time to study, and say hey, how, what do you think or how many, you ask me maybe how many envelopes or what am I meant to put them in? You get what I mean, or what documents meant to put, that time you use to study and design the processes and think, what can the possible alternatives be here?

RF: Yes.

IO: If you take that time and design the processes, it's less expensive than doing this whole reworking again. Imagine if we had to rework this and start, design the process again, and design the process again, and design the process again, every time there's a change, do you get what I mean?

RF: Yes.

IO: So what I've done for you guys here is, I've given you some additional information that we've put most of the possible changes, we now have the order in which the documents could come, so this is how, this is a modular process that is designed, so what you guys can do, is just read this, right, and design the process. I will run it again and you can see how smoothly or how fast it will go, yes? We're almost done.

RM: Right, so we're only going to get C6 or C5 envelopes.

RF: Big deal.

IO: So, what good is a modular process, do you get what I mean? With a possible predictability, with a predictability of say, these documents are going to come in either of three sizes really, an A4, that means window…

RF: A5.

IO: An A5, and an A6, that also means window, and how we're going to do it? So, if we can just basically follow that process [based on the size of paper received], you don't need to design it over and over again, because it's already designed for you. So, you follow that process, well based on that process, well actually you need to design it, you can just create that process on the board. Can you just recreate that process on the board? Then all you need to do, as a guide, you can do it in your own way.

RF: Okay.

IO: So as a guide you can recreate that process and who will handle what, so I will see how efficient it is in relation to the previous time yes?

RF: Yes.

RF: Okay.

IO: So, put it on the post it notes. Post it notes will design the process.

00:55:00:00

RF: Design the process.

RF: Yes.

RM: Really?

RF: Quick.

RF: So,

RM: So.

RF: I will need to receive A4 or A5.

RM: Yes, we need to, so

RF: Yes.

RM: Yes, that's good.

RF: Take paper, choose envelope.

RF: Fold in place.

RF: Seal.

IO: We'll do this together actually, because I won't try to test inspect paper, choose an envelope.

RF: Sorry, place,

IO: Sort.

RF: Okay.

IO: So on the list inspect paper, you can put the type of papers we expect to receive, so based on that, on that design, so we will say, inspect paper, underneath you can say A4, so A4 yes, so if it's A4, yes, so if it's A4, we'll choose this envelope.

RF: It will be C5.

IO: Yes, if it's A4, we choose C5, yes?

RF: Yes.

IO: C5, and we fold, yes?

RF: Yes.

IO: C5 window. Okay? Or rather, if it's a bill statement, it's a bill, yes?

RF: Yes.

IO: It's a bill, you choose A4, when it's A4, C5 window. If it's an invoice, invoices were, C5.

RF: C5, yes.

IO: Yes, so C5 paper, sorry, A5 paper. A5?

RF: A5 paper and then you fold.

RF: Which one A5, this one?

IO: C6 envelope. C6 window, requires a fold as well. And we know the type of fold, then if it's a receipt, if it's a receipt, we have,

RM: A6.

IO: We have A6, and it's a C6 not window, no fold, so it goes straight in. Yes?

RF: Yes.

IO: So, it will all take place actually, place. So, do you want to go, have a run at this, yes?

RF: Yes.

IO: Automatically, I'm sure you already can tell that this would be a lot easier, because we have more knowledge of what is to come...

RF: Yes.

IO: So, let's, are we ready?

RM: Are we folding those, because we didn't fold them last time, so folding them?

IO: So, who is going to fold or place?

RF: So, you're going to inspect and choose envelope, and I'm going to fold and it, and she's going to seal it and stamp it.

IO: Okay, can we just choose so I know we're doing the right thing.

RF: So, the first two will be Chr., Tif. Just the second. Then step two,

RM: That's me.

RF: Question,

01:00:00:00

RM: So, the one with no window goes the other two

RM: If you see one

RM: Put it in 5.

RF: Everything needs to be stamped?

RF: Yes.

IO: Okay, so we're ready?

IO: Right, are we ready?

RF: Yes, we're ready.

RF: Give me one sec, where is it, yes, I'm ready.

IO: Okay, we'll just go through it.

RF: Man!

RM: I was going to say; you are actually a lot better at this job than you are

RF: nothing to do at chain number two.

[Laughter]

01:02:23:00