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An exploratory investigation of the implementation of Lean in a UK automotive plant.

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Abstract

This thesis reflects upon several decades of research into Lean Production systems, highlighting the need for further investigation using an empirical study of exemplar implementations of Lean. The initial point of departure is an analysis of the current views of Lean based on a detailed literature review. The resulting Views of Lean Table provides a framework for the investigation of an exemplar Lean operation, viz the Nissan Sunderland Plant, widely regarded to be one of the most productive automotive plants in Europe. The exploratory nature of this investigation, and unique opportunity for access, argued for the use of an inductive single case study as an appropriate research approach. A four phase approach was used to; a) identify views of Lean, b) gain an initial understanding of the Nissan Production Way at the Nissan Sunderland Plant, b) acquire a detailed description of the Nissan Production Way and c) to assess the level of intrinsic motivation amongst employees.

The primary objective of this research is to establish whether our current knowledge of Lean sufficiently encapsulates the concept's many facets. Detailed semi-structured interviews with Nissan Production Way experts revealed that Nissan Sunderland Plant's production system uses a large number of elements in contrast to the relatively narrow list of 'Lean' elements cited in the Views of Lean Table. In contrast to academic theory there was a focus on extrinsic motivation with low intrinsic motivation offset by the plant's continuous fight for survival and 'whatever-it-takes' attitude. In practice Lean is viewed as an overarching philosophy with a toolkit encompassing a wide range of tools which are used when they are suitable for the task in hand.

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To Kevin and Olga. Thanks for getting me across the finish line.

For my family. We got there in the end.

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1 INTRODUCTION

Lean Production continues to generate debate four decades on from the generally accepted introduction of the phenomenon to the West in 1977 by Sugimori et al. (New 2007; Shah and Ward 2007). It is widely accepted that Lean Production is not confined solely to Japanese concepts but is influenced by the West (Ohno 1988; Petersen 2002; Black 2007; Reichhart and Holweg 2007; Schonberger 2007; Towill 2007) and is heavily inspired by the Ford Production System (Ohno 1988; Pettersen 2002). Despite continuing to garner a significant level of interest, and being based / adapted from pre-existing concepts, Lean Production is still to be fully understood.

The origins of Lean lie within the automotive industry, one of the most important industries in the world (Womack et al. 1990). Whereas in the 1950's American automotive manufacturers dominated the global car market this has changed significantly. Today Volkswagen is the world's biggest car maker, although this title has been tightly contested by Volkswagen and Toyota for several years (Taylor and Taylor 2008; Tovey 2017). As a result, Lean in the automotive industry continues to be of significant interest. Between 1988 and 2011 26% of Lean Production journal articles covered Lean in the automotive industry. (Jasti and Kodali 2015).

At the time of this study Lean in automotive research was primarily focused on technical aspects, the tools and techniques themselves. More recently research has become multi-disciplinary. Once such example is Jones et al. (2013) whom argue that Lean in the automotive industry silences employee empowerment, despite management claims to the contrary. Managers create illusions of empowerment under the guise of consensus decision making favouring efficiencies over employee welfare. Despite the continued focus on Lean in the automotive and manufacturing industries

Jasti and Kodali (2015) claim that *"many researchers are applying Lean principles in manufacturing field instead of applying across all activities of an organisation"* (p882).

In the UK alone the automobile industry turned over £69.5bn, employed ~800k people, produced 1.6m cars across 15 car plants, and added £15.5bn in value to the UK economy in 2015 (SMMT 2016a). In June 2016 UK car production hit a 16-year high following an 11th consecutive month of growth (SMMT 2016b). The UK's biggest producer of cars is the Nissan Sunderland Plant which produced 477k cars in 2015 (SMMT 2016a). Despite its status as UK's biggest car production plant research on the plant and its production system, the Nissan Production Way, are limited. Existing research focuses on specific elements rather than providing a holistic view.

Despite the threat of the strong pound, economic recession and constant pressure to reduce costs the plant continues to attract investment. In 2015 Nissan invested a further £137m for production of the Juke and a new press line. This brings total investment in the plant to in excess of £3.3bn (Nissan 2011b; SMMT 2016a). The Nissan Sunderland Plant is in a continuous fight for survival, competing for new car models against plants in the Renault-Nissan Alliance. The future of the UK following it's exit from the EU will have an impact on future investment at the plant (Macalister 2016) however the Nissan Sunderland Plant has thus far continued to survive, secure new car models and ultimately be successful. The plant's manifestation of Lean (The Nissan Production Way) can arguably be regarded as well-honed and its status as the most productive plant in Europe (SMMT 2011; Burn-Callander 2012; Kelly 2012; Moss 2012), as well as being the UK's biggest car producer, make the Nissan Sunderland Plant worthy of research.

At this time of this study empirical Lean research was in its infancy (Shah and Ward 2007) and was arguably focused more on the tools / technical aspects of Lean than offering a rounded view. The complex and context dependent nature of Lean suggested that academia would benefit from novel empirical approaches (Taylor and Taylor 2008). The limited research on the Nissan Production Way, the Nissan Sunderland Plant's reputation as an exemplar Lean operation, and the importance of the plant to the UK economy make Nissan an ideal case to help address the following research gaps:

1. A need for further empirical studies of exemplar Lean operations
2. A lack of rounded Lean studies focusing on both technical and human elements
3. A lack of knowledge regarding the Nissan Production Way

To address these research gaps this research's objective is as follows:

> ***To establish whether our current knowledge of Lean sufficiently encapsulates the concept's many facets.***

The remainder of this chapter provides a historical account of the Nissan Sunderland plant before providing an overview of this thesis.

1.1 Nissan Sunderland Plant

In 1984 the UK Government and Nissan Motor Co signed an agreement to build a car plant in Sunderland. The UK's flexible labour market, the relative ease of laying-off staff compared to other European countries, promise of tough cost-cutting targets by Nissan's British management, and a £40 million UK Government grant were likely to have helped land the deal (Rhys 2001). The plant started production in 1986 and by 1987 had agreed a single union deal with the Amalgamated Engineering Union, begun

exports of left-hand drive vehicles to mainland Europe, and completed phase two of the plant's construction which included a plastics injection moulding plant, press shop, engine assembly plant and paint shop extension.

The 1990's signalled a decade of continued investment and growth for the plant. The plant attracted over £500m of additional investment bringing total investment to in excess of £1.5bn. The plant began producing three new models (Micra, New Primera, Primera Estate) and Nissan's new car-carrying ship arrived into the Port of Tyne following its maiden voyage from Japan. By 1999 the plant had produced in excess of two million vehicles and was named the Economist Intelligence Unit's Most Efficient Car Plant in Europe for the fourth year running. The plant produced 105 cars per employee – 29 more than their nearest rivals (Harrison 1999)

Despite Nissan Sunderland's success Nissan Motor Co. was on the verge of bankruptcy in 1999. Donnelly et al. (2005) explained Nissan's problems as *"complex rather than monocausal… bound up with the overall stagnation in Japan's economy in the 1990s and the rising strength of the yen, which hampered exports*" (p432). A lack of control over supplier costs, over capacity, poor internal communications, and too wide of a product range (50 car models produced from 25 chassis) were likely causes to Nissan's money problems (Donnelly et al. 2005). In contrast Renault saw revenues grow by 33% between 1996 and 1998 with its plants nearing full capacity. The heavy concentration of sales to Western Europe in a rapid globalising industry made Renault vulnerable to takeover (Donnelly et al. 2005). Renault needed a partner to help the company into a major global auto-maker and Nissan, whose domestic market was in decline and had billions of dollars of debt, needed a substantial cash injection.

On 27 March 1999 the Renault-Nissan Alliance, a strategic partnership formed through a cross-shareholding agreement with Renault buying 36.8% of Nissan stock for $5bn, was formed. Carlos Ghosn, Carlos Ghosn, now CEO of Nissan and Renault, led a restructuring of Nissan's operations cutting costs, streamlining operations which included the loss of 21,000 jobs (thus not adhering to the concept of lifetime employment), improving manufacturing capacity utilisation by 29% and achieving further savings through alliance synergies (Renault-Nissan 2009). Donnelly (2005) noted that Ghosn moved fast to improve communications, establish English as the company-wide language, reduce Nissan board membership and remove promotion by seniority in favour of a merit system. The Nissan Revival Plan focused on a wider goal of repositioning Nissan *"in the market place for long-term growth and to identify where market and technological complementarities and other synergies could be identified and achieved"* (p434). Included in this plan were targets to be profitable by the end of 2002 and the reduction of business debt by 50% by 2003 (Donnelly et al. 2005). Renault also benefitted from the alliance through benchmarking Nissan's manufacturing operations and the synergies an alliance could provide (Renault-Nissan 2009).

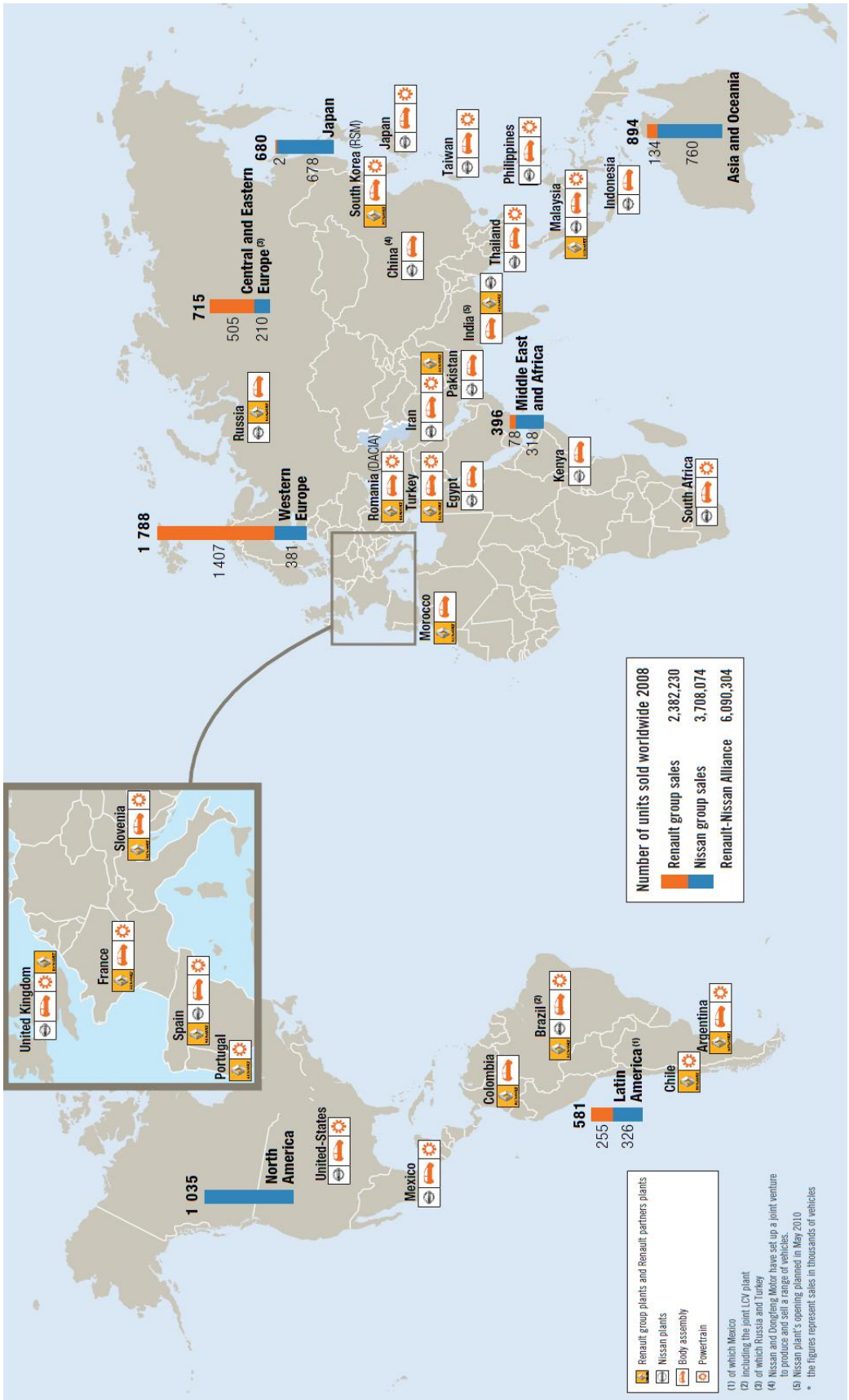


Figure 1-1 Renault-Nissan 2008 combined sales and production sites
Source: Renault-Nissan (2009: p5)

Now part of the Renault-Nissan Alliance the Nissan Sunderland Plant continued to secure new car models throughout the beginning of the 2000s despite increased competition from Renault and Nissan car plants. The next generation of the Primera, Almera, and Micra (which ramped up production in a European record of five weeks) were built at the plant. However the strength of the British Pound which increased the price of each car by 30% resulted in a warning by CEO Carlos Ghosn that production at the facility could be halved which resulted in a £40m aid package from the UK Government to avoid a reduction in production and job losses (BBC 2000; BBC 2001a; BBC 2001b). Despite being recognised as the most productive plant in Europe for the seventh year in a row the impact of the strong pound led to cost-cutting measures including plans to relocate the purchasing department which resulted in the threat of the plant's first ever strike by the single union (BBC 2003; Gow 2003; Jay 2003; Maguire 2003). The threat of strike action continued following Carlos Ghosn's (Nissan and Renault's CEO) remarks at the Detroid Auto Show suggesting that Nissan Sunderland Plant may lose its most important model should the UK stay out of the Euro (BBC 2004). Following promises of discussions and clarification regarding the future of the plant's employees the single union ended strike threats at the end of January 2004 (Binns 2004).

Following the plant's 20th anniversary in 2004 the plant produced it's 4 millionth car, the Micra C+C entered production, the plant' £2 million wind turbine plant opened (estimated to save £800,000 per year producing 5% of annual electricity), and the Note and Qashqai both started production in 2006. Between 2007 and 2008 more investment followed with the extension of the plant and axel shop, the creation of an additional 928 jobs to help meet Qashqai demand, and the start of production for the Qashqai+2 (SkyNews 2007; Nissan 2008b; Nissan 2008a). Faced with continued pressure from Carlos Ghosn (CEO) regarding the plant's future should the UK not join

the Euro, by the autumn of 2008 a European economic downturn forced the plant to reduce production, schedule non-production days, bring forward the Christmas shutdown, and in January 2009 make 1,200 staff redundant. (Hotten 2008; Johnson 2008; Massey 2009a). In response to the UK car industry's requests for assistance the UK Government launched the Car Scrappage Scheme in April 2009 and, with similar schemes launched across Europe, this had positive impact on demand. Production at the plant for 2009 Q3 increased by 24,000 units leading to the creation of 350 new temporary jobs to cope with the demand. Nissan Sunderland Plant also secured a £200m from the European Investment Bank and a £21m grant from the UK Government to secure the contract for the plant to build Nissan's first electric vehicle – the Nissan Leaf. The UK government also announced a £5,000 grant for those wishing to buy an electric vehicle. (English 2009; Manufacturer 2009; Massey 2009b; Massey 2010)

In 2010 the Qashqai's continued success led to the plant introducing a third shift on the model's production line. Both the Qashqai and Qashqai+2 both had model updates whilst production of the Nissan Micra moved to India (representing 4 in every 10 cars built at the plant) and the plant began production of the new Nissan Juke. As of this date the plant produced four models at the plant – the Qashqai, Qashqai+2, Note, and Juke. During 2010 the plant achieved record annual production figures with a total output of over 423k vehicles, an increase of 25% over the previous year (BBC 2010; Nissan 2010b; Nissan 2010a; Hughes 2011).

In 2011 the Japan earthquake resulted in a components shortage affecting all Nissan plants as well as plants of competitors Honda and Toyota (Arnott 2011; Milmo 2011). Despite the impact of the earthquake the Nissan Sunderland Plant, celebrating its 25th anniversary, beat the previous year's record production, and was credited with helping

Nissan to achieve strong first half earnings. Nissan Motor Co. also announced that the next version of the Qashqai would be designed, engineered, and built in the UK giving the plant a further boost (Arnott 2011; BBC 2011; McAteer 2011; Nissan 2011a; Nissan 2011b; SunderlandEcho 2011; SMMT 2012).

Further investment followed between 2012 and 2015 as the company announced that the plant was to produce a new compact car – the Nissan Invitation. Production of the plant's new lithium batteries (2012) and Nissan Leaf (2013) began. The plant also announced that it had secured investment to begin production of the Infiniti Q30 in 2015 – a new model under Nissan Motor Co's luxury Infinity brand. Construction of a new Infiniti production line began in 2013 covering a space of 25ksqm including body assembly, trim and chassis, and engine assembly. These additions to the plant resulted in a combined additional investment of over £375 million, a £9.3m grant from the UK Government, and resulted in the creation of over 600 jobs at the plant and many more in the supply chain (BBC 2012; Reed and Stacey 2012; Phillips 2013).

Today, in 2016, the Nissan Sunderland Plant directly employs over 6,700 people and continues to be a success despite a challenging economic and political outlook. The results of the UK's European Union Referendum do however create some uncertainties over the plant's future – the UK's new role in Europe is currently unclear. Despite this Carlos Ghosn (CEO) remains cautiously optimistic that Nissan Sunderland Plant will remain *"an important partner for Europe"* once trade negotiations are completed. However future investment decisions are on hold until the UK's trading arrangements following it's exit of the European Union are made clear (Thomas 2016).

1.2 RESEARCH OVERVIEW

This thesis includes a study, carried out in 2009, of the Nissan Sunderland Plant. The research's objective was to compare our view of lean (as of 2009) with the implementation of lean in an automotive plant. The Nissan Sunderland Plant was chosen for study due to its established implementation of lean. This thesis can be broken down into the following stages:

Stage	Purpose	Methods
1. Literature review	To identify our theoretical interpretation of Lean	Literature review and consensus analysis
2. Methodology	Review of existing methodologies and justification for approach	Literature review
3. Initial study of the Nissan Sunderland Plant	To gain a general understanding of life at Nissan Sunderland plant to aid in the formation of protocols for the primary study.	Semi-structured interviews
4. Expert Interviews	To identify the technical and human elements of the Nissan Production Way	Semi-structured interviews
5. Employee Survey	To gain further insight into the human elements of the Nissan Production Way	Survey
6. Discussion and Conclusions	To review all findings and address the research questions which emerged throughout the study	

Table 1-1 Thesis Stages

1.3 RESEARCH QUESTIONS

This thesis' research questions are as follows:

RQ1. What is our theoretical / academic view of Lean?

RQ2. What is the Nissan Production Way?

RQ3. How does practice compare to our theoretical / academic view of Lean?

RQ4. Is intrinsic motivation necessary for the success of a Lean implementation?

The following chapter, the Literature Review, answers RQ1. The Literature Review provides a detailed review of Lean and introduces the Views of Lean Table which is developed throughout this thesis. Chapters 4, 5, and 6 focus on the Nissan Production Way at Nissan Sunderland Plant and answer RQs 2-4.

2 LITERATURE REVIEW

This literature review was conducted alongside the empirical study in 2009. Key themes are explored before presenting the Views of Lean Table – a high level view of our academic interpretation of lean (as of 2009). Finally, section 2.7 (p58) provides a brief review of updates to Lean literature since 2009.

2.1 DEFINING LEAN

There are *"numerous academic and practitioner books and articles yet we still do not have a precise and agreed upon way of defining or measuring Lean production"* (Shah and Ward 2007: p786). The term Lean production was coined by Krafcik (1988), subsequently adopted by the International Motor Vehicle Programme and used in the book 'The Machine That Changed The World' (Womack et al. 1990). The term Lean production was used to contrast the Western 'mass production' system with Toyota's system (Holweg 2007). The use of the term was seen by the programme as *"an acceptable way of describing [Toyota Production System] without offending the other sponsors of the IMVP research"* (New 2007: p3547). There are differing views as to what constitutes Lean. Whereas it is commonly accepted that Lean is derived from the Toyota Production System the concept has continued to develop over time (Radnor 2010).

2.1.1 TOYOTA PRODUCTION SYSTEM

The Toyota Production System was introduced to the West by Sugimori et al. (1977). Despite the phenomenon being referred to as the Toyota Production System by its creators (cf. Ohno 1988; Shingo 1989) the terms Just-in-Time and Toyota Production System are often used interchangeably (Holweg 2007; Schonberger 2007; Swamidass 2007) and are both still in widespread use (e.g. Cua et al. 2001; Fullerton and

McWatters 2001; Yasin et al. 2001; Black 2007; Lee and Jo 2007; Matson and Matson 2007; New 2007; Swamidass 2007; Towill 2007; Bayo-Moriones et al. 2008). Just-in-time is also commonly used to describe the approach to manufacturing which originated from the Toyota Production System rather than the system itself (Sohal et al. 1989; Bayo-Moriones et al. 2008; Taylor and Taylor 2008). The meaning of Just-in-Time *"ranges from an emphasis on inventory reduction and elimination of waste to a new vocabulary of 'pull' versus 'push' system"* (Ramarapu et al. 1995: p39).

The Toyota Production System is a product of gradual evolutionary change originally developed in response to the then current market conditions (Spear and Bowen 1999; Holweg 2007; Taylor and Taylor 2008). The first published extensive description of the Toyota Production System in English is Sugimori et al.'s (1977) 'Toyota production system and Kanban system: materialisation of Just-in-Time and respect-for-human system' (New 2007). The journal article defines the phenomenon as a method which shortens the production time by having the minimum stock necessary, and having the right parts at the right time.

The Toyota Production System can also be viewed as creating *"a community of scientists. Whenever Toyota defines a specification, it is establishing sets of hypotheses that can then be tested. In other words, it is following the scientific method*" (Spear and Bowen 1999: p98). The tools and practices are not fundamental to the production system but are countermeasures in response to a problem which are temporary until improvements are made. Emphasis is placed on completing tasks at the lowest level with large scale improvements involving directly affected employees and their superiors being brought together to form improvement teams (Spear and Bowen 1999). The Toyota Production System adopts a 'scientific-Taylorist' approach and has commonalities with Fordist and Taylorist principles (Adler and Cole 1993). The

ultimate objective is *"to visualise such wastes as overtime and line-stop, and to urge each workshop to become capable in improvement"* (Sugimori et al. 1977: p562).

The secrets of Japanese manufacturing are fundamentally sound common sense management practices (Mehra and Inman 1992). Just-in-time is a basic policy pursued by all Japanese automakers. Just-in-time for deliveries of components and in-house production was introduced before 1950 at Toyota and in the mid-1950s at Nissan. Compared to traditional mass production Just-in-Time required faster setup times, tighter synchronisation, mixed scheduling to avoid specialised under-utilised workers and broader job specifications to allow easier rotation of staff thus reducing staff numbers. Quicker throughput led to rapid feedback and as a result defectives were reduced and learning rates improved (Cusumano 1988). The essential components of Just-in-Time are Kanban, standardisation, multifunction workers and production smoothing (Goyal and Deshmukh 1992). Just-in-time is interdepartmental bringing benefits which include increased productivity, better quality, less scrap, increased team work and less Work In Progress (Goyal and Deshmukh 1992).

Just-in-time has been classified as a method, concept, goal, belief, philosophy, system, approach, process, strategy, program, a state of mind and just common sense (Ramarapu et al. 1995; Vokurka and Davis 1996). However, many authors label the phenomenon a philosophy (Sohal et al. 1989; Goyal and Deshmukh 1992; Mehra and Inman 1992; Ramarapu et al. 1995; Vuppalapati et al. 1995). The labelling of Just-in-Time / Toyota Production System as a philosophy could have emerged through recognition of Just-in-Time / Total Quality Control / Quality Circles as a holistic set of principles. However the philosophy label could be viewed as being a bit of a stretch (Schonberger 2007).

Just-in-time's basic tenet is *"to minimise cost by restricting the commitment to expenditure in any form, including manufacturing or ordering materials, components, etc, until the last possible moment"* (Sohal et al. 1989: p15). Just-in-time requires participation by a number of stakeholders and for quick response to changes in market demands requires a high degree of organisation. The approach gained attention in Japan in the early 1970's and by the mid 1970's the approach had been adopted by many Japanese companies (Sohal et al. 1989). Despite classing Just-in-Time as a philosophy Mehra and Inman's (1992) working definition of Just-in-Time refers to the phenomenon as a strategy:

"Just-in-time is a production strategy that strives to achieve excellence in manufacturing by reducing setup times and in-house lot sizes through the use of group technology, cross-training of employees, and sound preventative maintenance. Additionally, Just-in-Time is a vendor strategy that yields higher levels of productivity and quality by minimising vendor lot sizes and their lead time through the use of sole sourcing and quality certification of suppliers" (p172).

2.1.2 LEAN PRODUCTION

Lean production arose *"in one country at a specific time because conventional ideas for the industrial development of the country seemed unworkable"* (Womack et al. 1990: p17). There are differing views as to what constitutes Lean. Whereas it is commonly accepted that Lean is derived from the Toyota Production System the concept has continued to develop over time (Radnor 2010). The distinguishing feature of Lean from other production systems is *"the factory physics of Lean production (reduction of capacity and inventory buffers, requiring reduction of system variability)"* (de Treville and Antonakis 2006: p102).

Lean can be viewed as being a wider concept which is not confined to a company's manufacturing operation (Karlsson and Ahlstrom 1996). Lean cannot be seen as an answer to a specific question but as an intended direction. The purpose of Lean is to lower costs through eliminating non-value adding activities. This is achieved primarily by limiting inventory, the most important type of waste due to it hiding problems and being wasteful itself. This can be achieved through lot-size reduction which requires a reduction in setup times to ensure a constant cost-per-unit but also increases flexibility (Karlsson and Ahlstrom 1996). One method of reducing setup times is Shingo's single minute exchange of dies method (Shingo 1985). Lean also seeks to eliminate waste by reducing work-in-progress, transportation and by increasing quality (Karlsson and Ahlstrom 1996). Lean's principles regarding production are; (i) Just-in-Time logistics, (ii) responsibility for quality with production, (iii) group technology in components production, (iv) economies of cooperation, (v) autonomation, and (vi) self-inspection and multitasking (Dankbaar 1997). Lean is *"providing car manufacturers with the needed flexibility, without giving up the advantages of the traditional system of mass production, including the undeniable productivity of the assembly line"* (Dankbaar 1997: p15).

Kaizen (continuous improvement) is sometimes regarded as the second most important Lean principle after removing non-value adding activities. Improvement activities should move from having no explicit organisation towards Quality Circles. Quality Circles "*became the hottest Japanese management topic by the early 1980's"* (Schonberger 2007: p404). As interest in Quality Circles decreased they were renamed to Small Group Improvement Activities removing the word quality to broaden the concept's scope. Despite the name change Small Group Improvement Activities did not gain traction and the concept largely faded into the background (Schonberger 2007). Karlsson and Ahlstrom's (1996) conceptualisation of Lean is shown in figure 2-1.

Karlsson and Ahlstrom (1996) cite pull instead of push as being fundamental to Lean production. Push and pull are differentiated by who triggers the order release, downstream (pull) or upstream (push) (Kim et al. 2002).

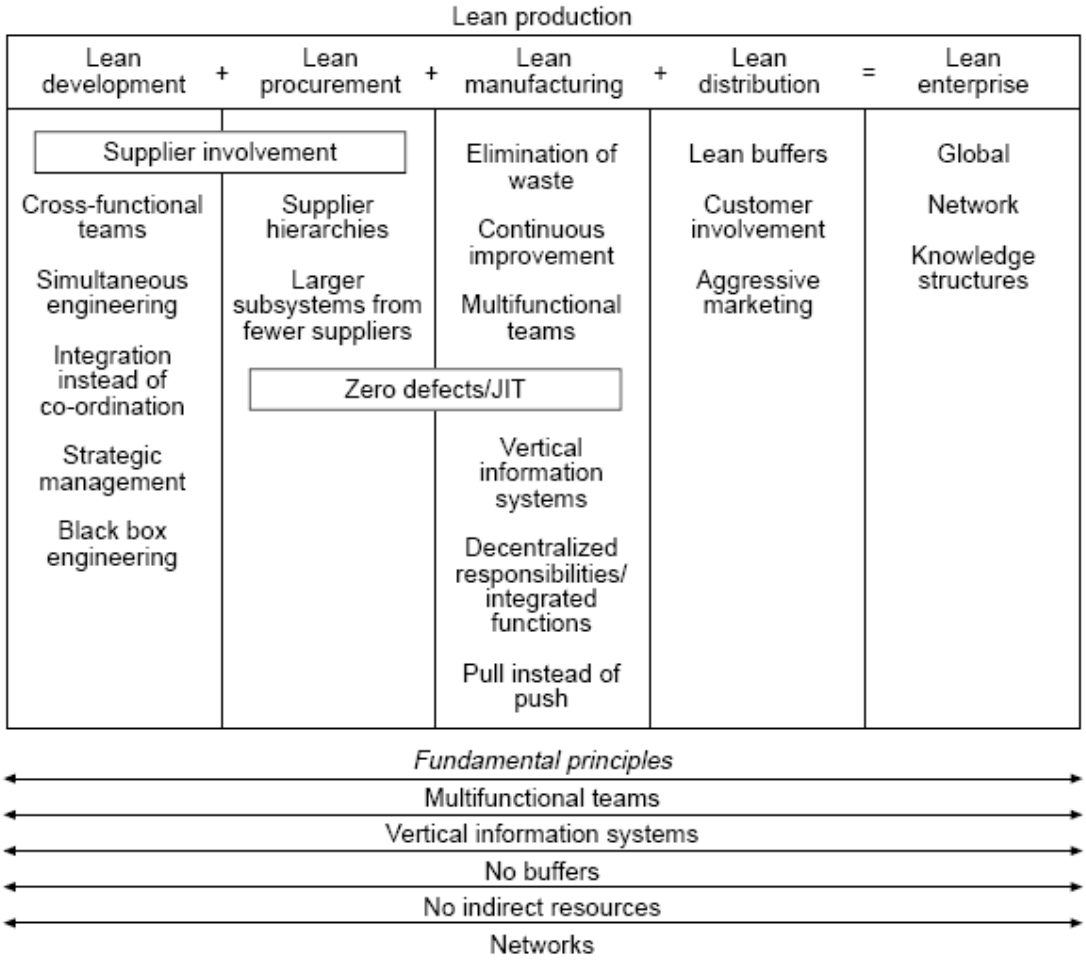


Figure 2-1 Conceptualisation of Lean Production
Source: Karlsson and Ahlstrom (1996)

Karlsson and Ahlstrom's (1996) research positions Lean Production as a wider 'umbrella concept' encompassing many Lean concepts including Lean Manufacturing. Whereas there is merit in highlighting the use of Lean principles outside of production the use of terminology is confusing. The re-purposing of existing established terminologies (Lean Production) to encompass a wider phenomenon will inevitably cause confusion to what is already a phenomenon whose functional elements are

complex, inter-related, and context-dependent (Taylor and Taylor 2008). Bhasin and Burcher's (2006) attempts to define Lean is clouded by the interchangeable use of the terms Lean manufacturing, Lean production, and Lean. Taking a prescriptive approach to defining Lean they argue that there are a set of technical requirements which companies more-or-less fully practice when implementing Lean. This arguably ignores any company context and instead suggests that Lean is transferrable.

Requirement	Definition
Kaizen	Continuous improvement
Cellular manufacturing	*"A philosophy that attempts to recognise and exploit similarities among components. Components are grouped into families based on similarity in shapes or production processes or both. Machines are then grouped into cells to produce these components"* (Al-Mubarak et al. 2003: ; p278).
Kanban	A scheduling system facilitating Just-in-Time production which aims to pull the right volume and type of component 'Just-in-Time'.
Single piece flow	Lot size of 1
Process mapping	*"Process mapping consists of constructing a model that shows the relationships between the activities, people, data and objects involved in the production of a specified output"* (Biazzo 2002: ; p42)
Single minute exchange of dies	A method for reducing machinery changeover times
Setup change / kaikaku	Kaikaku = breakthrough improvements (in contrast to incremental improvements conducted through Kaizen).
Supplier development	Helping to improve supplier operations to ultimately increase quality and/or lower cost.
Supplier base reduction	Reducing number of suppliers
Five S	*"A formalised approach to housekeeping and workplace organisation"* (Melnyk et al. 1998: ; p73)
General visual management	The use of visual aids to help manage production (i.e. signs and charts).
Total productive maintenance	Total Preventative Maintenance aims to maximise quality and quantity of production through improving production equipment effectiveness (Raouf 1994)

Table 2-1 Technical Requirements of Lean
Adapted from: Bhasin and Burcher (2006)

Lean Production's mutually reinforcing practices can be grouped into several complementary subsystems which include Just-in-Time, Total Quality Management, Total Preventative Maintenance, Kaizen, Design for Manufacture and Assembly, and supplier management with *"human resources management practices under the respect-for-workers umbrella serving as the glue to hold the system together"* (de Treville and

Antonakis 2006: p102). Total Productive Maintenance aims to maximise quality and quantity of production through improving production equipment effectiveness (Raouf 1994). At the heart of the Lean Production is the aim of reducing non-value adding activities through continuously improving processes. Lean Production considers there to be seven wastes (Ohno 1988);

1. Defects
2. Overproduction
3. Inventory
4. Motion
5. Transportation
6. Waiting
7. Over-processing

Reducing these seven wastes not only increases plant efficiency but can also help to identify more serious problems. For example, too much stock could hide problems with defects. Narasimham et al (2006) argue that Lean operations differ from 'low performers' in their increased use of *"statistical quality control, benchmarking, in-house technology development, customer orientation, integrated product development, teams, and advanced manufacturing technologies"* (p452). In contrast de Treville and Antonakis (2006) claim that the distinguishing feature of Lean Production is the reduction of buffers and variability. *"Lean production is an integrated manufacturing system that is intended to maximise the capacity utilisation and minimise the buffer inventories of a given operation through minimising system variability (related to arrival rates, processing times, and process conformance to specifications)"* (p102). They claim that Lean Production practices can be divided into two categories with a third category, respect for workers, combining all of the practices together:

1. Leanness practices:

   Kanban, reduction of setup times, flow-based layout, production levelling, continuous improvement.

2. Variability reduction:

   Involvement of employees in setting Standard Operating Procedures, standardisation, statistical process control, jidoka, poke-yoke, clean and tidy plant to allow for easy identification of problems, short-cycle times and Total Quality Management which emphasises "*the elimination of variability in incoming raw materials through a variety of supplier management tools and practices"* (p104).

3. Respect for workers:

   Sugimori et al. (1977) highlights the respect-for-human-system as a key element of the TPS which is cited as considering worker safety, empowering and using full capabilities of workers and eliminating workers' waste movements. This includes making maximum use of an employee's knowledge, offering competitive wages and giving teams responsibility for quality, allocating tasks, discipline and supporting fellow team members.

Whereas Narasimham et al's (2006) focuses on tools and de Treville and Antonakis (2006) focus on buffers and variability, Shah and Ward (2007) propose a more general and encompassing definition of Lean. *"Lean production is an integrated socio-technical system whose main objective is to eliminate waste by concurrently reducing or minimising supplier, customer, and internal variability"* (p791). Hines et al (2004) argue that Lean is moving away from eliminating waste and towards creating value (figure 2-2). *"The further above the cost-value equilibrium a product/service can be positioned, the more attractive proposition it is to the customers. The cost-value equilibrium denotes the*

situation whereby the product provides exactly as much value, which the customer is willing to pay for, as the product costs" (Hines et al. 2004: p997).

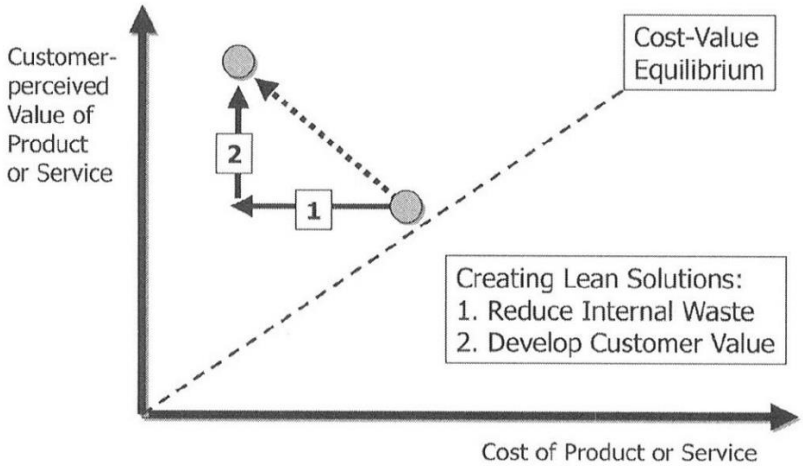


Figure 2-2 Relation of Value, Cost and Waste
Source: Hines et al. (2004)

Lean Production is widely acknowledged to focus on the elimination of waste and reduction of variability. Lean Production is effectively a 'tightly coupled system' of self-reinforcing components. *"Lean production may be viewed as a configuration of practices/tools because the relationships among the elements of Lean production are neither explicit nor precise in terms of linearity or causality"* (Shah and Ward 2007: p791). The complex, context-based nature of Lean makes it extremely difficult, and perhaps problematic, to propose a universal set of elements. Given the interchangeable use of terminologies it is also evident that academia has thus far been unable to agree on commonly accepted terminologies. This is discussed further in the following subsection.

2.1.3 ARE LEAN AND TOYOTA PRODUCTION SYSTEM DIFFERENT?

There is a lack of clarity as to what constitutes Lean (Hallgren and Olhager 2009). The continuous development of Lean has resulted in *"significant confusion about what is*

Lean, and what is not" (Hines et al. 2004: p997). Shah and Ward (2007) identify the confusion surrounding the phenomenon and attempt to further define, and identify the elements of Lean Production. To achieve this aim an in-depth literature review was first conducted to establish aspects of Lean Production which *"eliminate or minimise different aspects of variability"* (p792). These scale items were then refined through a series of structured interviews followed by a pre-test with practitioners and academics. Manufacturing firms with over 100 employees primarily sourced from a Lean consultancy company formed the sample. Shah and Ward (2007) claim that this sample is *"well-suited to the purpose of this study because it consists of a set of manufacturing firms that are at various stages of implementation of Lean practices"* (p792). Sixty-three responses were used in the pilot study (9% response rate), whereas 295 responded to the large-scale survey (13.5% response rate). The result is a set of ten distinct dimensions (see table 2-2) of a Lean system three of which measure supplier feedback, one which measures customer involvement with the remaining six addressing internal issues including setup time reduction.

Shah and Ward's (2007) approach to identifying dimensions of Lean provides a set of measurement scales which can be utilised in future research. The ten dimensions offer a neat and concise view of what Lean Production entails, and what needs to be present for a system to be considered to be Lean. The measurement scales are based on existing literature resulting in conclusions that are still heavily bound by theory, rather than practice. Additionally, existing research focuses heavily on the technical elements of Lean to the detriment of human elements which are under-represented and this is clearly reflected in the ten dimensions (see table 2-2). The idea of Lean being a set of dimensions can be seen as a restrictive view given the all-encompassing aim of Lean, viz, to reduce non-value adding activities. Whereas these ten dimensions may very well be 'stereotypically Lean' they may not all occur in practice. For example Hyundai's

manifestation of Lean does not include pull and employee involvement (cf. Lee and Jo 2007).

Dimension	Measure	Definition
Supplier feedback	Supplier feedback	Provide regular feedback to suppliers about their performance
Just-in-Time delivery by suppliers	Supplier feedback	Ensures that suppliers deliver the right quantity at the right time and place
Supplier development	Supplier feedback	Develops suppliers so they can be more involved in the production process of the focal firm
Customer involvement	Customer involvement	Focus on a firm's customer and their needs
Pull	Internal issues	Facilitate Just-in-Time production including Kanban cards which serves as a signal to start or stop production
Continuous flow	Internal issues	Establish mechanisms that enable and ease the continuous flow of products
Setup time reduction	Internal issues	Reduce process downtime between product changeovers
Total productive / preventive maintenance	Internal issues	Address equipment downtime through total productive maintenance and thus achieve a high level of equipment availability
Statistical process control	Internal issues	Ensure each process will supply defect free units to subsequent process
Employee Involvement	Internal issues	Employees' role in problem solving, and their cross functional character

Table 2-2 Ten Distinct Dimensions of a Lean System
Source: Shah and Ward (2007: p799)

The difference between Lean Production and earlier concepts needs to be resolved if theory and empirical work are to advance in this area. There are many descriptions of Lean Production and its underlying components. These have become increasingly expansive and are very general. For example despite Monden (1983) cites Just-in-Time as a concept within Toyota Production System whereas Just-in-Time has become known as the system in the US. *"The price paid for lacking a clear, agreed-upon definition is high because empirical testing of inexact and imprecise concepts leads to a body of research that examines slightly different aspects of the same underlying constructs masked by different terminology"* (Shah and Ward 2007: p785). There is a continuing emergence of high quality empirical studies within the automotive sector

(Taylor and Taylor 2008). Despite this Shah and Ward (2007) claim that empirical work is in its infancy. Figure 2-3 provides a view as to the existing knowledge of Lean production.

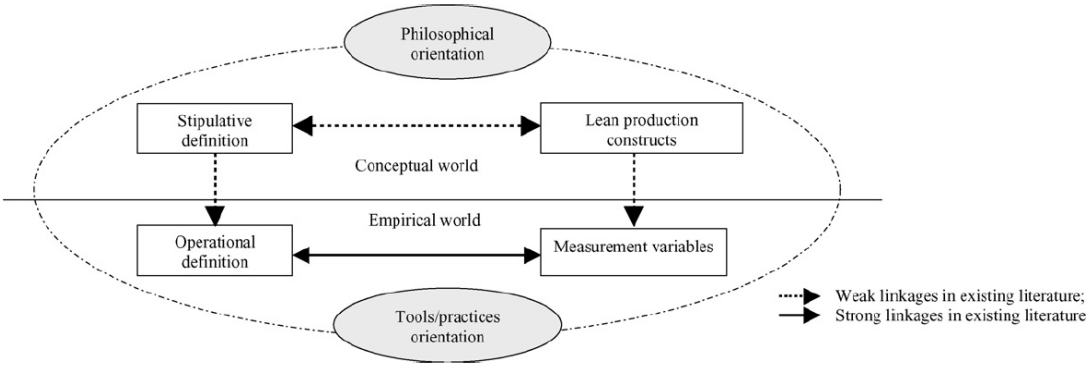


Figure 2-3 Existing State of the Conceptual and Empirical World Related to Lean Production
Source: Shah and Ward (2007)

Hall (2004) argues that the Toyota Production System and Lean Production are separate constructs with significant differences. He argues that the Toyota Production System spends more time creating standardised work and emphasises worker development. However, as any implementation of Lean principles is likely to have a varying level of standardisation this doesn't seem to apply in practice. Lean Production can be argued to be a more up-to-date term for the Toyota Production System which is more palatable for other manufacturers (Wu 2003; Liker 2004; Black 2007; New 2007). This was correct when the term was coined by Krafcik (1988). However since this time the concept has evolved, progressed, and been adopted in areas other than its manufacturing roots (Hines et al. 2004; Schonberger 2007).

Lean is different from the Toyota Production albeit still heavily grounded, or based upon, the system's original principles. The term Lean is neutral allowing for recognition of the Western modifications which have moved the concept forward beyond its origins (Schonberger 2007). The dissemination of Lean Production principles to other business

functions and the adaptation of Lean Production to fit company culture (e.g. Hyundai - cf. Lee and Jo 2007) has proved that Lean is not restricted to the manufacturing environment, or a rigid set of tools. Lean is arguably not something you can define as a system or an off-the-shelf solution. Lean is a set of overarching principles accompanied by a toolkit of best practice tools that have emerged, and evolved over time and will continue to do so. *"Production is Lean if it is accomplished with minimal waste due to unneeded operations, inefficient operations, or excessive buffering in operations"* (Narasimhan et al. 2006: p443).

This research has already established that there is an element of confusion surrounding Lean. Shah and Ward (2007) have already utilised existing knowledge to redefine what we already know. Their definition of Lean represents a widely-accepted view and will be adopted by this research – as will using the term 'Lean' to refer to the phenomenon which began as the Toyota Production System. Further development, and clarification of Lean, cannot come from repeatedly revisiting the current body of literature. Lean is a continuously evolving concept and therefore requires frequent empirical studies of exemplar Lean operations to ensure theory does not fall behind practice. *"By experimenting with novel approaches – both methodological and pedagogical we may derive original insights which will be of benefit to practice, improve our knowledge and extend our understanding"* (Taylor and Taylor 2008: p487). The following section discusses the implementation of Lean.

2.2 LEAN IMPLEMENTATION

"There is still a general misunderstanding of the contingent nature required to apply Lean thinking" (Hines et al. 2004: p998). In many companies the implementation of Lean is

only skin deep (Hines et al. 2004; Schonberger 2007). Womack and Jones (1996) suggest that there are five steps to Lean thinking:

1. Specify the value desired by the customer.
2. Identify the value stream for each product/service providing that value and, challenge all of the wasted steps.
3. Make the product flow continuously. Standardise processes around best practice allowing them to run more smoothly, freeing up time for creativity and innovation.
4. Introduce pull between all steps where continuous flow is impossible. Focus upon the demand from the customer and trigger events backwards through the value chain.
5. Manage towards perfection so that non-value adding activity will be removed from the value chain so that the number of steps, amount of time and information needed to serve the customer continually falls.

2.2.1 DESIGN RULES

Both Black (2007) and Spear and Bowen (1999) have attempted to capture Lean in a set of rules. Whereas Spear and Bowen's (1999) rules are more of a guiding set of principles which attempt to capture the *"tacit knowledge that underlies the Toyota Production System"* (Spear and Bowen 1999: p98) Black (2007) makes reference to specific practices. Spear and Bowen (1999) argue that the integral use of a scientific approach, viz defining a specification then formulating and testing hypotheses, is what makes Toyota a flexible, creative, continuously learning company. Their four rules of Lean are:

1. All work shall be highly specified as to content, sequence, timing and outcome

2. Every customer-supplier connection must be direct, and there must be an unambiguous yes-or-no way to send requests and receive responses
3. The pathway for every product and service must be simple and direct
4. Any improvement must be made in accordance with the scientific method, under the guidance of a teacher, at the lowest possible level in the organisation

In comparison Black's (2007) four design rules are more specific:

1. Production levelling - consistent daily output based on daily, monthly and yearly demand.
2. Single-piece flow - requires a redesign of production lines to arrange assemblies into either u-shaped cells or parallel assembly.
3. *"The machining or processing time for any part in any machine in the cell is less than the necessary cycle time"* (p3641).
4. Kanban - *"The manufacturing components are connected to final assembly with Kanban links which withdraw material from the subassembly and component suppliers cells as needed by final assembly and give production orders to all the suppliers automatically. This rule governs the maximum inventory in any link"* (p3641)

Whereas Spear and Bowen's (1999) rules are generic and widely applicable Black's (2007) rules do not consider the impact contextual factors have on the ability for facilities to use a rigid structure. Similarly Black's (2007) implementation strategy (table 2-3) is also rigid, taking the view that these elements can be universally applied. This strategy is based *"the methods used by many companies to successfully implement Lean manufacturing"* (p3645).

Steps	*Detail*
1. Level and balance the manufacturing system, smoothing the material flow **(Monden 1983):** Levelling involves the development of mixed model final assembly. Level or smooth the demand on the cells or the suppliers. Balancing is getting the output from the cells to match the needs of final assembly	• Establish the daily demand • Develop mixed model final assembly; takt time • Balance the output from the suppliers • Develop single-piece flow in the subassemblies • Sequence subassemblies with order of assembly • Design Rule 1
2. Design or reconfigure the manufacturing system: Design and implement manufacturing and assembly cells. The design of the manufacturing system must consider the design of the product and the need of the internal and external customers while meeting the functional requirements for system stability	• Standard work for operators in cells • Design/implement manufacturing cells (Black, 1991) • Design Rule 2
3. Setup reduction, changing methods and designs to reduce setup time **(Shingo, 1985):** Setup time is delay time. Affects lot size. Optimum lot size is one. Use SMED because it involves everyone on the factory floor. Permits small lots and creates flexibility.	• Teach everyone SMED • Develop one touch setups in the cells • Operators perform changeovers
4. Integrate quality control into the manufacturing system **(Shingo, 1986):** Does the manufacturing process satisfy the design specifications every time? Inspection to prevent the defect from occurring (Poka-Yokes).	• Inspect to prevent defects (Sekine, 1990) • Use the seven tools for quality control and line stop • Teach everyone quality • Zero defects via Design Rule 3
5. Integrate preventive maintenance **(Nakajima 1988):** Do the machines and people behave reliably? Design equipment to be reliable. Design methods to check people and methods for people to check machines, identify and solve problems. System will breakdown if machines and support equipment fail.	• Machines designed for reliability using Total Preventative Maintenance (Nakajima, 1990) • Operators solve problems • Operators perform daily maintenance
6. Integrate production control, link the cells, pull material to final assembly: Control the where, when, and how much material. The design of the manufacturing system defines flow and the Kanban operates within the structure. This is integrated production control or Kanban (Black, 1991).	• Link the cells • Pull material to final assembly • Kanban drives the production • Design Rule 4
7. Integrated inventory control: Reduce the work in progress in the links that connect the cells. This is control of the quantity of material in the links. Minimised and optimised and controlled by the internal customers, the users of the materials (Black, 1991).	• Gradually remove inventory from links • Expose problems • Solve problem, improve system TPT
8. Integrate the suppliers: make them Just-in-Time manufacturers just like you: Suppliers become remote cells. Suppliers become partners. Relationship built on trust. This is how real technology transfer takes place.	• Suppliers are sole source • Teach suppliers steps 1 – 7
9. Autonomation: autonomous control of quality and quantity within the manufacturing system: Automate the integrated pull manufacturing system.	• Design/implement Lean manufacturing cells • Apply computers, robots, automation
10. Design the Lean enterprise around the L-CMS	• Design new products concurrently with customers in mind • Design/implement Lean manufacturing with Lean machine tools

Table 2-3 Lean production methodology for implementation
Source: Black (2007)

2.2.2 IS LEAN UNIVERSAL?

At first glance providing a set of implementation rules offers a clear formula for companies to follow when implementing Lean initiatives. However it can be argued that *"Lean is not a system with universal applicability"* (Cooney 2002: p1144). Just-in-time, a core component of Lean, can only be applied under certain conditions which include production levelling and strong relationships with suppliers. Just-in-time may also be unsuitable for a company's workforce (Cooney 2002). Adopting Lean *"involves a complex evolutionary process of organisational learning and interpretation"* (Lee and Jo 2007: p3665). Consequently, there is no universally applicable method for implementing Lean. Companies create their own Lean production system by *"selecting, interpreting, and transmuting TPS [Lean] principles to meet its own business context"* (Lee and Jo 2007: p3665).

After recovering from an economic slump during 1997 and 1998 Hyundai took the decision to create their own unique production system; Hyundai Production System. Hyundai's Production System deviated from Toyota's minimising worker involvement through investments in automation and adopting a push system rather than the pull system and Just-in-Time advocated by Lean (Lee and Jo 2007). There are several factors distinguishing the Hyundai's Production System from the Toyota Production System. Firstly there is a reliance on *"engineer-driven workplace innovations and operational control, rather than the full utilization of worker capacity and involvement, highlighted by TPS"* (Lee and Jo 2007: p3674). Secondly suppliers lack the resources to be defect-free and flexible to allow the meeting of orders. Consequently, Hyundai and its suppliers are unable to protect against untimely deliveries and defects as they cannot maintain a buffer. This combined with the supplier dominated market condition has led Hyundai to adopt a push production model rather than a pull (Just-in-Time) system (Lee and Jo, 2007). Thirdly problematic labour relations have resulted in a lack

of worker involvement which is vital to implementing and maintaining Just-in-Time. Furthermore, the distrust between workforce and Hyundai has led to interferences and the inability of Hyundai to apply performance based Human Resource Management practices and to fully utilise labour (Lee and Jo, 2007).

These factors have resulted in Hyundai forming their own production system out of efforts to emulate Toyota's. Like the Toyota Production System, this effort has occurred over a long period of time and was very much an evolutionary process. Lee and Jo (2007) claim that although the Hyundai Production System deviated from Toyota Production System concepts it has achieved results such as utilisation ratio, product quality and inventory of parts which are comparable to the Toyota Production System. The authors also highlight that in 2003 Hyundai's productivity was less than half of Toyota. However, despite this statistic price competitiveness has been maintained. Lee and Jo's (2007) research adopts a contingency view and suggests that corporate culture cannot be changed to accommodate the Toyota Production System but that a company can use and modify Lean principles to fit in with their company culture. Wallace (2004) supports the notion that Lean principles can be modified to adapt to differing company cultures. He states that the Lean has been *"amended and hybridised across the globe to 'fit' to local, regional, national and organisational cultures"* (p750).

Regardless of Japanese manufacturers' competitive price, features and reliability in premium sectors European and US competitors have commanded more respect than their Japanese counterparts. The premium sector continues to be dominated by German brands including Mercedes, BMW and Audi (Oliver et al. 2007). Key influencers of car buyers reinforce the view of cars as a statement rather than a function. There are contradictions between Lean thinking and the nature of premium brands. One of the key aims of Lean is the reduction of waste. The practice of over-engineering cars above

functional requirements is in stark contrast to this goal. Furthermore whereas external considerations are the main driving factor for Japanese manufacturers German auto producers are driven by engineering sophistication (Oliver et al. 2007).

"German producers such as Mercedes have continued to out-sell Lexus, especially in Europe" (Oliver et al. 2007: p3736). Japanese manufacturers are focusing on pleasing the needs of the market at the cost of risking product identity. Too much attention on the customer potentially results in products being created that are similar to pre-existing products. Additionally, it can also stifle radical innovation. Real brand value is intangible and is partly a social construction. The role of opinion leaders is highlighted as is the impact of societal views. Lean would view over-engineering and the focus on one area, to the detriment of another, a waste. However, the trade-offs inherent in Lean work against an important factor in the premium markets; product personality. Oliver et al. (2007) argue that Japanese manufacturers have not achieved universal success in all segments.

2.2.3 IMPLEMENTATION ISSUES

Matson and Matson (2007) highlight twenty potentially troublesome Lean issues (table 2.4) which were identified by *"previous surveys of Just-in-Time [Lean] companies"* (p433). Their research found that poor production quality and poor quality of supplied parts were the most frequently cited problems. This list of issues is based on previously known or suggested issues. Sources utilised were primarily published in the 1990s and can therefore not be posited as new or up-to-date. The continuously evolving nature of Lean systems may result in new issues which Matson and Matson (2007) is not equipped to identify. However, this research does provide value in

empirically testing the prevalence of these potential problem areas and how often they typically occur.

1. Lack of supplier support
2. Supplier inability to deliver materials on time
3. Substantial distance between suppliers and customers
4. Poor production quality
5. Poor quality of supplied parts
6. Difficulty establishing systems to support JIT
7. Poor and/or inaccurate data
8. Difficulty establishing accounting practices to support JIT
9. Training difficulties
10. Lack of JIT information
11. Lack of top management support
12. Lack of employee support
13. Union difficulties
14. Difficulty achieving setup time reduction
15. Difficulty laying out the facility to support JIT
16. Difficulty implementing smaller lot sizes
17. Unstable customer schedules/scheduling
18. Difficulty with large number of items produced and/or amount of material handed
19. Forecasting inaccuracies
20. Difficulty justifying JIT

Table 2-4 Potentially Troublesome Just-in-Time/Lean Issues
Source: Matson and Matson (2007)

Lean implementation issues can include employee resistance, management resistance to sharing authority with employees, lack of supplier co-operation and demand forecast uncertainty (Yasin et al. 2001). To enhance the success of Lean implementation firms should systematically train both management and staff. This will help to create an organisational culture consistent Just-in-Time philosophy and will help prevent lack of support and resistance to the changes (Yasin et al. 2001). Quality, cost and philosophy criteria for suppliers should be defined by establishing new supplier interaction procedures. Private sector organisations should identify where standardisation, automation and simplification are needed through analysis of operations. *"Operational processes and procedures should be re-engineered based on the operations analysis prior to the implementation of Just-in-Time"* (Yasin et al. 2001: p1202). Without addressing these issues supplier and human related problems are likely to arise (Yasin et al. 2001).

It is important to focus on *"driving out volatility"* in Lean implementations (Towill 2007: p3626). General Motors was found to be the worst original equipment manufacturer in terms of overall induced supplier uncertainty whereas Nissan was found to be the best (Toyota were a close second). US plants were noticeably worse than their Japanese counterparts (Towill 2007). The original equipment manufacturer can have a negative impact on the supplier's efforts to implement Lean due to pressures to meet requirements or uneven and unpredictable demand (Matson and Matson 2007). Lean implementation is a long-term goal. *"The ideology, objectives, practice, and outcomes of successfully implementing TPS are less transparent than many gurus and management consultants will admit"* (Towill 2007: p3624).

2.3 HUMAN ELEMENTS OF LEAN

The focus on efficiencies possible through Lean implementation has arguably overshadowed the effects of Lean on the workforce. Current Lean literature, particularly in Operations Management, focuses on the technical elements of Lean. Interest in human issues in Operations Management has recently increased, however *"the topic is infrequently covered in Operations Management research journals"* (Neumann and Dul 2010: p924). Hines et al. (2004) argue that *"Lean should be regarded as more than a set of mechanistic hard tools and techniques and the human dimensions of motivation, empowerment and respect for people are very important"* (p998). It is essential for future studies to address the imbalance between the number of technical and human focused studies to ensure that we fully understand the phenomenon. Therefore, this section will provide a brief overview of Operations Management research focusing on human factors.

"In the 278 pages of The Machine That Changed The World there is not a single quote from the people who work within the system… Books like The Machine That Changed The World just look at the numbers without any regard to the human costs of Lean work implementation. They talk about high productivity and extol the fast assembly-line speeds. But on these lines, workers must work every second of every minute, without a moment for a break" (Mehri 2006: p25)

Conti et al. (2006) conducted a mixed-method study to assess the impact of stress on workers in Lean environments. The research used existing frameworks to underpin their empirical study including the ASSET questionnaire which is designed to measure mental and physical job stress. Participants were from twenty UK production facilities which had implemented Lean to 'some degree'. A questionnaire completed at each site by manufacturing and human resource management used a five-point Likert scale to assess the degree to which ten key Lean elements were implemented (table 2-5). These elements shared some similarities with Shah and Ward's (2007) ten dimensions (see table 2-2) of Lean; (i) supplier development/feedback/partnerships, (ii) preventive / productive maintenance, (iii) Kanban / pull, and (iv) low setup / setup reduction. An observational study was also conducted and the findings triangulated with the management questionnaires. Finally, workers completed a questionnaire to establish the perceived work practices at each production facility. A panel of Lean practitioners, consultants and researchers assessed the validity of the items (Conti et al. 2006).

LP element	LP element definition	References with pages
Set-up reduction	Reducing the time to change from making one item to making a different item. Shortens lead times and reduces inventory	Shingo (1981, p. 63), Schonberger (1982, p. 20), Krajewski and Ritzman (2003, pp. 439, 451) and Suzaki (1987, pp. 33, 167)
Inventory and waste reduction	Waste is any activity that does not add value for the customer. Excess inventory is a major waste and a prime reduction target	Shingo (1981, p. 112), Schonberger (1982, p. 18), Krajewski and Ritzman (2003, 439) and Suzaki (1987, p. 7)
Kanban pull signals	A shopfloor control system of visual signals from using to supplying work centres indicating the need for more parts. This "pulls" the needed replacement parts based on actual usage, or demand	Shingo (1981, p. 272), Schonberger (1982, p. 85), Krajewski and Ritzman (2003, pp. 437, 444) and Suzaki (1987, p. 146)
Supplier partnerships	Lean firms form cooperative supplier relationships, sharing design and cost improvement responsibilities and emphasising the on-time delivery of high quality parts	Shingo (1981, p. 219), Schonberger (1982, p. 157), Krajewski and Ritzman (2003, p. 441) and Suzaki (1987, p. 196)
Continuous improvement program	An ongoing program of improving the quality, costs and lead times of processes and products, through the cooperative efforts of shop workers and engineers. Often referred to as "kaizen"	Shingo (1981, p. 7), Schonberger (1982, p. 181), Krajewski and Ritzman (2003, p. 443) and Suzaki (1987, p. 69)
Mixed-model production	Assembling different products and product variations on the same line. Balances shopfloor workloads when combined with level production schedules. Reduces lead times and inventories	Shingo (1981, pp. 191, 204), Schonberger (1982, 93), Krajewski and Ritzman (2003, 440) and Suzaki (1987, p. 124)
Total quality management (TQM)	Integrated program for improving process and product quality through techniques such as statistical process control (SPC), "quality at the source" (workers self-inspect and stop the line if defects occur) and supplier pre-delivery quality control	Shingo (1981, p. 34), Schonberger (1982, p. 49), Krajewski and Ritzman (2003, pp. 114, 438) and Suzaki (1987, p. 101)
Foolproof (poka-yoke) or design for assembly (DFA) systems	Foolproof techniques seek to eliminate judgement and discretion in performing production tasks to produce high-reliability products. DFA is a computer rule-based design system for reducing the parts in a product, improving quality and reducing costs	Shingo (1981, p. 25), Schonberger (1998, p. 3) and Suzaki (1987, p. 135)
Total preventive maintenance (TPM)	Highly organised program of periodic machine maintenance, and pre-emptive replacement of components such as bearings to minimise the frequency and duration of machine break-downs. Routine minor maintenance during work hours is done by workers	Shingo (1981, p. 188), Schonberger (1982, p. 136), Krajewski and Ritzman (2003, p. 442) and Suzaki (1987, p. 113)
Standard operating procedures (SOPs)	Detailed descriptions of production tasks are documented to aid in organisational learning, training and ISO 9000 compliance. Helps maintain the cumulative effect of continuous improvement	Shingo (1981, p. 219), Krajewski and Ritzman (2003, p. 441) and Suzaki (1987, p. 135)

Source: Fullerton *et al.* (2003)

Table 2-5 Lean Production Elements, Definitions and References
Source: Conti et al. (2006)

Lean was found to not be inherently stressful (Conti et al. 2006). The level of stress in Lean operations is affected by management decisions concerning the design and operation of production systems. Whereas Lean implementation can result in performance improvement this is not dependent on utilising stressful practices. Stress levels do not increase in line with improvements. Benefits achieved through being Lean

are not conditional on the use of stressful practices. Low job control, typical of Lean plants, can actually decrease job stress through removing frustrations including inability to locate correct parts, or fitting poorly designed parts (Conti et al. 2006). Lean also has the potential to be intrinsically motivating (de Treville and Antonakis 2006). However, the level of intrinsic motivation will differ significantly depending on the specific configuration of the Lean operation.

The use of a highly specific concise set of Lean items to assess levels of Lean could result in an inaccurate assessment of the participants' level of Leanness. The focus on UK plants arguably prevents Conti et al. (2010) from being able to provide a conclusion that is universally relevant due to the likelihood of Lean being adapted to suit national contexts (cf. Cooney 2002).

Employee approval of Lean Production at an American car plant which transferred ownership from a U.S. company to a Japanese company was low (Shadur et al. 1995). The transfer of the facility, and its employees, occurred after the negotiation of redundancy pay and was therefore not viewed positively, particularly by personnel with long service records. Whilst union representatives acknowledged the system's improved efficiency they expressed concerns over employee welfare, particularly concerning a perceived increase of stress and pressure. Additionally Lean's team based structure was viewed as isolating grievances in small groups thus damaging the impact of the unions (Shadur et al. 1995).

Shadur et al.'s (1995) study was conducted two years after Lean implementation. Questionnaires were distributed to a random sample of 445 employees. The response rate was 45% (200 responses). The study found that speed of work and company commitment were predictors of employee approval of Lean Production. Therefore,

companies which ensure the speed of work is satisfactory and cultivate a highly-committed workforce may 'enhance' the adoption of Lean. Additionally, in some circumstances employee age can affect approval and therefore older employees' needs should be considered. Job satisfaction, teamwork orientation, consultation and perceived level of stress were not identified as predictors of approval.

Neumann and Dul (2010) conducted a 'systematic' literature search to *"identify peer-reviewed papers that presented empirical elements of both the human and the system effects of OS design changes in manufacturing"* (p927). It was not possible to define system effects and human effects with a concise set of terms and therefore several terms were used which were considered to identify papers which discuss each concept. Three databases (Web of Science, Ergonomics Abstracts, and Business Source Elite) were used to search for relevant English language articles which were published in journals indexed by Thomson Scientific's Institute of Scientific Information. A total of 45 empirical studies were identified (through two literature search phases) which discuss both the system effects and human effects of operating system design. Table 2-6 shows the types of human effects identified in the study.

	No. of studies	Percentage of studies
Human effects		
Health	18	40
Attitudes	13	29
Physical workload	28	62
QWL	5	11
Safety	5	11
Employee performance	1	2
System effects		
Productivity	40	89
Quality	14	31
Implementation	4	9
Intangibles	8	18

Notes: $n = 45$; some studies included more than one type of factor listed here, resulting in > 100 percent total

Table 2-6 Types of Human Effects Included in the Identified Pool Studies
Source: Neumann and Dul (2010)

"The set of design choices made during system (re)design lead simultaneously to both human and system effects" (Neumann and Dul 2010: p926). Both human effects, and systems effects, can be improved by the application of Human Factors. Human Factors concerns the optimisation of human well-being and overall system performance through understating how employees interact with system elements. Human Factor literature is often separated from Operations Management research, rarely appears in business and management journals, and is primarily confined to journals which focus on employee well-being (Neumann and Dul 2010). Operations Management researchers typically study the system effects whereas human effects are the focus of worker health researchers. Operations Management and Human Factors researchers need to produce collaborative research to widen our existing knowledge and increase inter-disciplinary Human Factors – Operations Management studies. *"Future research into OS design alternatives should include Human Factors aspects as well as both human and system effects… Collaboration between Human Factors researchers and Operations Management researchers can help to span the gap between Operations Management and Human Resource Management"* (Neumann and Dul 2010: p942).

For Lean knowledge to progress we require empirical studies which focus on both the technical and human elements of Lean in practice. The study of human elements in Lean is not new - *"early criticism of Lean production was concerned with the effect it had on the worker"* (Radnor and Boaden 2004: p425). Our current Lean knowledge is however focused on the technical elements, or 'tools of Lean'. Radnor and Walley (2008b) warn against solely focusing on the implementation of Lean tools without considering the principles and conditions underpinning Lean. Through shifting a focus to these principles and conditions, including human elements within Lean, we also have the potential to help practitioners.

2.4 CRITICISMS OF LEAN

Lean criticisms range from a focus on technical elements to discussions on the human impact of Lean. These criticisms are discussed in the following two sections.

2.4.1 CRITICISM OF TECHNICAL ELEMENTS

The significant interest surrounding Lean is 'unsurprising'. Highly positive results from the International Motor Vehicle Programme's research combined with the studies based on, and in support of, their findings have cultivated interest in Lean principles (Lewis 2000). The production system and its constant battle against waste *"made it seem almost axiomatic that Lean implied better"* (Lewis 2000: p960). Williams et al. (1992) claim that the International Motor Vehicle Programme's plant performance data is inaccurate as the performance gap has never been precisely measured and causes haven't been identified. They view the world as comprised of good and bad companies which can be turned into good companies by managers, viz, *"privileged agents of change"* (p323). Womack et al. (1990) do not establish that the long run result of Japanese competitive success will be balanced trade and multi-regional production. There is also no explanation to how Japanese plants take labour out and control labour costs. Even though the Japanese have the advantage of better manufacturability, higher capacity utilisation and long hours and wages in the supplier networks their added performance compared to American firms was not 2:1 but was in fact marginal (Williams et al. 1992).

There is a lack of understanding of the contingent nature required to apply Lean thinking (Hines et al. 2004). The shop floor is the major focus for many companies, particularly those in the car industry, who have yet to rely on recent integrative approaches. *"The paradoxical situation of piecemeal Lean application is that the most*

productive car plants in Europe produce into the highest level of finished stocks in Europe" (Hines et al. 2004: p998). Resulting from Europe's build-to-forecast, rather than build-to-order approach, was $18bn worth of unsold vehicles in European markets at the time of the research's publication (Hines et al. 2004).

Discussion concerning Lean has primarily focused on applying tools and techniques as opposed to strategic Level thinking (Hines et al. 2004). Pilkington (1998) argues that production managers must consider how techniques will fit into the business strategy. "*Strategic approaches to manufacturing management have been missing in the models of Just-in-Time production, Lean production, flexible manufacturing and total quality control"* (p31). Lean advocates pay little attention to external factors (i.e. business conditions) (Cooney 2002). Businesses must respond to these factors when making choices including the selection of an appropriate production system. The Lean model *"ignores the limits of a theory which is focused solely upon the management practices of enterprises in that chain"* (Cooney 2002: p1135) . Lean assumes that long-term supplier relationships will become the norm effectively smoothing the flow through the manufacturing chain. Short-term agreements disrupt this flow. Production levelling throughout the manufacturing chain is a precondition which may not always be achievable in practice. *"Mass production practices were adjusted to conform with national and local institutions, as they spread in the 1930s and 1940s, and there is no reason to assume that the same will not apply to Lean Production practices"* (Cooney 2002: p1134). Whereas Lean seeks to manage variability and create capacity the system was created in a market with stable demand. Consequently demand variability is the main inhibitor of Lean implementation (Hines et al. 2004).

Imitation is not manufacturing's most valuable weapon; flexibility that enables the achievement of long-term goals is the most valuable weapon of manufacturing (Hayes

and Pisano 1994). Following a best practice approach can actually hinder rather than improve the performance of a company as was the case with Rover who implemented Honda's systems. This resulted in the firm being prevented from pursuing the firm's sales-led recovery. *"The attractiveness of system imitation and the need for quick results often prevents their integration with strategic considerations"* (Pilkington 1998: p40). A best practice approach advocates a 'catch-up' approach and in the long term is arguable insufficient. *"The notion of Lean Production as a well-defined approach universally adopted throughout the Japanese car industry is inaccurate"* (Pilkington 1998: p40). Pilkington (1998) argues that the individual systems of Japanese firms are not similar at all when analysed in isolation from each other and in more detail. Transplant factories also highlight differences from their respective mother plants. Both Nissan and Toyota plants in the UK differ from their Japanese counterparts as they are *"more like the simple final assembly plants that any overseas firm would establish in a new market"* (Pilkington 1998: p37).

2.4.2 Criticism of Human Elements

The West's largely positive view of the Toyota Production System is a result of our failure to distinguish between *"tatemae (what you are supposed to feel or do) and honne (what you actually feel or do)"* (Mehri 2006: p21). The realities of the Toyota Production System are dangerous working conditions, poor working environment, narrow skillsets, limited potential for innovation and creativity, excessive overtime, harassment of workers and isolation of workers (Mehri 2006). Mehri (2006) worked as a 'covert participant-observer' at Nizumi, an upper-level Toyota group company, for three years. Nizumi was considered by Toyota to be an exemplar Lean operation. At time of publication he reported that Nizumi had been a Toyota keiretsu affiliate (within the Toyota industrial pyramid) for several years. Mehri's (2006) data collection

methods included direct observation, informal (unstructured) interviews and 'more formally' structured interviews. Most interviews were conducted with employees at Nizumi with the remainder being off-site interviews with politicians, labour scholars, lawyers and members of the community.

Mehri (2006) claims that the true impact of Lean is the human cost. *"Lean work consumes less space not due to a superior production system but to gross negligence by the company, which subordinates the safety of its workers to lowering plant costs"* (p25). Toyota operates through a culture of rules; written (i.e. internal documents), unwritten (learnt through observation) and cultural (learnt by simply living in Japan). These rules coerce employees into sharing *"attitudes, values and goals as defined by the group, the team or the entire corporation"* (Mehri 2006: p25). These rules were either formal (enforceable) or informal (not enforceable), and dictated which were the correct gestures and language to be used in talking to superiors. Infringement of rules results in an employee being punished as a deterrent to others.

Lean has moved beyond Toyota's well publicised production system (cf. Schonberger 2007). The 'human cost' of Nizumi's implementation of Lean is not necessarily guaranteed to appear in other Lean implementations. This insight does not provide any indication as to whether this behaviour was present due to the way Nizumi utilises Lean or whether this is a side-effect of the efficiencies Lean can achieve. It is possible for companies to be excessively Lean resulting in adverse effects, including negative side-effects on the firm's workers (de Treville and Antonakis 2006). Further research to assess the degree of Leanness at Nizumi could provide insight as to whether the 'human cost' could be due to the company being too Lean. Williams et al. (1992) and Garrahan and Stewart's (1992) also suggest that Lean can involve a 'human cost'. *"The experience of isolation through personal exclusion and dislocation creates a dependence*

on the 'Nissan Way'. This allows for commitment to personal security through working for devolved worker-managing strategies (Kaizen, VES and Neighbour Check). If this doesn't work, passivity can be guaranteed as individuals are told to 'put up or shut up'" (Garrahan and Stewart 1992: p139).

There is a critical point where organisations can become excessively Lean (de Treville and Antonakis 2006). The result is a decrease in job rotation, training and participation of workers. Firms can enter the state of corporate anorexia where working conditions decrease and managers become addicted to increasing a firm's Leanness (Radnor and Boaden 2004). Corporate anorexia can be defined as *"the inability to utilise or balance effectively the facets/resources of the organisation"* (Radnor and Boaden 2004: p424). Where Lean firms are optimised to compete efficiently in a specific market changing to serve different markets can cause the state of corporate anorexia. It is possible to gain an indication of a company's state of health and in doing so prevent permanent damage by formulating a solution based on whether corporate anorexia was likely or not likely, to be permanent (Radnor and Boaden 2004).

2.5 VIEWS OF LEAN TABLE

The confusion surrounding Lean posits the need to use multiple Lean definitions to increase accuracy in studying the phenomenon. The complex, context-based nature of Lean (Taylor and Taylor 2008) has resulted in accounts that include views and mixes of elements which are both different and valuable in contributing to our understanding of Lean. Contextual factors significantly affect the use of Lean practices (Sousa and Voss 2008). We need to understand the definition variations as these can cause problems on both a theoretical and practical level. Empirical studies which focus on a singular Lean definition risk omitting features which may not be part of the theoretical construct but

are, in practice, crucial to the Lean operation. Similarly, empirical studies need to utilise approaches which are flexible and allow for elements which we do not consider to be typical of Lean to emerge. Shah and Ward (2007) and Pettersen (2009) are two studies which aim to increase validity through use of multiple accounts of Lean. As a result, they provide a good starting point to bringing together further accounts of Lean, which view the phenomenon through differing lenses, into one Views of Lean Table.

Shah and Ward (2007) used 11 existing studies to aid in identifying items and underlying components which represent Lean Production. *"The empirical objective of this study is to identify the dimensional structure underlying Lean production and to develop reliable and valid scales to represent it"* (p792). To achieve this objective, they conducted a detailed literature review which identified 25 measurement instruments from 11 articles which are *"associated with the operational instruments used to measure the components of Lean Production"* (p788). These measures where then assessed through a two-stage process; (i) structured interviews with 10 practitioners working in manufacturing firms at varying stages of Lean implementation, (ii) followed by a pre-test of scale items with practitioners and academics. Statistical analysis and a large-scale survey (utilising confirmatory factor analysis to analyse findings) then resulted in the identification of 48 items and 10 operational constructs (see figure 2.4).

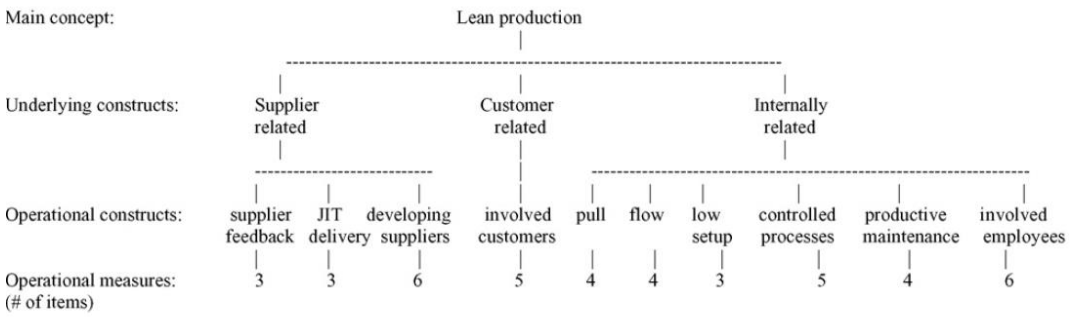


Figure 2-4 Conceptual and Empirical Mapping of Lean Production
Source: Shah and Ward (2007)

Shah and Ward's (2007) mapping of Lean Production omits elements others cite as belonging to Lean. For example, their study does not include Hoshin Kanri (policy deployment) which Womack et al. (1990) cites as an element of Lean. The focus on elements of Lean that reduce, or eliminate variability also results in a more technical mapping which contains limited detail regarding human elements. However the study's outcome does identify what Shah and Ward (2007) consider to be the "*dimensional structure underlying Lean"* (p788) and not a comprehensive account of all elements found in Lean operations.

Pettersen (2009) takes an alternative approach in aggregating what he considers to be key views of Lean into a single table sorted by accumulated frequency. The resulting data is sourced from a total of ten books from which 33 characteristics of Lean were identified. These sources were deemed to contain *"presentations of techniques and/or overall goals associated with Lean Production, thus contributing to a conceptual discussion"* (p129).

There are several criticisms of Pettersen's (2009) study. Firstly, he claims that the 20 most cited articles containing the terms Lean Production or Lean Manufacturing from two citation databases (ISI and Scopus) were chosen for further study. From these articles the most influential books were identified based on the results of a citation analysis program. However, he describes the literature review as involving *"two database searches produced a total of 37 articles… a number of books turned up in the literature search… an investigation of the books' citation rankings led to a filtering process with 13 books remaining"* (p128). 3 books were omitted from Pettersen's (2009) study owing to theirspecific focus leaving 10 books in total. This suggests a far less rigorous process of identifying influential books. Secondly, errors were identified in the study's account of Ohno (1988). As a result, the remaining 9 books were carefully

studied to assess the study's accuracy. There were no errors in the accounts of the other 9 books. Finally, despite identifying 12 articles (table 2-7) deemed suitable for further analysis his views of Lean table only concentrated on the 10 books.

Krafcik (1988)	Oliver et al. (1996)
Sanchez and Perez (2001)	Lewis (2000)
Mumford (1994)	James-Moore and Gibbons (1997)
MacDuffie et al. (1997)	Dankbaar (1997)
White and Prybutok (2001)	Hayes and Pisano (1994)
Jagdev and Browne (1998)	Cusumano (1994)

Table 2-7 Twelve Articles Deemed Suitable for Further Analysis
Source: Pettersen (2009)

Pettersen (2009) provides a good starting point to collate multiple Lean definitions and in doing so increase accuracy in studying Lean. However, the focus on books, omission of journal articles, and lack of recently published sources presents the need to further expand the study. Combining his study with Shah and Ward's (2007) findings provides additional insight and extends the study to also cover journal articles. However, both studies are primarily technical focused. It is therefore important to also include articles which focus on human elements and offer alternative views of Lean in forming a Views of Lean Table. Therefore not all of the additional 12 articles identified by Pettersen (2009) will be included in the expanded study.

To expand Pettersen's (2009) original dataset this research has been selective in the choice of articles to be included in a Views of Lean Table. A detailed search of two major databases (ABI/INFORM and Business Source Complete) was conducted using the key terms Lean, Lean Production and Lean Manufacturing. A detailed search using the terms Just-in-Time and Toyota Production System was also conducted for this

literature review but not utilised for the Views of Lean Table. This is due to the terms Lean, Lean Production, and Lean Manufacturing being commonly accepted as the most up-to-date taxonomies for the phenomenon. Articles were also identified through searching sources reviewed for this chapter.

The following table (table 2-8) provides a list of the selected articles along with justification for their inclusion in the Views of Lean Table. Whereas the choice of these articles was subjective (as opposed to being based on the number of citations) it is deemed that this collection of articles provides a wide-range of viewpoints and is relatively recent. Two of the articles were also included in Pettersen's (2009) original study but considered valuable additions due to the reasons provided.

Source	Justification
Schonberger (2007)	Provides a more up-to-date analysis of Lean and the Western modifications to the phenomenon. Schonberger (2007) provides a holistic view of Lean and identifies elements which are not included in Pettersen (2009) and Shah and Ward's (2007) studies.
Cusumano (1994)	This article was included in Pettersen's (2009) selection of articles but chosen due to its negative view of Lean. Cusumano (1994) provides a concise view of Lean whilst identifying elements which are not included in Pettersen (2009) and Shah and Ward's (2007) studies.
Aoki (2008)	Aoki (2008) provides further depth by including the possibility that communities of practice (COP) are commonplace in Lean systems. *"In this perspective, people learn something through participating in a practice, and also develop their identities through the participation"* (p523). A COP has the drawback of creating subcultures with their own norms and language that may not match the company's norms and language. Additionally it may be difficult to share a COP's norms and language with people outside of that group. Whereas Aoki (2008) focuses on Kaizen, rather than Lean in general, the interesting perspective warrants inclusion in this study.
Mehri (2006)	Provides an insider perspective into the realities of Lean. The article focuses on human, rather than technical elements of Lean. Mehri (2006) reveals social mechanisms such as bullying, harassment, inter-department rivalry and an 'old boys' culture where those with a face-that-fits are the employees moving through company ranks. Central to the study is the idea of tatemae/honne, viz what you say and do in public is different.
Lewis (2000)	Lewis (2000) discusses whether Lean can provide a sustainable competitive advantage. He conducted an 'opportunistic' empirical study of fourteen manufacturing firms which have between 150 – 500 employees. Managers were asked to identify which Lean techniques (as defined by Womack et al. (1990), Oliver and Hunter, Schonberger (1982) and Schonberger (1986)) were utilised by their company. Lewis (2000) provides the results of the three top firms which were adopting more than 60% of the characteristics. This focuses not only on supplier inputs and manufacturing processes but human resources as well. The results from these top three firms therefore provide a good view of both the technical and human elements of Lean in practice.

Table 2-8 Additional articles and justification for selection

The Views of Lean Table combines Pettersen (2009), Shah and Ward's (2007) findings, and the additional five articles listed in the above table. In total the Views of Lean Table includes 10 books and 17 articles (11 by incorporating Shah and Ward's study). Whereas the Views of Lean Table does not claim to represent the gamut of views existing in Lean literature this dataset provides a more valuable source to utilise in empirical protocols which aim to identify Lean elements in existing operations. The Views of Lean Table is shown in table 2.9. Due to the errors identified in Pettersen's (2009) account of Ohno (1988) this source was re-examined with the differences shown in black. Notes can be found in Appendix A (p241).

Table 2-9 Views of Lean Table
See Appendix A (p241) for notes

		Additional Sources							Pettersen (2009)							
		Ohno (1988)	Schonberger (2007)	Aoki (2009)[10]	Mehri (1996)[11]	Lewis (2000)	Cusumano (1996)	Shah & Ward (2007)	Womack & Jones (2003) & Womack et al (1990)	Liker (2004)	Bicheno (2004)	Dennis (2002)	Feld (2001)	Shingo (1984)	Monden (1998)	Schonberger (1982)
1	Kaizen / Continuous improvement[1]	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
2	Just-in-time	●	●		●	●	●	●[7]	●	●		●	●	●	●	●
3	Kanban / pull system	●	●		●	●	●	●	●	●	●	●	●		●	●
4	Setup time reduction	●	●				●	●	●	●	●	●	●	●	●	●
5	Production leveling (Heijunka)	●	●			●[22]	●	●[6]	●	●	●	●	●	●	●	
6	Small lot production	●	●			●	●	●		●	●		●	●	●	●
7	Inventory reduction	●	●		●	●	●		●	●		●		●	●	●
8	5S/Housekeeping	●	●	●					●	●	●	●	●		●	●
9	Waste elimination	●	●	●		●			●	●	●	●		●		●
10	Supplier involvement	●[2]	●			●		●	●	●	●	●	●		●	
11	Poka yoke[4]	●	●				●			●	●	●	●	●	●	●
12	Standardised work	●		●			●			●	●	●	●	●	●	●
13	Andon	●	●		●	●			●	●			●	●	●	●
14	Visual control and management	●	●							●	●	●	●	●	●	●
15	TPM / preventative maintenance	●	●					●		●	●	●	●			●
16	Improvement circles		NO_3	●	●	●[19]		●[8]		●		●			●	●

		Additional Sources							Pettersen (2009)							
		Ohno (1988)	Schonberger (2007)	Aoki (2009)[10]	Mehri (1996)[11]	Lewis (2000)	Cusumano (1996)	Shah & Ward (2007)	Womack & Jones (2003) & Womack et al (1990)	Liker (2004)	Bicheno (2004)	Dennis (2002)	Feld (2001)	Shingo (1984)	Monden (1998)	Schonberger (1982)
17	Education / cross training (OJT)	●	●	●	NO[16]		●	●[5]		●			●			●
18	Employee involvement	●	●	●	NO			●	●	●		●			●	
19	Layout adjustments				●[12]	●	●	●				●		●	●	●
20	Teamwork	●		●	NO	●[20]			●	●		●	●			
21	Time/work studies	●							●	●	●	●	●		●	
22	Takted production	●								●	●	●	●	●	●	
23	Autonomation (Jidoka)[33]	●					●[23]			●		●		●	●	●
24	Statistical quality control / SPC					●		●	●		●	NO	●		●	●
25	Work force reduction	●				●						●		●	●	●
26	Root cause analysis (5 Whys)	●	●	●					●	●	●					
27	Cellular manufacturing		●			●		●			●		●		●	
28	Value stream mapping / flowcharting		NO			●[21]			●	●	●	●				
29	Policy deployment (Hoshin kanri)				●				●	●	●	●				
30	Process Synchronisation	●	●							●				●		●
31	Lead-time reduction					●				●		●			●	
32	100% inspection									●		●		●		●

Table 2-9 Views of Lean Table (continued)
See Appendix A (p241) for notes

		Additional Sources							Pettersen (2009)							
		Ohno (1988)	Schonberger (2007)	Aoki (2009)[10]	Mehri (1996)[11]	Lewis (2000)	Cusumano (1996)	Shah & Ward (2007)	Womack & Jones (2003) & Womack et al (1990)	Liker (2004)	Bicheno (2004)	Dennis (2002)	Feld (2001)	Shingo (1984)	Monden (1998)	Schonberger (1982)
33	Multi-manning	●							●					●	●	
34	Management disciplining workers			●	●											
35	Customer focus/involvement							●								
36	Kaizens / Kaizen events			●												
37	Managerial job rotation					●										
38	Job rotation		●													
39	Communities of Practice			●[9]												
40	Total Quality Control			●				NO								
41	Employee and Employer need each other to survive				●											
42	Seniority				●											
43	Open office arranged by seniority			●[18]	●											
44	Performance appraisal for all					●										
45	Supplier reduction					●										
46	Company council or similar					●										
47	Single / no unions				●											
48	Bullying as form of control				●											

Table 2-9 Views of Lean Table (continued)
See Appendix A (p241) for notes

Table 2-9 Views of Lean Table (continued)
See Appendix A (p241) for notes

		Additional Sources							Pettersen (2009)							
		Ohno (1988)	Schonberger (2007)	Aoki (2009)[10]	Mehri (1996)[11]	Lewis (2000)	Cusumano (1996)	Shah & Ward (2007)	Womack & Jones (2003) & Womack et al (1990)	Liker (2004)	Bicheno (2004)	Dennis (2002)	Feld (2001)	Shingo (1984)	Monden (1998)	Schonberger (1982)
49	Promotion through being close to management				●											
50	Manager is parent, subordinate is child (hierarchical)				●											
51	Relentless line speeds				●											
52	Employees required to have work experience				●											
53	Design for manufacture		NO			●										
54	Innovation through copy and enhance				●											
55	Intense rivalry and resistance to co-operate between depts				●											
56	Performance -related pay					●										
57	Profit-sharing scheme					●										
58	Inductive problem solving				●											
59	High levels of subcontracting						●									
60	Culture of rules				●13											
61	Profit over employee welfare				●17											
62	Tatemae/honne (private vs public)				●14											
63	Innovation from outside				●15											

This research found an additional 30 cited Lean elements not included in Pettersen (2009) and an additional 48 elements not included in Shah and Ward (2007). A number of these additional elements are potential effects on the employee. The only unanimously cited Views of Lean item was Kaizen which will have different implications in different contexts. Twelve or more sources cited setup time reduction, Just-in-Time, Kanban/pull system and production levelling as Lean elements. Eliminating non-value adding activities is central to Lean however there is no universal description as to what a non-value adding activity is – its context dependent. One company's waste could therefore be another's value adding activity.

Lean cannot be defined as a neat, and concise, set of tools and practices. From studying the Views of Lean Table it is clear that such an approach may cause more problems than it solves. Despite there being a wealth of research regarding Lean there is still a lot to learn. Human elements, or consequences, of Lean are a key criticism of the phenomenon yet prominence in research is still often given to technical elements. Radnor and Boaden (2004) and De Treville and Antonakis (2006) raise the problem of companies being excessively Lean, becoming fixated on constantly driving through Lean initiatives at a cost of entering a state of corporate anorexia whereby assets are unbalanced and quality of work-life decreases. Companies will not benefit from focusing solely on implementing Lean tools (Radnor and Walley 2008b) and, to allow us to benefit practice we should not focus solely on Lean tools either. We therefore need to include human elements in future Lean research whilst looking to increase collaboration between Human Factors and Operations Management researchers to help further our knowledge (Neumann and Dul 2010).

The Views of Lean Table is not intended to provide an exhaustive list of Lean views. The differing views of Lean represented in the table allows this research, and other research, to base empirical protocols on a number of views thus potentially increasing the value of any findings. Furthermore, the significant interest surrounding Lean and wealth of Lean literature make it difficult to establish a dataset which fully covers all views of Lean. To contribute towards our knowledge of Lean it is important to compare not only academic views of Lean but to also compare our knowledge with real-life examples of Lean operations. The following chapter therefore details the methodology behind this study's empirical study at the Nissan Sunderland Plant.

2.6 NISSAN PRODUCTION WAY

The Nissan Production Way is Nissan's global standard manufacturing system. The Nissan Production Way's philosophy is *"build it right the first time and do it with the minimum amount of resources or, better yet, quality driven, waste free"* (Dodge 2004). Established in 1994 the system is a manifestation of lean utilising tools including kaizen and just-in-time (Nissan 2008b: p22). Central to the Nissan Production Way is Douki Seisan, viz the ideal situation. Douki Seisan advocates following a rigid production sequence and ensuring that product flow is consistent to avoid disruption. *"It is the state of production where the whole manufacturing process (including the supplier base) receives order information at the same time, allowing them to schedule and build to order"* (Nissan 2008b: p22).

Nissan cite quality as being key aiming to be best in class and incorporating Total Quality Management into their production system. Through consistently and correctly applying the Nissan Production Way, Nissan claims to use financial resources effectively, improve manufacturing capability and enhance customer satisfaction. The

Nissan Production Way's complementary tools and techniques also include Genba Kanri, Improvement Diagnostic System, and Quality Circle Stories. Genba Kanri is the system by which standards for running the day-to-day business are established, maintained, controlled and improved. Total Preventative Maintenance is a systematic approach involving all employees in executing maintenance with the goal of achieving zero breakdowns and zero defects. Quality Circle Stories are a way of ensuring that those outside of a Quality Circle are able to benefit from any findings. The following figure provides Nissan's visualisation of the Nissan Production Way.

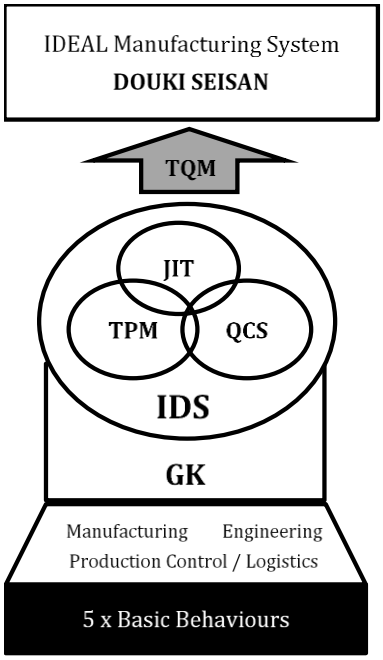


Figure 2-5: Nissan Production Way
Adapted from: Nissan (2008b)

Research focusing on the Nissan Production Way and the specific practices that form the system is limited. Notable works published in 1987 by the Nissan Sunderland Plant Director of Personnel (at time of publication) Peter Wickens and in 1992 by Garrahan and Stewart were produced before the introduction of the Nissan Production Way at Nissan Sunderland Plant, Nissan's financial crisis and the formation of the Renault-Nissan Alliance.

Wickens (1987) focuses on the human resource management at the Nissan Sunderland Plant. *"It is essential that we look at the 'people' part of our businesses in the same way as we look at investment or product – and that is strategically"* (p182). He claims that, at the time of publication, Nissan's management tripod consisted of teamwork, quality and flexibility. For teamwork to exist managers must genuinely want to involve their employees and keep them informed. Additionally, work practices must enable flexibility and terms and conditions of employment need to be standardised. Flexibility also involves the use of temporary staff (often employed around vehicle registration changes) that are carefully selected, recruited and trained prior to commencing employment. Nissan views such appointments as a step towards permanent employment. Quality forms a major part of Nissan Sunderland Plant's human relation policies and is considered to be the highest priority. Quality circles, kaizen and employee involvement are utilised alongside formal processes designed to resolve bigger issues that may also require the use of statistical techniques.

Wickens (1987) paints a largely positive image of the Nissan Sunderland Plant. *"Quality standards exceed Nissan's worldwide target, schedules are always met, the commitment of all staff can, according to most visitors, virtually be felt, improvements in quality and productivity are constantly made by the people actually doing the job, turnover and absenteeism is low, lateness is virtually non-existent"* (p189).

In contrast, Garrahan and Stewart (1992) are highly critical of the Nissan Sunderland Plant. They claim that the plant achieves social control through management-by-stress using inter-group rivalry and peer competition. Quality, flexibility, consensus and teamwork (viz, the Nissan Way) are used to control, exploit and monitor staff. *"The experience of isolation through personal exclusion and dislocation creates a dependence on the 'Nissan Way'. This allows for commitment to personal security through working for*

devolved worker-managing strategies (kaizen, VES and Neighbour check). If this does not always work, passivity can be guaranteed as individuals are told to 'put up or shut up'" (p139). Garrahan and Stewart (1992) claim that Nissan Sunderland Plant's success can be attributed to national government support, union restraint and a passive workforce.

Subsequent limited research focuses on individual, or related, aspects of the Nissan Production Way. For example Herron and Braiden's (2006) research focuses on productivity improvement in manufacturing. Identified problems are addressed by applying lean tools which have been successfully utilised at the Nissan Sunderland Plant. Reichhart and Holweg (2008) conducted a range of site visits and semi-structured interviews at automotive plants including the Nissan Sunderland Plant. Their research explores co-located supplier clusters. They found, at the time of publication, that the NSP had loose co-location; *"a number of key module suppliers (e.g. seats and cockpit module) are scattered loosely around the vehicle assembly plant, mostly within a distance of around 7 kilometres"* (p65). Reichhart and Holweg (2008) also acknowledged that the Nissan Sunderland Plant had started to locate key suppliers on site in 2006. Sako (2004) studied supplier development at Honda, Nissan and Toyota but focuses on Nissan's supplier relations before the Renault-Nissan alliance.

To summarise there are limited studies focusing on the Nissan Production Way. Existing research primarily focuses on elements of the production system rather than taking a holistic approach. Furthermore, there does not appear to be a clear account of the Nissan Production Way which states exactly which elements form the production system.

2.7 LEAN LITERATURE POST-2009

Since the completion of this study, and literature review, lean has continued to garner significant interest. *"Lean has come a long way from its shop floor origins… it continues to evolve today and to infiltrate our strategic and operational management thinking into the twenty-first century"* (Samuel et al. 2015: p1400). Lean research has continued to spread outside of automotive manufacturing to industries including software, food production, the luxury fashion market, and government services (e.g. Radnor 2010; Manzouri et al. 2014; Carmignani and Zammori 2015; Shah et al. 2015). There is a growing body of literature focused on Lean healthcare. The use of Lean tools and techniques within healthcare, including the NHS, is a reaction to constant pressure to improve efficiency and deliver value-for-money (Radnor and Walley 2008a; Burgess and Radnor 2012; Burgess and Radnor 2013; Malmbrandt and Ahlstrom 2013; Matthias and Brown 2016). Similarly, other areas of the Public Sector (HMRC, Cabinet Office, HM Court Services), all facing similar pressures, are also exploring the use of Lean tools and techniques to help improve cost-efficiency (Hines et al. 2010; Carter et al. 2011b; Radnor and Johnston 2012; Waterman and McCue 2012; Proctor and Radnor 2014; Carter et al. 2017). Despite a growing body of literature on the use of Lean in services studies are largely confined to larger enterprises. Research on the use of Lean in small to medium enterprises is limited and primarily focused on manufacturing (Qing et al. 2015).

It is now more widely acknowledged amongst academics that an organisation's culture it's people, and the environment within which it operates, have an impact on a firm's ability to implement and sustain Lean practices (Moyano-Fuentes and Sacristan-Diaz 2012; Bhasin 2013; Jadhav et al. 2014; Proctor and Radnor 2014; Pakdil and Leonard 2015; Wiengarten et al. 2015). It is also recognised that a country's culture can also impact the success, or failure, of Lean adoption (Raffaella et al. 2011; Kull et al. 2014;

Oudhuis and Olsson 2015; Wiengarten et al. 2015). There is however limited research on the involvement of Human Resource specialists in Lean implementation, and in practice the benefits Human Resource Management can bring to Lean are not fully realised. For example, in attempts to transfer Lean Thinking to higher education Human Resource specialists are often left out of the process which can hinder the success of Lean implementation (Bamber et al. 2014; Thirkell and Ashman 2014).

Academics continue to debate whether Lean has a positive or negative impact on the workforce. For example, Carter et al. (2011b; 2011a; 2013b; 2013a; 2017) focus on the human aspects of Lean as adopted by Her Majesty's Revenue and Customs. Their work draws parallels to Mehri (2006) in that Lean is described as having a detrimental impact on sickness and morale, going as far as to call Lean "mean" and a "backwards step" for Her Majesty's Revenue and Customs. In contrast Proctor and Radnor (2014; 2017) argue that the use of Lean at Her Majesty's Revenue and Customs has not been overwhelmingly negative. Whereas there are still challenges to Lean adoption, and varying levels of use across the organisation, the increased structure / predictability has given greater understanding as to how employees' work contributes to the organisation's overall goals.

Studies on Lean continue to become increasingly multi-disciplinary. One area of increasing debate, in addition to human aspects in Lean, is Lean and sustainability. *"Lean operations meet a wide range of sustainability outcomes beyond environmental benefits (including supply monitoring, transparency, workforce treatments, and community engagement"* (Piercy and Rich 2015: p282). However, current studies on Lean and sustainability focus primarily on environmental benefits. Despite the *"investigation of lean and sustainability interrelationships [being] perhaps one of the*

most recently researched topics" existing studies are narrow in focus (Martinez Leon and Calvo-Amodio 2017: p4384).

To summarise, our knowledge of Lean has advanced since the completion of this study in 2009. Research has moved beyond a one-dimensional focus on technical elements / practices of Lean to acknowledge that any implementation of Lean needs to consider the human aspects, and this might include the need to borrow learnings from Human Resource literature. The study of Lean continues to spread beyond manufacturing into Public Services (where healthcare is a key debate), software development, and other service based industries. The ever-increasing focus on the need to be responsible to our environment, and our communities, has arguably increased the importance around needing to be 'Green and Lean'. Lean continues to generate significant debate over 40 years since the publication of Sugimori et al. (1977). It is evident that the Lean philosophy, and its tools and practices, remain of significant interest to both academia and practice alike.

3 METHODOLOGY

This chapter will review four methodologies frequently used in Operations Management before justifying the approach of this thesis.

3.1 OPERATIONS MANAGEMENT METHODOLOGIES

The following four methodologies are frequently used in the Operations Management field; (i) modelling and simulation, (ii) survey, (iii) case study, and (iv) action research. This section explores each of these four methodologies and their application in Operations Management to inform the choice of methodology at each emergent phase of the research.

3.1.1 MODELLING AND SIMULATION

Quantitative methods such as model-based research are used prolifically in Operations Management research. Model-based theories can be defined as the development, analysis and testing of models of causal relationships between performance and control variables (Bertrand and Fransoo 2002). Model-based theory assumes that real-life decision problems and processes can be captured and explained through use of objective models. It is recognised that a change in one value in one variable will affect the same value in another variable, viz relationships between variables are causal. In contrast, in survey research, relationships between variables are often not quantitative and usually are not causal (Bertrand and Fransoo 2002).

Bertrand and Fransoo (2002) split model-based research into axiomatic research and empirical research. Axiomatic research focuses on a defined model which is used to formulate solutions which must provide insights into the problem's structure. Knowledge produced is based upon other variables within the model to produce

knowledge on the behaviour of specific variable(s). Empirical research aims to create a model which fits reality. Descriptive empirical research seeks to understand processes by creating a model that explains the real-life causal relationships. Prescriptive empirical research is concerned with improving the current situation by developing actions, strategies and policies.

Simulation of models is often used when the problem or model is very complex and therefore it is not suitable to use formal mathematical analysis. Simulation often lowers the scientific quality but can cause a high increase in scientific relevance as a wider range of scientific models can be used. Simulation requires a higher degree of justification, an experimental design, statistical analysis of the results of the computer simulations and interpretations of results related to research questions (Bertrand and Fransoo 2002).

An example of the use of model-based theory is the comparing of Kanban control with the theory of constraints using Markov chains (Takahashi et al. 2007). The research aimed to *"research effective control systems for unbalanced production systems" (p3600)*. The authors compare the performance of Kanban control systems and the drum-duffer-rope system using Markov analysis.

The key criticisms of modelling and simulation are low external validity; heavy reliance on quantitative data could cost the chance to increase knowledge through comparing with qualitative data. The specific nature of the methodology allows for clarity in the research but at the same time is restrictive in scope. A high level of existing knowledge is needed which may not always be available and as reliability relies on explicit mathematics the skills of the researcher have a big impact on the quality of the research.

3.1.2 SURVEY

Surveys involve the collection of data from individuals regarding the social units they belong to or about themselves. There are different types of survey research. Exploratory survey research provides an initial insight into a phenomenon and in doing so provides the basis for more detailed research. Confirmatory survey research is suitable for use when there is existing knowledge of a phenomenon which has been used to build theory. Research tests the validity of the existing theory developed in relation to the phenomenon. Finally, descriptive survey research can provide information to contribute to theory building and refinement but is not a theory building exercise. Survey research aims to describe the relevance of a phenomenon and its distribution in a population (Forza 2002).

An example of survey research is the survey of car manufacturers' and suppliers' strategies and relations conducted by von Corswant and Fredriksson (2002). An identical questionnaire was administered to manufacturers and first tier suppliers to enable the authors to identify source related trends and to make future predictions.

The use of survey research in operations management is increasing and the quality of survey research is also improving (Rungtusanatham et al. 2003). Surveys require meticulous planning and very careful wording of questions. The researcher must avoid bias or double barrelled questions. The language used must be universal to all to avoid any misinterpretations which could render the survey useless. Surveys are not an easy option for a researcher nor are they cheap. They require a systematic approach to be adopted (Marsh 1982).

There is a very low degree of researcher involvement in the process and a high degree of control except at the survey completion stage. Generalisability can be achieved

through quality sampling. There is however limited control over the final respondent who may not be the person the survey was intended to be completed by, or the person best suited to answering the survey. Some respondents may have not answered the survey correctly or deliberately answered with misleading information. Forza (2002) adds that missing data is a key concern for all survey research. Despite potential drawbacks surveys can reach a wider audience compared to case research and action research and quality of the survey and sampling can reduce the chances for error.

3.1.3 CASE STUDY

Case research can be defined as a real life empirical investigation of a phenomenon (Yin 2003). Case studies are more flexible than surveys and models (Voss et al. 2002). Studies may be qualitative, quantitative or utilising mixed methods. Validity can be increased by triangulating data collection methods. Case studies are important in Operations Management research as case studies accommodate complexity and can be used in a number of ways. The approach *"focuses on understanding the dynamics present within single settings"* (Eisenhardt 1989: p534). Case research allows for a holistic perspective arising from the need to explain and understand complex phenomena and allow the exploration of real-life scenarios (Remenyi et al. 1998). Case research is *"one of the most powerful research methods in operations management, particularly in the development of new theory" (Voss et al. 2002: p195).*

Case research is based on a limited number of cases where the use of statistical analysis might be limited (Voss et al. 2002). Whereas single cases are more suited to discovering a new phenomenon multiple case studies are suitable for phenomena where some knowledge exists but is largely unknown (Meredith 1998). Case research is personally

enriching for the researcher helping to provide inspiration for new ideas for both academia and practice (Voss et al. 2002).

Yin (2003) suggests that case studies can be exploratory, explanatory, descriptive or both exploratory and explanatory or any other mix of exploratory, explanatory and descriptive. Voss et al (2002) suggest that there are four key research purposes; exploration, theory building, theory testing and theory extension/refinement. *"Regardless of how cases are eventually used, research involving case data can usually get much closer to theoretical constructs"* (Siggelkow 2007: p22).

An example of mixed method case research in the automotive industry is Reichart and Holweg's (2007) research in collaboration with a large vehicle manufacturer. Both quantitative and qualitative methods were used. The research utilised semi-structured interviews, secondary datasets and personal observation. The research concluded that there is an inherent conflict between the need to link the production pull signal to variable demand in the workplace and Lean manufacturing techniques.

Limitations of case studies include potential bias in the case study and the ability of the researcher to set parameters of the research which consider available time and resources. Case research is challenging and not an easy option (Remenyi et al. 1998). Rigorous case research requires care in drawing generalisable conclusions and skilled interviewers (Voss et al 2002). It is for this reason that case studies need to be meticulously planned as many mistakes can be avoided in the planning stages (Remenyi et al. 1998). Case studies are costly both in time and financial resources. For example, Mehri's (2006) detailed account of shortcomings in Toyota plants was only facilitated by his ability to use his employment to provide an insider perspective. However, Lewis (1998) argues that iterative triangulation can be used as a theory

development process using existing case studies thus reducing the financial and time aspects. *"Iterative triangulation employs systematic iterations between literature review, case evidence, and intuition" (Lewis 1998: p456)*. Prior research has been conducted using existing case studies (Lewis 1998).

3.1.4 ACTION RESEARCH

Action research is not a new methodology but has been practiced as early as the mid-1940's (Coughlan and Coghlan 2002). In contrast to positivist thinking action research only aims to create knowledge whereas the term action research is generic and covers many forms of action-orientated research. Action research is not about researching action but instead researching in action. The researcher is an active participant in the process and takes a collaborative process in a sequential cyclical process of gathering data, making the data available to others in the process, analysing the data, planning for and taking action and finally evaluating (Coughlan and Coghlan 2002). Action research aims to combine action with reflection, theory and practice. It must be noted that action research is a systematic process of accumulating knowledge (Reason and Bradbury 2001) and is therefore not to be mistaken for an easy option.

Action research enables the researcher to explore links between theory and practice (Costello 2003). Although this method is an organic process researchers can anticipate what they need to consider by systematically designing some key variables at the outset (Coghlan and Shani 2005). The nature of data validation is contextually embedded and experimental, knowledge gained is specific and situational and the researcher is embedded into the process being an agent of change. Action research should be conducted in real time and is appropriate *"when the research relates to describing an unfolding series of actions over time"* (Coughlan and Coghlan 2002: p223).

An example of the use of action research regarding the evolution of manufacturing cells is provided by Chakravorty and Hales (2007). Their study sought to gain understanding of why manufacturing cells evolve over time. The authors argue that there are observational limitations for this research topic and therefore a real-time research method is required. The authors took a systematic process to using the methodology including a researcher-client agreement to establish relationships and to help gain internal validity. The researchers were actively involved in the case company.

The key limitation of action research is the difficulty in gaining access. Securing access is more difficult than with case research due to the intensity of the researcher's involvement with the company and its processes. Researchers are required to cope with uncertainty and are not in control of the flow of research. Coughlan and Coghlan (2002) claim that the key threat to action research validity is researcher bias. *"As action researchers are engaged in the shaping and telling of a story, they need to consider the extent to which the story is a valid presentation of what has taken place and how it is understood, rather than a biased version"* (p237). Quality of the overall research is essential; inferences need to be supported by observable data and reasoning needs to be explicit and open to critique. Due to the time and cost involved in undertaking action research there is a limited resource of action research papers in operations management (Coughlan and Coghlan 2002).

3.2 DATA APPROACH

Research can be qualitative, quantitative, or both. Qualitative research typically focuses on words whereas quantitative research focuses on numbers. Bryman and Bell (2007) suggest that qualitative research tends to have *"an inductive view of the relationship between theory and research"* (p402). Robson (2011) states that qualitative research is

generally small scale, focused on meanings and context, sees objectivity as *"distancing the researcher from participants"* (p19) and values the researcher's self-awareness, openness and receptivity. Additionally, he claims that the research design is emergent and flexible with a focus on meanings and an importance placed on context. Generalisability is not a major concern (Robson 2011). The main data collections associated with qualitative research are interviews, narratives, focus groups and ethnography (Flick 2006; Bryman and Bell 2007).

Quantitative research tends to be deductive with a pre-specified design that places an importance on reliability, generalisability, validity and replication. Objectivity and de-contextualisation is sought to obtain a neutral position. Data analysis usually involves statistics (Robson 2011). Questionnaires / surveys are a key quantitative data collection tool. de Vaus (1991) notes that criticisms of surveys include being too restrictive due to rigid structures and the failure to look at the context in which people's beliefs and actions occur. Questionnaires are however cheaper and quicker to administrate than interviews. They are more convenient for the respondent and remove interviewer effects and variability in administering the empirical study (Bryman and Bell 2007).

Researchers must appreciate the value of both quantitative and qualitative as neither method is intrinsically better. The choice of the correct method is reliant on the research objectives (Silverman 2005). Hakim (1987) states that case studies usually employ multiple data collection methods. This research will employ the method best suited to each empirical stage whether that is quantitative or qualitative. The focus on employees, rather than being objective, posits that this research will be primarily qualitative. The following section discusses the level of access secured at the Nissan Sunderland Plant.

3.3 ACCESS TO NISSAN SUNDERLAND PLANT

Access to the Nissan Sunderland Plant was obtained in September 2009 through contacts gained during an industrial placement at the facility and through the Press Office. The opportunity arose to interview production line personnel during scheduled downtime during Q4 2008. The downtime, a rarity, was in response to a fall in demand caused by the economic downturn. This level of access would have otherwise not been possible. In the November 2009 access was also granted to interview the two members of staff who work in the Nissan Production Way Office plus the senior of the Quality Assurance department who had completed studies focusing on the Nissan Production Way. The Nissan Sunderland Plant considers these individuals to have a concrete understanding of the Nissan Production Way.

Support in administering a representative survey was also secured through the Nissan Sunderland Plant Press Office. Following the UK Government's introduction of the car scrappage scheme in April 2009 demand for the Nissan Sunderland Plant's models surged and production was increased to levels that required the hiring of 350 temporary staff. This was in stark contrast to the beginning of the year which saw the Nissan Sunderland Plant lay-off 1200 staff to protect its long-term future (Massey 2009a). This resulted in full support for this research being withdrawn due to the high workload at the plant. Access was however secured to administer the survey to a single department. Through consultation with the Nissan Sunderland Plant Press Office the Quality Assurance team was chosen due to their mix of production and office staff being the least dissimilar to that of the plant. All forty members of the team participated in the survey.

3.4 CHOICE OF APPROACH

Restrictive access and time constraints make action research inappropriate for this study. Modelling and simulation relies on quantitative data and requires a high level of existing knowledge. The low level of existing knowledge and the aims of this research do not lend themselves to adopting modelling and simulation as the methodological approach. The access levels granted do not guarantee a representative sample or the volume required to be able to run statistical analyses on survey findings. This discounted the use of surveys as the study's methodology.

Operations Management theorists are faced with a significant challenge due to the evolution of managerial methods and operations technologies which may require a move away from the quantitative and deductive tools prevalent in operations research (Lewis 1998). Where there is confusion surrounding definitions of constructs (e.g. Lean) case studies are a useful tool (Mukherjee et al. 2000). Inductive case studies can be a good starting point if limited theoretical knowledge concerning a phenomenon exists (Siggelkow 2007). The need for empirical studies of exemplar Lean operation, as identified from existing literature, posits an inductive single case study as the appropriate approach. This case study can be regarded as exploratory due to the limited existing research of both the Nissan Production Way and human factors in Lean. Voss et al (2002) highlights the use of case studies as a good strategy of exploratory investigations.

Taylor and Taylor (2009) analysed all 310 articles published in the International Journal of Operations and Production Management during their tenure as editors (2004 – 2009). They found that 87 papers (28% of total) used a case study method with 33% of this number (29 papers) using a single case. Siggelkow (2007) argues that a single case can be a very powerful example; *"in fact, it is often desirable to choose a particular*

organisation precisely because it is very special in the sense of allowing one to gain certain insights that other organisations would not be able to provide" (p20). He also suggests that the use of cases as illustrations is also valuable.

3.5 RESEARCH PHASES

This research contains five phases (figure 3.2). Firstly, this thesis has presented a detailed literature review from which a Views of Lean Table has emerged (Chapter 2). Chapter 4 presents data from an initial set of semi-structured interviews focused on gaining a view of life at Nissan Sunderland Plant. Chapter 5 presents data from a set of more in depth semi-structured interviews with Nissan Production Way Experts aimed at identifying the elements of this Lean Production system.

Despite the literature identifying a view that intrinsic motivation was central to Lean (Sugimori et al. 1977) the first two empirical phases uncovered a focus on a continuous fight for survival and a lack of focus on intrinsic motivation. Chapter 6 explores this further through use of a small scale exploratory survey. Chapter 7 brings the results of the initial interviews, expert interviews, and exploratory survey together. The Nissan Production Way is added to the Views of Lean Table to enable comparison of academia's interpretation of Lean and elements that form the Nissan Production Way.

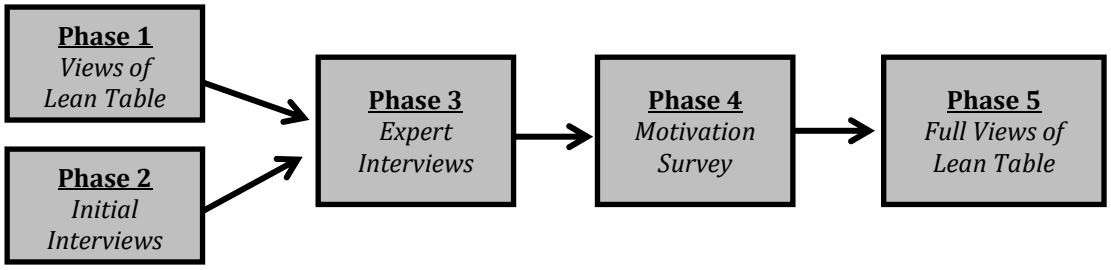


Figure 3-1 Thesis high level overview

The following subsections discuss the methodology for each of the five phases (Initial Interviews, Expert Interviews, and Exploratory Survey).

3.5.1 PHASE ONE: VIEWS OF LEAN TABLE

The Views of Lean Table and the methods used to create the table, are discussed in section 2.5. (p43). The Views of Lean Table combines multiple views of Lean creating an aggregated set of elements which current literature associates with Lean. This phase answered RQ1: What is Lean?

3.5.2 PHASE TWO: INITIAL INTERVIEWS

The overall aim of Phase Two was to gain a holistic view of the Nissan Sunderland Plant and Nissan Production Way from the stance of an employee. Particular attention was paid to focusing on human issues. The objectives for this phase were as follows:

1. To gain an understanding of the Nissan Sunderland Plant from an employee perspective
2. To gain understanding of Nissan's universal production system, the Nissan Production Way, from an employee perspective
3. To gather employee perceptions of Nissan products
4. To gather employee perceptions of how customers, perceive Nissan's products
5. To establish the key success factors for Nissan Sunderland Plant and Nissan globally from an employee perspective

Initial interviews were exploratory and designed to identify the attitude of Nissan Sunderland Plant staff towards Nissan and the Nissan Production Way. Through gaining this information any human issues could be raised as prompts or direct questions in the subsequent expert interviews to encourage discussions covering human issues, as well as the more technical aspects of the system.

Access to personnel was gained through the Press Office who arranged the interviews and selected individuals based on criteria of selecting staff in both office, and production line, roles from different levels of seniority. Gaining access to interview production line staff is usually a difficult task due to the flow production system and Lean staffing levels. At the time of request (second half of 2008) the U.K. was in the midst of an economic downturn which resulted in reduced production levels including non-production days. This enabled access to the manager of Trim & Chassis Line 2 and seven members of his team. Access was also secured to four office staff. Of these twelve interviewees one was a manager, two were senior supervisors, two were supervisors, three were team leaders and four were team members.

Initial interviews utilised open ended semi-structured interviews to allow the interviewer scope to direct the interview and prompt (probe) for more information where needed. Maykut and Morehouse (1994) claim that effectively using probes is an important skill as the purpose of qualitative interviews is to gain a deep understanding of interviewee views and experiences. Interviews were deemed to be the most appropriate data collection method due to the need to obtain employee opinions. This allowed for views to be individually sought and then collectively compared ensuring participants were not influenced by their peers. This was particularly important as employees of varying seniority levels were taking part and individuals may have felt uncomfortable expressing negative views in front of their superiors. It also took full opportunity of the access levels granted. At this point of the research it was vital to gain a general understanding and the task of formulating specific questions for a survey was not possible given the current level of knowledge. Open ended semi-structured interviews were therefore a logical choice to best gather the required information.

Phase two used convenience sampling, viz a sample that is accessible to the researcher. *"In the field of business and research management, convenience samples are very common and indeed are more prominent than are samples based on probability"* (Bryman and Bell 2007: p198). Bryman and Bell (2007) state that convenience samples are not generalisable but acceptable when the gathered data is too good to miss - it can provide the basis for future research. Siggelkow (2007) argues that claiming to have a representative sample in case research is *"a mismatch of method and goals: to say something's representative, you need to pick a different methodology"* (p21).

Before conducting the actual interviews three pilot interviews were conducted with researchers at the University of Bradford. One of these pilot interviewees had a detailed knowledge of this research, one was a doctoral researcher who was in the process of conducting interviews and one was a seasoned academic with minimal knowledge of this research. The interview was also piloted with a member of staff at Nissan Sunderland Plant. As a result of these pilot interviews the protocol was refined. Feedback was also gained as to whether interviews were effectively conducted. As the actual interviews were conducted over two days it was possible to adjust the prompts, or gather data to probe into themes explored by previous interviewees. Maykut and Morehouse (1994) claim that flexibility, responsiveness and ability to pursue aspects of the phenomenon not included in the prepared questions is important. The flexibility offered by a semi-structured approach was therefore instrumental in maximising the insight gained from the interviews. Table 3-1 shows the interview protocol.

Question	Prompts
Why did you choose to work for Nissan UK?	*Was it location? Was it salary? Was it general interest?*
How do you think working for Nissan UK differs in comparison to other car manufacturers?	*Is it the manufacturing style? Is it the human resource policies?*
What words would you use to describe the Nissan working environment to an outsider?	*Morale, stress, being controlled, rewards, involvement, encouraging initiative, training*
Do you own a Nissan? If so why, or why not?	*Good deal? General liking for the car? Peer pressure?*
Why do you think customers buy Nissan vehicles?	*Is it their design? Is it their practicality? Is it their quality?*
What factors in your view make Nissan (the whole global company) successful?	*Employees? Range of cars? Manufacturing process? Service?*
What factors in your opinion make Nissan Sunderland successful?	*Productivity? Employee relations? Manufacturing process?*
Do you think that Nissan has good supplier relations? If so why, or why not?	*Communication? Link into manufacturing process? Location near to suppliers?*
What do you think makes the Nissan Production Way different to other car production systems?	*Douki-seisan? Supplier integration? It's everyone's system?*
What do you think are the biggest challenges in implementing the Nissan Production Way?	*People, culture, lack of top management commitment?*

Table 3-1 Initial interviews protocol

Interviews lasted up to one hour and were all conducted by the same researcher. Data was recorded by combination of transcripts and audio recordings. Maykut and Morehouse (1994) claim that it is essential to record interviews if they are to be used as the main source of data. Permission to record the interview was sought and was granted by all participants. The combination of transcripts and audio recordings allowed the interviews to proceed with a single interviewer whilst still collecting the required data.

It is important to follow your instincts as to what seems important in data. *"There is no right or wrong about analysis. Nor is there a set of rules or procedures that must be followed. Analysis is, for a large part, intuitive and requires trusting the self to make the right decisions"* (Corbin and Strauss 2008: p71). The low sample size and need to gain a deep understanding of the data made it appropriate to analyse each transcript by hand. This enabled the full value of the data to be realised. To progressively refine the

analysis interview data was analysed twice. By performing a cross-interview analysis common themes were identified. This enabled the final account to pay more focus on these themes whilst comparing quotes and answers to the questions to provide a richer dataset. Within-interview analysis ensured that there were no contradictions in the transcripts and by once again comparing with the other interviews it was easy to ascertain whether respondents had interpreted the questions in the same way.

Once the interviews were fully transcribed two additional researchers checked the transcripts were accurate using the original audio. Transcripts were then sent to the interviewees by post for validation and to encourage further comments. No feedback or errors were highlighted by any of the interviewees and therefore the transcripts were deemed to be an accurate account.

3.5.3 PHASE THREE: EXPERT INTERVIEWS

The primary aim of the expert interviews is to formulate a clear understanding as to what elements form the Nissan Production Way. This data allows the comparison of the Nissan Production Way against the common perception of Lean, viz addition to the Views of Lean Table. This primary objective can be broken down into seven further objectives. These objectives were formed by identifying the key areas of Lean Production systems as identified in the Views of Lean Table. 'Add-on' components refer to additional elements that are used in the system but not strictly classified as belonging to the Nissan Production Way. The seven objectives are as follows:

1. To identify resource reduction tools
2. To identify production management techniques
3. To identify how the Nissan Production Way manages the supply chain
4. To identify standardisation, defects and improvement tools
5. To identify human relations issues
6. To identify 'add-on' components and levels of standardisation across Nissan plants
7. To identify and other components and interviewee opinions

The required participants are those responsible for the maintenance of the Nissan Production Way at Nissan Sunderland Plant or who have a detailed knowledge of the system. Access was granted through the Nissan Sunderland Plant Press Office to the two members of staff working in the Nissan Production Way office whose job it is to ensure the correct application of the Nissan Production Way. Additionally, access was granted to the Quality Assurance senior supervisor who has studied the production system in detail for his academic research. Access was easy to obtain due to the required personnel being office based. This phase involved Nissan Sunderland Plant staff with a holistic detailed knowledge of the Nissan Production Way.

This phase utilised semi-structured interviews. This decision was taken due to the lack of existing knowledge of the phenomena to enable the formation of a detailed survey protocol. Using a focus group, rather than three semi-structured interviews, would not have enabled the gathering of individual accounts and the amalgamation of data to provide an accurate account. It would also have removed the ability to probe for more information on Nissan Production Way aspects based on the findings from the previous interview.

The interview protocol was piloted by an academic and a member of staff at Nissan Sunderland Plant. It was important to ensure that the pilot included a member of Nissan Sunderland Plant staff to test that the questions were easy to understand and clear in what they were asking of the interviewee. This process resulted in several language / terminology changes.

Each interview was conducted by the same interviewer and lasted up to an hour in duration. Interviews were recorded by notes and audio recordings. All interviewees granted permission to record the interviews to aid in data analysis. Following the interviews, the notes and audio were combined to create a transcript for each of the three participants. Clarification on transcript content was sought from participants by email as required. An additional researcher than checked the transcript against the audio and notes to ensure an accurate account was logged. Transcripts were then finalised and sent by mail to each participant for validation and to encourage further comments. No issues were raised and therefore the transcripts can be seen as accurate.

To progressively refine the analysis interview data was analysed twice. Within-interview analysis ensured that there were no contradicting statements provided by each of the three interviewees. Cross-interview analysis was then performed to identify commonly cited elements and to identify the themes, and emphasis on certain Nissan Production Way elements. These themes then allowed the analysis to focus more on these areas whilst also paying sufficient attention to the other emerging elements.

Interview findings were also checked by the same academic who validated the interview transcripts to ensure they utilised the full value of the data and to identify any discrepancies. Finally, the report from the collective interview findings was also

sent to the three participants who were asked to check the report and write back if they identified any errors.

The aforementioned objectives were used to structure the interview protocol. The interview was comprised of seven sections with relevant open questions which were asked to all interviewees. This was supported by a number of probing questions which were formed during the interview to encourage a deeper level of conversation around topics the interviewer deemed to be of interest to this investigation. Table 3-2 provides the expert interview protocol.

Category	Questions	Prompts
Resource reduction	What is the Nissan Production Way's view about resource reduction?	*A resource can be working hours, movements, raw materials, space, or production time*
	How does the Nissan Production Way reduce the use of resources?	*An example could be the reduction of setup times or the reduction of lead times*
Production management	How is the Nissan Production Way organised?	*Is the system arranged by cells or groups? Are processes synchronised? Is production levelled or smoothed. Are products pushed to the next process or pulled from the previous process?*
	To what extent is Just-in-Time utilised in the Nissan Production Way?	*Is it used factory wide? How important is it to the Nissan Production Way?*
	Does the Nissan Production Way use tools to analyse work flows with the aim of increasing productivity?	*Such as time/work studies, multi-manning, statistical process control, layout adjustments, cellular manufacturing*
Supply chain management	To what extent are Nissan Production Way production management techniques used by Nissan Sunderland Plant's suppliers?	*Is the Nissan Production Way used by first tier suppliers, second tier suppliers, third tier etc*
	Are suppliers involved at Nissan Sunderland Plant and if so how are they involved?	*Are there joint training initiatives, joint product development programmes*
	Does the Nissan Production Way include value stream mapping or flowcharting?	*Value stream mapping is the mapping of product and information flows and the analysis of this data to identify and eliminate wastes*

Table 3-2 Expert interviews protocol

Category	Questions	Prompts
Standardisation, defects and improvement	What does the Nissan Production Way have in place to identify, stop and fix defects?	*For example intelligent automation / autonomation, line stop, Poka-Yoke / failure prevention*
	What does the Nissan Production Way have in place to standardise elements of the production system?	*Standard operations, housekeeping (5S), visual control and management / management by sight*
	What improvement strategies or techniques are used in the Nissan Production Way?	*For example continuous improvement, root cause analysis*
Human relations	How are employees involved with the Nissan Production Way?	*Are they involved in improvement circles / group problem solving?*
	How are employees managed within the Nissan Production Way?	*Appraisals, discipline, company hierarchy*
	What development and training opportunities are there for employees within the Nissan Production Way?	*Training, promotion/progression, taking extended leave for travelling etc*
	How does the Nissan Production Way get the full value from employees?	
	What rewards and recognition schemes exist for employees?	
Other features / components	Are there any features / components that the Nissan Production Way utilises but are recognised as an 'add-on' rather than part of the core production system?	
	Have all of the elements of the Nissan Production Way we have discussed thus far been part of the Nissan Production System at Nissan Sunderland Plant since the system was first introduced?	*How has the system developed at the plant, what are the notable omissions and additions. Are the additions / omissions core components or add-ons?*
	Is the Nissan Production Way at Nissan Sunderland Plant a mirror image to the Nissan Production Way used at other Nissan plants?	*Is anything unique to Nissan Sunderland?*
Additional information	Are there any other aspects or is there anything about the Nissan Production Way we have not covered?	
	Do you have any opinions you are comfortable sharing with us with regards to the Nissan Production Way in general and its long-term viability as the way to manage production?	

Table 3-2 Expert interviews protocol (continued)

3.5.4 PHASE FOUR: MOTIVATION SURVEY

Despite Lean being described as a respect-for-human system, Lean at Nissan Sunderland Plant may come at a human cost (Garrahan and Stewart 1992; Williams et al. 1992). Garrahan and Stewart (1992) claim that this cost is a focus on "*personal security through working for devolved worker-managing strategies"* (p139). The opportunity for further study due to good access, and a lack of focus on intrinsic motivators in the Nissan Production Way, prompted this research to use an adapted version of Hackman et al's (1975) Job Classification Model to assess whether staff at the Nissan Sunderland Plant found their jobs to be intrinsically motivating.

Convenience sampling was utilised in this research phase. This is a valid choice as the opportunity to gather data is 'too good to miss (Bryman and Bell 2007). The low sample size has not permitted the data to be statistically tested. However, as previously mentioned, claiming to have a representative sample in case research is *"a mismatch of method and goals: to say something's representative, you need to pick a different methodology"* (Siggelkow 2007: p21). Whereas the intention of this research was to conduct random sampling and administer a larger number of surveys this research phase has still been able to gather valuable information that gives further insight into the levels of intrinsic motivation at the Nissan Sunderland Plant.

The complete survey is provided in Appendix D (p263) and its development documented in the following subsections. For all statements a positive and negatively worded statement was included to increase the quality of the results gathered. One doctoral researcher, one established academic and the Quality Assurance team's manager participated in the pilot survey. All of them were asked to comment on the survey's wording and phrasing. Based on the pilot's feedback minor changes were made to the introduction / instructions section and the role of employees was changed

from production or office to direct (production), semi-direct (production and office) or indirect (office). This change in role categories was made to match the Nissan Sunderland Plant's internal job role classification. Surveys were sent by post to the Nissan Sunderland Plant Press Office and distributed to the Quality Assurance team. All copies of the survey were accompanied by a self-addressed envelope which the participants were asked to use and seal to ensure confidentiality. These were then placed in the internal mail before being forwarded back to Bradford University School of Management for analysis.

The low sample size and desire to gain an in-depth understanding of the data resulted in the analysis being conducted by hand. The completed analysis was checked against the raw data by two separate academics. The feedback from this process then enabled the reporting of results as detailed in Chapter 6.

3.5.4.1 Original Job Classification Model

Hackman et al's (1975) original version of the Job Classification Model (figure 3-2) is the most cited and influential model of job design theory (de Treville and Antonakis 2006; DeVaro et al. 2007). The model suggests that work satisfaction, performance and intrinsic motivation are all affected by three critical psychological states. These critical psychological states are in turn formed from one, or several, core job dimensions. The potential for a job to be intrinsically motivating depends on the views of workers as to the characteristics of their jobs. Growth Need Strength (Growth Need Strength) is a moderating variable relating to an individual's need for personal development. For those who have a low Growth Need Strength jobs with high core job dimension scores may have a detrimental effect on their intrinsic motivation.

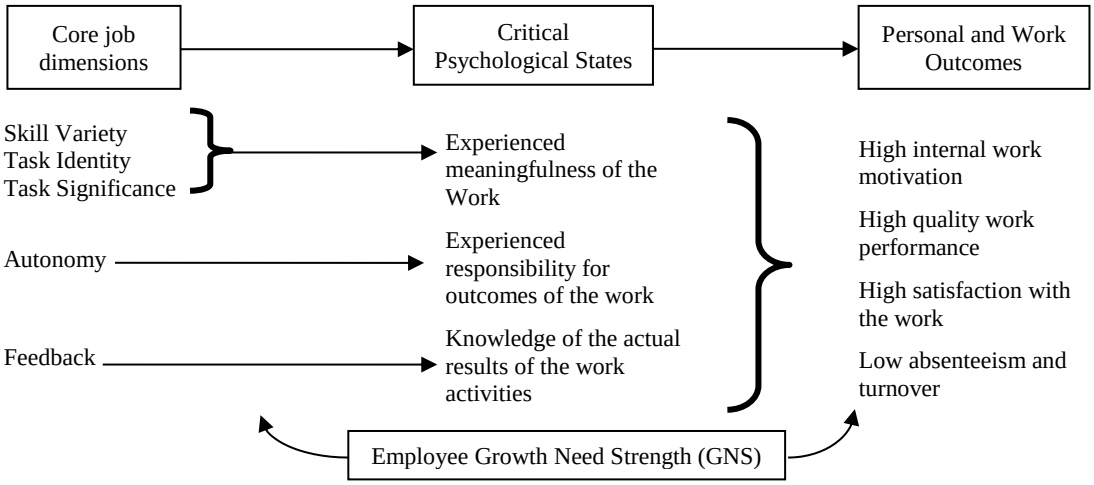


Figure 3-2 Job Classification Model
Source: Hackman and Oldham (1975)

To assess intrinsic motivation, and to operationalise the Job Classification Model, Hackman and Oldham (1975) created the Job Diagnostic Survey (Job Diagnostic Survey). Employees participating in the survey read a series of statements and indicate the level to which they either agree, or disagree, using a Likert scale. A short form of the survey focuses on measuring *"several characteristics of jobs, the reactions of the respondents to their jobs, and the growth need strength of the respondents"* (cf. Hackman and Oldham 1974: p74). The Motivating Potential Score (Motivating Potential Score) places a value on a job's potential to be intrinsically motivating (see figure 3-3) based on the core job dimension results. Table 3-3 provides the original short form Job Diagnostic Survey core job dimension statements which allow the calculation of the Motivating Potential Score. The first statement in each category (written in green) is answered on a visual seven-point Likert scale. The positive and negatively worded statements are answered by choosing a number which corresponds to a seven-point Likert scale where 1 is 'very inaccurate' and 7 is 'very accurate'.

CJD	Questions
SV	How much variety is in your job? That is, to what extent does the job require you to do many different things at work, using a variety of your skills and talents?
SV	The job requires me to use a number of complex or high-level skills
SV	The job is quite simple and repetitive
TI	To what extent does your job involve doing a whole and identifiable piece of work? That is, is the job a complete piece of work that has an obvious beginning and end? Or is it only a small part of the overall piece of work, which is finished by other people or by automatic machines?
TI	The job provides me the chance to completely finish the pieces of work I begin
TI	The job is arranged so that I do not have the chance to do an entire piece of work from beginning to end
TS	In general, how significant or important is your job? That is, are the results of your work likely to significantly affect the lives or well-being of other people?
TS	This job is one where a lot of other people can be affected by how well the work gets done
TS	The job itself is not very significant in the broader scheme of things
AU	How much autonomy is there in your job? That is, to what extent does your job permit you to decide on your own how to go about doing the work?
AU	The job gives me considerable opportunity for independence and freedom in how I do the work
AU	The job denies me any chance to use my personal initiative or judgement in carrying out the work
FB	To what extent does doing the job itself provide you with information about your work performance? That is, does the actual work itself provide clues about how well you are doing aside from any feedback co-workers or supervisors may provide?
FB	Just doing the work required by the job provides many chances for me to figure out how well I am doing
FB	The job itself provides very few clues about whether or not I am performing well

Key: SV (Skill Variety), TI (Task Identity), TS (Task Significance), AU (Autonomy), FB (Feedback)

Table 3-3 Short Form Job Diagnostic Survey Core Job Dimension Statements
Source: Hackman and Oldham (1974)

Motivating Potential Score =

$$\left[\frac{\text{(skill variety + task identity + task significance)}}{3}\right] \text{ x autonomy x feedback}$$

Job Diagnostic Survey Scoring Key			
	Meaningfulness	Skill Variety	(2, 8, 11*, 14, 18*) / 5
		Task Identity	(3, 7*, 16*, 22) / 4
		Task Significance	(4, 13*, 20*, 23) / 4
	Responsibility	Autonomy	(1, 9*, 17*, 21) / 4
	Knowledge of Results	Feedback	(5, 6, 10, 12*, 15, 19*) / 6

Note: For items with asterisks, reverse the score

Figure 3-3 Motivating Potential Score and Job Diagnostic Survey Scoring Key
Adapted from: Leonard and Hilgert (2004) & Hackman et al (1975)

The following section discusses de Treville and Antonakis' (2006) proposal for a variant of the Job Classification Model built for Lean contexts.

3.5.4.2 Lean Job Classification Model

De Treville and Antonakis (2006) claim that the Job Classification Model is a good starting point for investigating intrinsic motivation as "*much of the impact of Lean production implementation on motivation occurs through changes in job design*" (p118). They argue that the Job Classification Model cannot explain intrinsic motivation in Lean contexts. Therefore de Treville and Antonakis (2006) proposed a variant of the Job Classification Model built to suit Lean's specific context (figure 6.4).

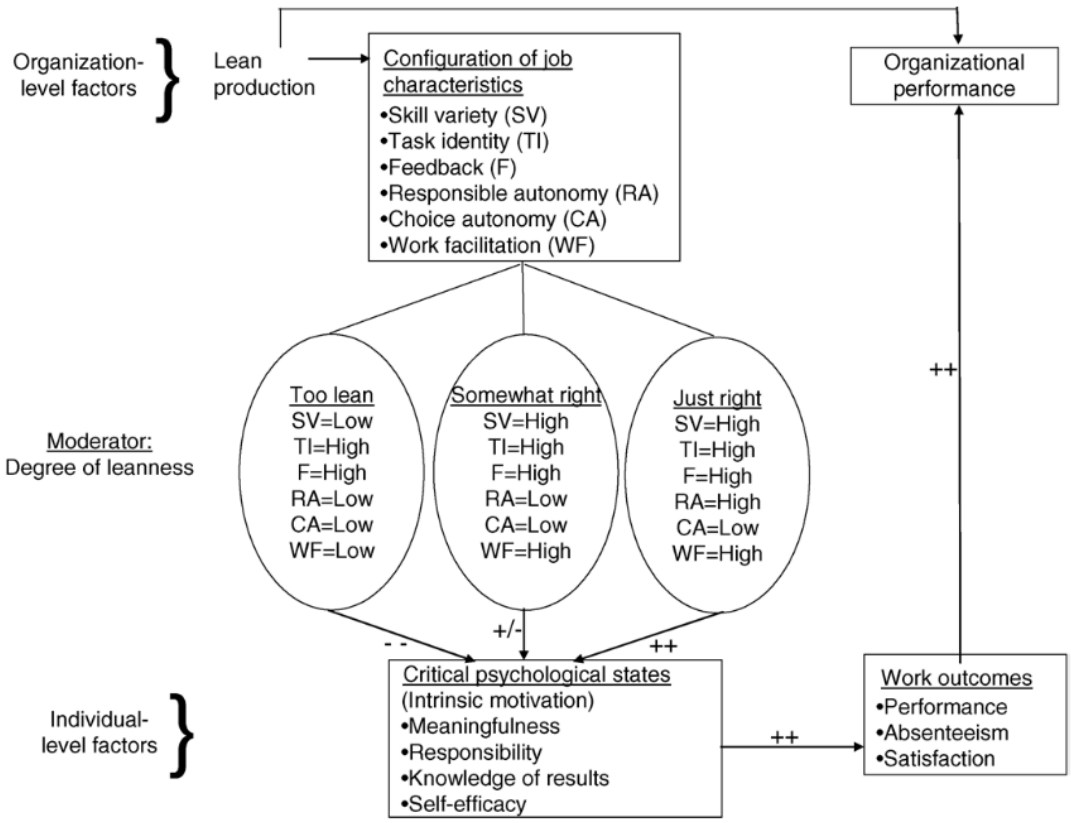


Figure 3-4 Lean Job Classification Model
Source: de Treville and Antonakis (2006)

There are several key differences between Lean Job Classification Model (figure 3-4) and Hackman and Oldham's (1975) original version (figure 3-2). Firstly de Treville and Antonakis (2006) argue that autonomy is formed of two constructs rather than one; (i) choice autonomy, and (ii) responsible autonomy. Choice autonomy is a simple

renaming of the original model, viz, control over work schedules or procedures. Choice autonomy will always be low in Lean operations due to standardisation. Responsible autonomy refers to the level of active worker participation in developing standard procedures. Secondly, task significance (a core job dimension) has been completely omitted from the Lean variant. De Treville and Antonakis (2006) argue that *"evaluating the impact of Lean job design on motivating potential is not aided by the inherent meaning of the task"* (p109). Task significance is *"the degree to which the job has a substantial and perceivable impact on the lives of other people, whether in the immediate organisation or at the world at large"* (Hackman et al. 1975: p59).

Thirdly, Growth Need Strength is removed due to a *"lack of reliable empirical evidence to support the moderating effect of Growth Need Strength combined with the situational strength of Lean production"* (de Treville and Antonakis 2006: p113). Instead de Treville and Antonakis (2006) propose that the degree of Leanness within the company has an impact on the critical psychological states and in turn the work outcomes. Excessive Leanness has a negative effect on intrinsic motivation as companies cut staffing levels to the point where the core job dimension scores decrease. For example, staff many no longer have the time, or ability, to give and receive feedback, rotate roles (skill variety), and be involved in setting standard procedures (responsible autonomy).

Fourthly, a new core job dimension, work facilitation, has been included in the Lean Job Classification Model. Work facilitation refers to the *"actions centred on removing obstacles that inhibit worker performance and on the provision of resources that are instrumental for the achievement of worker goals"* (p112). This job dimension forms the addition of a new critical psychological state, self-efficacy. De Treville and Antonakis (2006) suggest that whilst job design can lead to higher satisfaction this arguably has no impact on job performance. The critical psychological states therefore need to be

expanded to include aspects which result in increased performance such as self-efficacy. Self-efficacy refers to *"beliefs in one's capabilities to mobilse the motivation, cognitive resources, and courses of action needed to meet given situational demands. Self-beliefs of efficacy affect the challenges that are undertaken, the amount of effort expended in an endeavour, the level of perseverance in the face of difficulties, whether thinking patterns take self-aiding or self-impeding forms, and vulnerability to stress and depression"* (Wood and Bandura 1989: p408).

Finally de Treville and Antonakis (2006) also explore the idea that a configural perspective should be used when studying Lean practices. *"The configural model implies that the unit of analysis is a set or bundle of practices that cause motivation in workers and hence organisational performance, and that independent main effects account for less of the variation in the dependent variables – or may even lead to a completely different prediction"* (p114 – 115). They also discuss cross-level effects. Cross-level effects are where a phenomenon at a lower level is influenced by a phenomenon at an upper level.

De Treville and Antonakis (2006) claim that the Lean Job Classification Model offers *"a testable and parsimonious representation of how organisational-level factors (i.e. the Lean production system) affect individual level outcomes (e.g. intrinsic motivation, work performance), which in turn can be linked to organisational performance"* (p107 – 108). However, the article does not mention or provide a Lean variant of the Job Diagnostic Survey, nor does it provide a Lean variant of the Motivating Potential Score which calculates the intrinsic motivation potential based on the shorthand version of the Job Diagnostic Survey. For this reason, it is very difficult to ascertain whether the researchers propose a completely new set of questions, minor modifications or additional contextual questions on top of the original Job Diagnostic Survey in creating

a Lean variant. This leaves this study only able to infer that the Job Diagnostic Survey would have to be modified to match the changes in the Job Classification Model. Additionally it is likely the Lean practices de Treville and Antonakis (2006) cite as impacting on the core job dimensions would translate into additional context questions within an expanded Job Diagnostic Survey.

3.5.4.3 Issues with Lean Job Classification Model

Whereas it has already been identified that the Job Classification Model is suitable to provide an insight into intrinsic motivation in Lean settings (including Nissan Sunderland Plant) and can be modified to suit the Lean context there remain some issues with the modifications proposed by de Treville and Antonakis (2006).

Task significance is not included in the Lean Job Classification Model. De Treville and Antonakis (2006) claim that *"Lean production factory physics do not change the significance of the task"* (p118). However, the significance of the task can also be affected by the social structure within the plant. Results from the Nissan Production Way initial interviews and expert interviews suggest that there is a high level of social identification within the company. Employees express a great deal of pride for Nissan Sunderland Plant and the situation exists whereby both employer and employee depend on each other to survive. The intense fight for survival from both competitors and internal plants competing for new models has resulted in a situation where employees give up liberties for the good of the company. *"Do you want a job or private healthcare?"* (Nissan Sunderland Plant Production Employee). It's this fight for survival that changes the significance of the task. Furthermore, layout changes, increased signposting or any other number of elements could increase task significance. It's not as

straightforward and easy to discount as de Treville and Antonakis (2006) propose and therefore should not be removed from a Lean variant of the Job Classification Model.

The Lean Job Classification Model includes a new core job dimension, work facilitation, and a new critical psychological state, self-efficacy. Work facilitation involves removal of barriers and provision of resources and training which is a vital characteristic of Lean (cf. Womack et al. 1990). De Treville and Ankonakis (2006) claim that the concept work facilitation originates from leadership and argue that jobs are made easier and work performance increased through practices that reduce variability. The justification for the addition of work facilitation is a theoretical link to self-efficacy, viz, how employees judge their ability to perform the job role. Self-efficacy's inclusion is justified based on claims by Conger and Kanungo (1988) and Thomas and Velthouse (1990) who argue that *"workers feelings of competence (i.e. self-efficacy) should be included in the Job Classification Model as a mediatory critical psychological state"* (p111).

Although the inclusion of work facilitation and self-efficacy is an interesting proposal it does not add up. In the original Job Classification Model all existing core job dimensions are linked to a critical psychological state. For example, the critical psychological state of experienced meaningfulness of the work is equal to skill variety, plus task identity, plus task significance. De Treville and Ankonakis' (2006) Lean Job Classification Model, perhaps unintentionally, implies that by assessing work facilitation you can identify self-efficacy which is incorrect. Bandura (1986) states that there are two commonly used measurements of self-efficacy; (i) the ability for an individual to assess how the can perform (magnitude), and confidence at performing at that level (strength). Work facilitation does not assess any of these points. Although de Treville and Ankonakis' (2006) intentions are clear (work facilitation could help improve self-efficacy scores

which in turn could improve work outcomes) the current placement of the concepts do not fit into a Job Classification Model.

De Treville and Antonakis (2006) claim that excessive Leanness can result in worker alienation, increased injuries, decreased suggestions, decreased job rotation and worker discontent. Their Lean Job Classification Model includes the degree of Leanness as having a moderating effect on the core job dimensions and as a result an overall impact on the Motivating Potential Score. The degree of Leanness is grouped into what can be considered as three vague categories; (i) too Lean, (ii) somewhat right and (iii) just right. There is value in highlighting the potential to be excessively Lean and the consequences that de Treville and Antonakis (2006) claim result from being too Lean. However, the degree of Leanness does not take into account a firm's particular context. Whereas low skill variety may be an indicator of excessive Leanness in one company in another it may be a necessity due to its particular context. For example a history of poor employee relations meant that Hyundai's manifestation of Lean required low autonomy and an engineer led approach (Lee and Jo 2007). The degree of Leanness should not be added to a Lean variant of the Job Classification Model as the categories do not take into account a company's individual context. However, it is important to understand that there is a balance between being Lean and excessively Lean.

This research supports the decision to add responsible autonomy and in doing so rename autonomy to choice autonomy. This research also supports the decision to remove Growth Need Strength based on the lack of empirical evidence. The following section builds a Nissan Sunderland Plant variant of the Job Classification Model, Job Diagnostic Survey and Motivating Potential Score based on information in this section.

3.5.4.4 Nissan Sunderland Plant Job Classification Model

This chapter has established the following key points; (i) Job Classification Model is a suitable tool for use in Lean settings, (ii) Job Classification Model is operationalised through administering the Job Diagnostic Survey from which the Motivating Potential Score can be calculated, and (iii) there are issues with Lean Job Classification Model which prevent it being used in this research 'as is'. This research therefore needs to create a Nissan Sunderland Plant version of the Job Classification Model, Job Diagnostic Survey and Motivating Potential Score which will assess the potential for the Nissan Production Way at Nissan Sunderland Plant to be intrinsically motivating. This will address the gap from the Expert Interviews which focused on extrinsic motivators. Based on the Lean Job Diagnostic Survey issues in the previous section figure 3-5 provides a Job Classification Model adapted for use at Nissan Sunderland Plant.

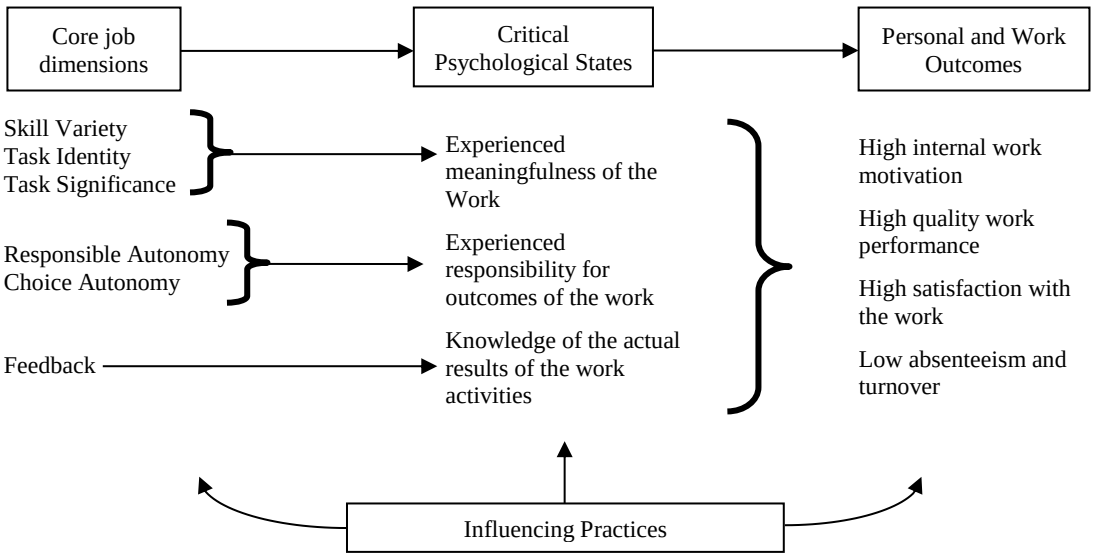


Figure 3-5 Nissan Sunderland Plant Job Classification Model
Adapted from: Hackman and Oldham (1975) & de Treville and Antonakis (2006)

Whereas the Nissan Sunderland Plant Job Classification Model (figure 3-5) remains largely faithful to the original Job Classification Model there are two noticeable differences; (i) the renaming of autonomy to choice autonomy and addition of responsible autonomy, and (ii) the replacement of Growth Need Strength with

influencing practices. Lean practices can influence the scores employees provide for the core job dimensions (de Treville and Antonakis 2006). Similarly, by identifying influencing practices we can better understand the outcome of a Job Diagnostic Survey (e.g. why skill variety score is low). Influencing practices let us look at the results in light of the Nissan Sunderland Plant's context. De Treville and Antonakis (2006) claim that the following practices influence the core job dimensions (table 3-4).

CJD	Lean Practices	Impact
Skill Variety	Group problem solving and participation	Positive
	Cross training	Positive but small relationship
	Job rotation	Positive but small relationship
Task Identity	Short cycle time	Negative
	Flow based layout	Positive
	Cross training	Positive
	Inventory reduction (prevents obscuring product flow)	Positive
Feedback	Flow based layout (allows for easier communication)	Positive
	Standardisation (easy to see if deviating away from plan)	Positive
	Jidoka / poke yoke (instantly clear if figure not inserted correctly)	Positive
Choice Autonomy	Lean reduces choice through standardisation and therefore in Lean systems this CJD will always be negative	Negative
Responsible Autonomy	Decision making authority	Positive
	Developing standard procedures	Positive
	Personally accountable for tasks performed	Positive

Table 3-4 Influencing Lean Practices
Adapted from: de Treville and Antonakis (2006)

The Nissan Sunderland Plant Job Diagnostic Survey will be administered to both production and office staff. It is therefore imperative that the influencing practices included in the survey are those which can be identified by these members of staff. Additionally, those working practices which, if included, have a high probability of attracting an emotional response or causing access problems (e.g. workforce reduction) were omitted. Table 3-5 provides the list of Nissan Job Diagnostic Survey influencing practices.

CJD	Nissan Production Way Practice	Impact
Skill Variety	Group improvement activities (inc. improvement circles, Kaizen activities)	Positive – involvement in improving standard procedures or practices increases opportunities to use a variety of skills.
	Cross-training / education / employee development	Positive – increases the skills at a worker's disposal
	Job rotation	Positive – increases the number of skills employees use
Task Identity	Cross-training / education / employee development	Positive – enables an employee to fully understand, and be able, to undertake their tasks
Task Significance	Teamwork / Cellular Manufacturing / 100% inspection*	Positive – team member absences or poor performance by that individual impacts on other team members
	Hoshin Kanri	Positive – enables employees to see how their work has an impact on the overall company
	Group improvement activities (inc. improvement circles, Kaizen activities	Somewhat positive – the outcomes of group improvement activities can have an impact on other members of staff
	Team-based recognition	Positive – the performance of all team members has an impact on the overall team
Feedback	Company council	Somewhat positive – if the company council is deemed to have a strong influence on others employees may have an impact on other staff through views and issues raised at this council.
	Team-based recognition	Positive
	Teamwork	Positive – if working effectively as a team it is proposed that team members will give each other feedback / help
	Hoshin Kanri	Positive – clear objectives enable employees to compare their work against their objectives
	Group improvement activities (inc. improvement circles, Kaizen activities	Somewhat positive – can provide feedback in the form of identifying areas for improvement
Responsible Autonomy	Hoshin Kanri	Positive – knowing exactly where you fit into the company objectives gives responsibility to help achieve and overall goal
	Group improvement activities (inc. improvement circles, Kaizen activities	Positive – staff are given responsibility for making improvements in their work area

** Includes neighbourhood checks (checking the upstream staff member's work) and a check and repair station at the end of every zone / cell*

Table 3-5 Nissan Job Diagnostic Survey Influencing Practices

The following section discusses the Nissan Job Diagnostic Survey.

3.5.4.5 Nissan Sunderland Plant Job Diagnostic Survey

Modification of the original Job Diagnostic Survey was required to ensure that the statements were in language that was accessible to all those who would participate in the survey. It was likely that the participants would have to complete the survey during lunch or tea breaks. Therefore, it was important to keep the format simple and concise preferably fitting on a double sized sheet of A4 paper. The Nissan Press Office advised that this would be the best approach for maximising participation. As page space was at a premium this study chose not to include the visual seven point scales. Where the original Job Diagnostic Survey' visual scale statements (see table 3-3) were similar to the non-visual scale statements they were omitted (task identity, autonomy and feedback). Where the visual statements differed to the non-visual scale statements they were changed into concise positive and negatively worded statements (skill variety and task significance).

CJD	Questions
SV	My job requires me to use a number of complex or high-level skills$_1$
SV	My job is repetitive$_2$
SV	There is a lot of variety in my job$_2$
SV	My job is always the same and never different$_3$
TS	My job is one where a lot of other people can be affected by how well the work gets done$_1$
TS	The job itself is not very significant or important in the broader scheme of things$_1$
TS	The results of my work are likely to significantly impact the well-being of other people$_2$
TS	My job performance has no impact on anyone else$_3$
TI	My job provides me the chance to completely finish the pieces of work I begin$_1$
TI	My job is arranged so that I do not have the chance to do an entire piece of work from beginning to end$_1$
CA	My job gives me considerable freedom in how I do the work$_2$
CA	My job denies me any chance to use my personal initiative or judgement in carrying out the work$_1$
RA	I am responsible for continually improving my work area$_3$
RA	I do not have the authority to make decisions that affect my work area$_3$
FB	My job is arranged so that I can judge for myself how well I am doing$_2$
FB	I cannot tell how well I am performing just by doing my job$_2$

$_1$Original Job Diagnostic Survey question $_2$Rewritten Job Diagnostic Survey question $_3$New question

Key: SV (Skill Variety), TI (Task Identity), TS (Task Significance), RA (Responsible Autonomy), CA (Choice Autonomy) FB (Feedback)

Table 3-6 Nissan Job Diagnostic Survey Core Job Dimension Statements

3.5.4.6 Influencing Practices

Table 3-7 shows the Nissan Job Diagnostic Survey influencing practices. Negatively worded statements are shown in grey.

Nissan Production Way Practice	Statements
Group improvement activities (inc. improvement circles, Kaizen activities	I regularly participate in improvement teams I am hardly ever involved in improvement projects
Cross-training / education / employee development	If I would like to learn additional skills I can easily ask to attend extra training courses I am unable to ask to attend additional training courses if I would like to learn new stills I am trained to do several tasks I have only been trained to do one task
Job rotation	I frequently change jobs I am always doing the same job
Teamwork / feedback from others	Supervisors often let me know how well they think I am performing the job My supervisors almost never give me any feedback about how well I am doing in my work I frequently receive feedback from other members of my team My team never share work related tips or give each other advice
Hoshin Kanri	I am able to clearly see how my job contributes towards achieving company objectives My job does not contribute towards company objectives
Team-based recognition	The team I work in receives recognition if we do a good job Our team's efforts never receive any recognition
Company council	Company council has a big impact on us The company council has no real power

Table 3-7 Nissan Job Diagnostic Survey Influencing Practices Statements

The first statements on teamwork / feedback from others are not job characteristics and are therefore separate to the data received from the core job dimension feedback. Hackman and Oldham (1974) states that assessing feedback from others (or agents) *"is not a job characteristic per se, and is included only to provide information supplementary to [feedback]"* (p75). In other words, it provides additional information rather than being included in the Motivating Potential Score calculation.

In addition to the Lean practices it is proposed that intense competition between Nissan-Renault plants and the need to fight for survival may have an impact on the

Motivating Potential Score. The fight for the survival of Nissan Sunderland Plant has been consistently highlighted throughout all of the interviews conducted thus far as well as the possible foregoing of liberties with the aim of securing jobs. It can be inferred from these interviews that competition is a motivator driving employees to improve in the competitive working environment. Before the Nissan Production Way Expert Interviews were conducted in November 2009 a 130 item list of the best ideas from a global e-room (a Nissan initiative) was published. The list suggested ideas which every plant should consider implementing. *"Instantly the first thing everyone did was to look down and see how many of them are ours, how many they (other plants) have got – why have we not got as many as them – oh we have got more than them so that's alright then isn't it?!"* (Nissan Production Way Expert).

The fight for survival / intense competition at the Nissan Sunderland Plant could potentially outweigh negative values gained from all of the job characteristics whilst enhancing the values achieved when measuring task significance. In other words, intense competition could potentially increase the perceived importance of a person's job at the plant as both employee and employer fight to survive. The addition of statements to research this factor could provide an interesting insight and aid in the explanation of the Nissan Job Diagnostic Survey. Therefore, the following additional statements (table 3-8) will be added to explore fight for survival.

Statements
We do not have to compete with other Renault-Nissan plants
There is intense competition for new models between all the company's plants
My job is 100% secure
We are under constant pressure to keep improving the plant to secure our jobs

Table 3-8 Nissan Job Diagnostic Survey Fight for Survival Statements

3.5.4.7 Nissan Sunderland Plant Motivating Potential Score

The following figure provides an amended version of the Motivating Potential Score for use in the Nissan Job Diagnostic Survey, based on de Treville and Antonakis' (2006) Lean Job Classification Model.

$$\textbf{Motivating Potential Score} = \left[\frac{(SV + TI + TS)}{3}\right] \times (RA + CA) \times FB$$

Key: SV (Skill Variety), TI (Task Identity), TS (Task Significance), RA (Responsible Autonomy), CA (Choice Autonomy), FB (Feedback)

Figure 3-6 Nissan Motivating Potential Score
Adapted from: Hackman and Oldham (1974)

See Appendix D (p263) for the full version of the Nissan Job Diagnostic Survey.

3.5.5 PHASE FIVE: FULL VIEWS OF LEAN TABLE

The final phase of this research takes the Views of Lean table created in the Literature Review and adds a further column detailing the Nissan Production Way's implementation of lean. This is provided in the Discussion chapter.

3.6 SUMMARY

The following table provides an overview of the methodology.

Phase	Activity	Outcome
1. Views of Lean Table	Literature review	Aided creation of Expert Interview protocol
2. Initial interviews	Interviews with office and production staff	Highlighted lack of focus on human factors, supplemented Expert Interview protocol
3. Expert interviews	Interviews with plant Lean experts.	Identified key elements of Nissan Production Way, highlighted lack of focus on human factors resulting in phase 4.
4. Motivation survey	Survey of office and production staff	Identifies low levels of intrinsic motivation offset by a fight for plant survival.
5. Views of Lean Table	Brings together phases 1-4 to create a view of Lean at the plant.	Highlights narrow view of lean in current research compared to the broad philosophy / toolbox view of Lean used at Nissan.

Table 3-9 Overview of Methodology

4 RESULTS: INITIAL INTERVIEWS

It is difficult to secure access to gather data on employee attitudes towards Lean (Shadur et al. 1995) however access was secured to interview the staff at Nissan Sunderland Plant in 2009. The aim of the initial interviews was to gain an initial understanding of both the Nissan Sunderland Plant and its Lean Production system – the Nissan Production Way. These interviews not only gave this research a starting point given limited existing knowledge of the plant but also formed the basis of the Expert Interviews which are detailed in the following chapter.

The following sub-sections provide the findings of the initial interviews. A total of 8 production staff and 4 office workers participated in these interviews. The average interview times were 26 minutes for production staff and 20 minutes for office staff. Whereas all of these interviewees were asked the core set of questions they were also encouraged to expand on other themes that emerged during their interview or previous interviews. As a result, this research phase gathered a rich data set which discussed themes which may not have been covered by all interviewees. Table 4-1 provides a list of the initial interview questions, the full protocol is provided in section 3.5.2 (p75), and an example transcripts is provided in Appendix B (p245).

#	Question
1	Why did you choose to work for Nissan UK?
2	How do you think working for Nissan UK differs in comparison to other car manufacturers?
3	What words would you use to describe the Nissan working environment to an outsider?
4	Do you own a Nissan? If so why, or why not?
5	Why do you think customers buy Nissan vehicles?
6	What factors in your view make Nissan (the whole global company) successful?
7	What factors in your opinion make Nissan Sunderland successful?
8	Do you think that Nissan has good supplier relations? If so why, or why not?
9	What do you think makes the Nissan Production Way different to other car production systems?
10	What do you think are the biggest challenges in implementing the Nissan Production Way?

Table 4-1 Initial Interview Protocol

4.1 CHOICE OF EMPLOYER

The pay package was the key factor in choosing to work at the Nissan Sunderland Plant. Whereas office staff discussed their education, interest in the job role, and job security as influencing their choice of employer there was no mention of these factors by production staff. The majority of interviewees had worked at the plant for over five years with several of those employees stating that they had only ever worked at the Nissan Sunderland Plant. Locality was not considered to be an issue for the majority of interviewees; only 3 participants claimed that locality was an important decision factor.

A production team leader claimed that the Nissan Sunderland Plant had lived up to expectations *"to a certain extent."* Despite being offered a promotion he was disinterested due to the high expectations and increase in offline work at supervisor level. The supervisor role had "*lost its original meaning."* Several production interviewees claimed that their job had 'its ups and downs'.

Whereas none of the interviewees had worked for another car manufacturer they claimed that Nissan Sunderland Plant employees work harder, the plant has a real sense of team work and the working environment would be different to other plants. Office staff claim that human resource policies would be similar to other car plants. This could be due to the Nissan Sunderland Plant's membership of the Motor Industry Industrial Relations Group which conducts benchmarking, and shares information on human resource practices.

The Nissan Sunderland Plant is open and transparent with good benefits. Nissan Sunderland Plant staff are disciplined and unwilling to fail. The Trim and Chassis Line 2 Manager discussed the Nissan Sunderland Plant as having a Japanese manufacturing ethos and, after visiting other Nissan plants in Japan, he believed that the Nissan

Sunderland Plant was good if not better than its Japanese counterparts. *"[Nissan Sunderland Plant] definitely has the cultural element of how to make cars Japanese style"* (Trim and Chassis Line 2 Manager). Office staff claimed that possible differences to other plants could be a flatter organisational hierarchy, open plan offices and a real sense of teamwork. However, they believe that there are probably more similarities than differences.

Table 4-2 provides an overview of the key points raised by interviewees for questions 1 & 2. Whereas production staff results are split by seniority office staff have been grouped into one category. This was due to the strong similarities between office staff answers and the desire to clearly display the difference in opinion between production and office staff. Production staff were far more open and willing to share their opinions than the office staff. There are several noticeable differences between production staff seniority levels. Whereas all levels expressed an interest in the pay package only the team leaders considered the prospects for promotion at the plant when choosing to work at the Nissan Sunderland Plant.

Staff	Why did you choose to work for Nissan UK?	How do you think working for Nissan UK differs in comparison to other car manufacturers?
TM	• Personal interest • Good pay • Looked pretty secure at the time	• Never worked for any other car manufacturer • Looks pretty similar • Different working environment
TL	• Wage • Long-term future • Job security • Prospects	• Never worked for any other car manufacturer • More demanding • Harder working • Most productive plant in Europe
S	• Good package • Long-term job	• Never worked for any other car manufacturer • Japanese influence – Leaner
M	• Main motivation was money • Joined as a trainee maintenance technician	• Haven't seen many other car manufacturers • Nissan Sunderland Plant staff work harder • Other Japanese plants may be getting closer but older car makers (i.e. Ford) would be a million miles away

Table 4-2 Choice of Employer Overview

Staff	Why did you choose to work for Nissan UK?	How do you think working for Nissan UK differs in comparison to other car manufacturers?
Office	• Had university placement at Nissan Sunderland Plant • Interest in role • Close to home	• Never worked for any other car manufacturer • Guessing would be similar • Benefits are good but expect a lot in return • Very open and transparent • Human resource policies similar • Real sense of team work

Key: TM (team member n=2), TL (team leader n=3), S (supervisor n=1), M (manager n=1)

Table 4-2 Choice of Employer Overview (continued)

4.2 WORKING ENVIRONMENT

Jobs at the Nissan Sunderland Plant are demanding, challenging, fast paced, and at times stressful. One of the production interviewees claimed that the plant tries to get every drop of energy from their staff and pushes them to the limit. In an off the tape comment one member of staff claimed that they *"used to be persecuted so much that a supervisor lost his voice for six months – turned him into a jibbering wreck. It's eased off nowadays but they still demand a lot."* A number of production staff felt that their jobs were repetitive.

Production line workers have a lot of demands including physical and mental (the monotony). The Nissan Sunderland Plant always make sure new starters know how difficult and demanding their jobs are; they want everyone to be very clear about the role and what it entails. *"You need to be the right person for the job"* (Trim and Chassis Line 2 Manager). Production staff are all given a minimum of 2 hours' production line experience, viz a line trial, as part of the application and interview process. Despite these measures there is still a dropout rate – some people are just not made for the job.

"There are some people I refer to as car builders with affection – it never ceases to amaze me how they work – they are a special breed" (Trim and Chassis Line 2 Manager).

Interviewees view the workforce as key to the Nissan Sunderland Plant's success and hold the plant in high regard. However, they don't necessarily appear to feel that they are treated as the most important asset. In June/July 2008 an independent plant-wide survey revealed that employees don't think that the company listens to what they say. One production interviewee expressed the belief that some suggestions are dismissed due to internal politics and *"ridiculous reasons."* The Trim and Chassis Line 2 Manager expressed his disappointment over these findings stating it should be as easy as approaching the supervisor although its impractical to act on every suggestion. *"It is essential that we give feedback to suggest why an idea may not have been acted upon… the opportunity is there; we have just got to make it happen perhaps better than it does at the moment"* (Trim & Chassis Line 2 Manager).

The following table (Table 4-3) provides an overview of the insights and opinions regarding the Nissan Sunderland Plant's working environment. One production interviewee cited health and safety as being important to Nissan. *"Nissan are big on health and safety at the moment… sometimes the light hurts my eyes so I asked my supervisor and he said no problem and got me them (tinted safety glasses) straight away."* He also claimed that the supervisors are always there to listen if there any problems. Rewards and recognition, training, and union and company council are explored in more detail in the following subsections.

Staff		What words would you use to describe the Nissan working environment to an outsider?
Production	TM	• Hard work • In the last six months it hasn't looked so secure • Don't think people outside of Nissan understand what it is like to work on the line • Can be stressful • Safety conscious • Supervisors listen if you have problems
	TL	• Demanding • Repetitive • Rewarding for some staff • Hard – more regimental than it used to be • Very physical • Not suited to everyone
	S	• Busy • Hard work • Target orientated • Some days can be non-stop
	M	• Extremely demanding • Extremely challenging • Can be rewarding as well • Relentless
Office		• Team work • Fast paced • Always changing • Quality focused • Emphasis on training • Challenging • Responsibility • Rigorous • Professional • Thoughtful

Key: TM (team member n=2), TL (team leader n=3), S (supervisor n=1), M (manager n=1)

Table 4-3 Working Environment Overview

4.2.1 REWARDS AND RECOGNITION

Only three of the twelve interviewees cited rewarding as a key word to describe the Nissan working environment. Several interviewees confused rewards with the basic pay package. Whereas the Trim and Chassis Line 2 manager believed that rewards and recognition are in place he acknowledged that the staff may have a different opinion. *"It*

is important that people understand that their efforts are appreciated and recognised… it is something we are always trying to work to improve" (Trim and Chassis Line 2 Manager). The manager emphasised the overall competitive pay package with benefits *"second to none"* including pension scheme, healthcare scheme, gym, and car lease scheme for all staff.

A production supervisor who had been with the company for 21 years claimed that there had been no rewards since he started working for Nissan. *"If you are talking of something they can recognise as a reward there's not much lying around to be honest."* When asked about rewards one interviewee rhetorically asked *"do you want a job or private health?"* He also claimed that the pension scheme had been changed and a lot of the rewards had been taken away.

The Trim and Chassis Line 2 Manager felt that his job was rewarding and satisfying. He was recently heavily involved in a Nissan workshop management audit. The auditors concluded that the Nissan Sunderland Plant was as good or in many cases better than their Japanese counterparts. *"Yes it is demanding for everyone and challenging – everyone is stretched to the limits but when things go well it is very rewarding."*

4.2.2 TRAINING

There appears to be a strong emphasis on worker training at the Nissan Sunderland Plant. At the time of interview the plant was on scheduled downtime due to lower demand for products caused by the economic downturn (see Chapter 1 for more information). During this time production staff were attending training courses which were primarily held in the company's sports and social building. *"The company obviously think that they are developing people… most of them lads are saying that they*

don't want to go to training today as they would rather be working. Training is a long day. Most of the lads are not office / training minded. Time goes quicker when on the line" (Production Interviewee).

The production interviewees did not believe that training helped them to perform their jobs. One interviewee described attending an environment course as *"important but doesn't really impact on my job."* Staff often do not get the chance to implement ideas and put learning into practice. Although the company thinks training is the right thing to do you don't necessarily get to use it as you are tied to the production line (Production Team Leader). There are no spare men on the production line as there is normally someone covering holidays, tied up with courses, or off ill. *"I don't think that people realise how much we are tied to the line now"* (Production Team Leader).

Production staff often viewed training as a company benefiting exercise focusing on attracting government grants rather than improving the skills and abilities of workers. *"I don't think that a lot of the lads are interested in it [training] - it's more an exercise for the company"* (Production Team Leader). According to one interviewee production staff would rather have time off to look at something on the line. *"It's just a waste of time – I have to go and write things down – I come back, put the folder in my locker, and it doesn't see the light of day again. For the lads who are working on the line there are very few that will take that as a qualification that they can get and use it – an NVQ or whatever"* (Production Team Leader). The company is trying to do too much with too few people. Those in charge of training are distant from the production line – decisions should be made by those with first-hand experience. However, this is unlikely to happen because of the government incentives offered (Production Team Leader). Production interviewees suggested that they were able to request additional training if desired.

4.2.3 Union and Company Council

Office staff claimed that the single union arrangement with Unite was positive. A good support network exists with the local works councils, company council, and the union. The Nissan Sunderland Plant has never lost time due to industrial action. The single union arrangement makes negotiation easier; Nissan's Barcelona Plant has six or seven unions which increases 'complications'.

Whereas office staff responded positively to the single union arrangement they did not comment on the effectiveness of the union or the extent to which the union has the ability to influence Nissan Sunderland Plant practices. Half of the production interviewees claimed that the union was not very active. Several production interviewees did believe that the union was necessarily a good thing; internal mechanisms (local works councils and company council) were considered to be the real 'union type' setup at the Nissan Sunderland Plant. Interviews with production staff suggested that employees may not have a voice through trade unions and are instead forced to use internal channels rather than an independent external body.

4.3 Perception of Products

Nine of the twelve interviewees drove a Nissan. The overriding reason for driving a Nissan was the money employees can save by either using the car leasing scheme or the discounts offered by the company. However, at the time of interview the friends and family discount was often similar to discounts attainable by the general public due to the economic climate and fall in demand. One production interviewee claimed that the advertised percentage family and friends discount is in reality never gained; the deals for buying Nissans are not as good as they were in the past. This particular interviewee

owned a Vauxhall Meriva to accommodate the family and a Vauxhall Corsa as the deal was *"too good to turn down."*

The general consensus amongst production staff was that the deal is more important than the design of the car. In contrast the office staff claimed that both the deal and the general liking of the car were the key reasons behind their decision to drive a Nissan. The majority of interviewees expressed a general liking of the Nissan Sunderland Plant's products. Two of the office interviewees did not have a Nissan at the time of interview but expressed their intensions to return to the lease scheme in the near future. The Trim and Chassis Line 2 Manager claimed that managers were expected to drive Nissans. One production interviewee stated the view that staff should own Nissan as otherwise they are aiding the competition and making their jobs look less secure. The Trim and Chassis Line 2 Manager would like to think that he would have driven a Nissan, be taken by it, and become sold on it even if he didn't work for the company. However, several of the interviewees claimed that it was unlikely they would have driven a Nissan if they hadn't of worked for the company.

The design of the cars has improved since Carlos Ghosn became CEO of Nissan. The company has made an effort to change their brand image to make customers feel that their products are more appealing, sporty, interesting and adventurous. *"The 350Z, Infinity range (Nissan's luxury brand), and GTR are examples of deliberately adding products to the range to try and shift the brand. Nissan has a foundation for inbuilt quality but you now need more than this as even some of the low cost manufacturers are creating good quality cars. You need more than just good quality and that is one of Carlos Ghosn's goals"* (Trim and Chassis Line 2 Manager). Whereas the interviewees were of the opinion that the design is improving they do not appear to believe that the current range of cars (at time of interview) is attractive; *"I nearly said attractive cars… I suppose*

they are not too bad – there are a lot worse out there" (Production Interviewee). One of the interviewees claimed that staff used to get the impression that Nissan was 18 months behind the other manufacturers. Models seemed to have the same shapes as the competitors' vehicles. For example, the Micra C+C (convertible) launched after a similar looking Peugeot was already on the market.

The interviewees believed that customers bought their vehicles for their quality and reliability. Whereas the Nissan Sunderland Plant previously bought expensive parts which had an exact fit a lot more people were buying Renaults which were fitted with cheaper parts. The company realised that its specifications were above what the customer desired. As a result, the plant switched to cheaper parts which saved money but also reduced the quality and were harder to fit (Production Interviewee). Value for money, reputation, and customer loyalty were also cited as potential decision makers for customers. The general consensus amongst all interviewees was that design is improving and increasing becoming a more significant factor. Several of the interviewees stated that they viewed the Qashqai as being a big success. The Trim and Chassis Line 2 manager suggested that customers may also buy a Nissan if they know friends and family working at the plant. Between his father-in-law and mother-in-law, they were *"on about their third Nissan so far."*

Table 4-4 provides an overview of the two questions relating to perception of products. Perceptions are very similar in each of the groupings. The key decision factor for both customer and employees in buying / leasing a Nissan vehicle is quality and reliability.

Staff		Do you own a Nissan? If so why, or why not?	Why do you think customers buy Nissan vehicles?
Production	TM	• Good car & good deal • Vauxhall had better offers when I purchased my latest car • Public can get deals just as good as the friends and family discount	• Quality & Reliability • Value for money / the deals • Reputation • Must like the car designs or else they wouldn't buy them
	TL	• Mainly for the deal • Reliable • Nice cars • Design has improved	• Reliability • Value for money • Quality is still there but has reduced • More customers now buying based on the car's design • Brand loyalty
	S	• It is all about having faith in the products you are building • Reliable • Main reason is the deal • Style of the car was not an important factor	• Reliability • Reputation • Design has improved • Contradicting views on quality
	M	• Managers expected to drive Nissans • Very good cars • Family drive Nissans • Friends and family scheme levels of discount now similar to what the public can get	• Reputation for quality • Well built cars • Design used to be bland
Office		• 2 out of 4 drove a Nissan • Good scheme • Nice car • One interviewee didn't have a Nissan as wanted to try something new • One interviewee had already bought a non-Nissan car before joining Nissan Sunderland Plant	• Reputation as a quality brand • Brand loyalty • Value for money • Becoming more innovative • Moving towards good quality, well built, reliable and good looking cars

Key: TM (team member n=2), TL (team leader n=3), S (supervisor n=1), M (manager n=1)

Table 4-4 Perception of Products Overview

4.4 Success Factors

Leadership and a clear unified vision were cited as key factors behind Nissan's success. Five interviewees directly attributed Nissan's success to the Renault-Nissan Alliance and Carlos Ghosn's leadership. Most of Nissan's global workforce will be able to talk about similar things; brand positioning, Nissan Production Way, and the GT2012 midterm plan. *"We now all pull together in the same direction for the same cause which is the good of the company. I honestly believe that is a strength of this organisation on a*

global basis" (Trim and Chassis Line 2 Manager). Workforce flexibility, the Nissan Production Way, and a focus on customer needs were all cited as key to Nissan's global success.

Quality, tight cost control and continuous improvement were cited as the Nissan Sunderland Plant's success factors. Production interviewees were unanimous in viewing the workforce as the key success factor for Nissan Sunderland Plant. *""As corny as it might sound it's the truth of the matter. I don't think that there are many other areas in this country or other countries in Europe that could have produced a success story like Sunderland. It is all based on the efforts of the people here. You regularly hear when you talk to the lads on the line or management in the MD office that we all agree that everyone works extremely hard and we are where we are because of their efforts"* (Trim and Chassis Line 2 Manager). Although the workforce is seen by many as integral to Nissan Sunderland Plant's success a Production Team Leader argued that there is *"always going to be a bit of resentment [from the employees] that the company makes them work so hard."* The ability of the plant and its staff to react to changes, low sickness rates, and determination were also cited as contributing to the plant's success.

Office interviewees focused on the product and plant functionality as the Nissan Sunderland Plant's key success factors rather than the employees themselves. This included a higher number of jobs per hour compared to other Nissan plants, the use of Kaizen activities, good communications and the desire to overachieve on both local and international level targets. One office interviewee claimed that employee relations were increasingly challenging especially in light of the current economic climate.

Table 4-5 provides an overview of the factors interviewees cite as making Nissan Sunderland Plant and Nissan Global successful. Interestingly one of the team leaders

claimed that the plant's success could be attributed to Sunderland historically being home to hard-working manual workers. Whereas the office interviewees cited the speed of the production line and a customer focus as success factors these were not mentioned by the production interviewees.

Staff		What factors in your view make Nissan (global) successful?	What factors in your opinion make Nissan Sunderland successful?
Production	**TM**	• Nissan Production Way works in every plant • Continuous improvement • Flexible workforce • Ability to meet customer demands • Good range of cars – Qashqai is the biggest thing we have	• Rewards • Never fail • Meet every target set • Low sickness rates • Staff always turn up on time
	TL	• Leadership • Renault-Nissan Alliance • Quality • Value for money • Focus on cost reduction • Continuous improvement • Clear plan	• Hardworking, committed workforce • The plant is in an area where families have historically been hard working manual workers • Management team driven to succeed
	S	• Strong leadership • Good reputation and quality product • Emphasis on cost reduction • Clear strategy / vision • Not afraid to learn off each other	• Hardworking committed workforce • Ability to adapt to changes • Not afraid to take on new practices
	M	• Clear strategy • Clear expectations • Carlos Ghosn • Renault-Nissan Alliance • Clear direction	• Workforce • Nissan Production Way – global standard, clearly defined production system
Office		• Manufacturing process (Nissan Production Way) • Range of cars • Workforce • Continuous improvement • Commitment and meeting targets • Leadership • Clear plans • Customer focused • More cost focused than in past	• Production line speed • Quick decisions • Employee commitment • Cost driven / Lean • Aiming to overachieve • Quality • Customer focus

Key: TM (team member n=2), TL (team leader n=3), S (supervisor n=1), M (manager n=1)

Table 4-5 Success Factors Overview

4.5 SUPPLIER RELATIONS

The majority of interviewees consider Nissan Sunderland Plant to have good supplier relations. On-site suppliers are often considered as Nissan Sunderland Plant employees due to their integration into morning meetings. They also follow the plant rules and procedures; on-site suppliers have non-production days when Nissan Sunderland Plant has non-production days. The Nissan Sunderland Plant had to make certain alterations to accommodate suppliers moving on-site which included improving the provision of female toilet facilities. *"We help them out if any of their equipment has broken down so that they don't get told off for stopping the line"* There is also a degree of cross-functional training and there are also crisis teams for when problems occur. Office staff claimed that the Nissan Sunderland Plant had a lot of power in the North-East. Developments and issues at the Nissan Sunderland Plant can have a direct impact on its suppliers (e.g. fall in demand). However, office interviewees claimed that there must be some benefit for suppliers being associated as supplying Nissan Sunderland Plant.

Table 4-6 provides an overview of interviewee opinions regarding supplier relations. It is particularly interesting to note the Production Team Leaders' claims of Nissan Sunderland Plant staff and suppliers' staff often lending each other a helping hand. The office interviewees highlighted good communication with suppliers given information in advance whilst noting the power the Nissan Sunderland Plant has over their suppliers and the link in fortunes.

Staff		Do you think that Nissan has good supplier relations? If so why, or why not?
Production	TM	• Yes – they have to • Excellent relations with the on-site staff • Nissan audits suppliers and they audit Nissan • It all works really well
	TL	• Yes although it can be difficult as Nissan places demands on them • Supplier staff and Nissan staff help each other out • On-site suppliers' staff are thought of as part of the team
	S	• Yes! • Supervisors are sometimes seconded to suppliers to help them implement Nissan style procedures • On-site suppliers are more involved and are almost like Nissan staff
	M	• Yes! • Supplier employees are treated similarly to our workforce • Cross-functional working • Suppliers on-site • Suppliers attend Nissan meetings • We are very demanding of suppliers • We are all honest and transparent
Office		• Yes but it is quite difficult due to the power Nissan yields • Good communication – we bring suppliers into the plant on a regular basis • On-site suppliers • Suppliers information in advance to allow them to do their analysis • Sure it won't do suppliers any harm to be a Nissan supplier • Sometimes feel sorry for suppliers as what happens here affects them • They are under as much pressure as we are to deliver

Key: TM (team member n=2), TL (team leader n=3), S (supervisor n=1), M (manager n=1)

Table 4-6 Supplier Relations Overview

4.6 NISSAN PRODUCTION WAY

Production interviewees seemed to find questions relating to the Nissan Production Way and its implementation easier to answer than the office interviewees. This may be due to their direct interaction with the production line. The Nissan Production Way is considered to be an important part of Nissan. Bi-monthly meetings, chaired by a number of executives who are responsible for the Nissan Production Way, involve Nissan Production Way functions from each region and each plant. During these

meeting best practices is shared and advances in technology are discussed. There is a Nissan Production Way office in Nissan HQ (Japan). The Nissan Sunderland Plant also has a Nissan Production Way office run by employees who have considerable knowledge of the production system. The Nissan Production Way is 'drummed into staff' although one of the office interviewees could only remember small parts of the system. The Nissan Production Way is *"their way of having a good working relationship where everyone is kept informed, everyone appreciates the main elements and this way of working is also used in our appraisals"* (Office Interviewee).

Four interviewees believed that other manufacturers may have similar production systems; *"differences are probably found on a local level and concerned with the staff, quality of management, and suppliers"* (Production Interviewee). However, it is also claimed that the Nissan Sunderland Plant must be doing something different from the competition as they are regarded as Europe's most productive plant.

Supervisors often complete around four Quality Control Stories a year on top of a couple of two hour Kaizens. Quality Control Stories can be 4, 8 or 11 'steppers'; the number indicates the number of tools you use. In essence a Quality Control Story looks at the concern and identifies a few potential areas of interest. The supervisor also stated that big ideas tend to be put into the Improvement Diagnosis System which identifies and helps find ways to reduce Non-Value Added Activities Non-Value Added Activities. Other cited Nissan Production Way features include Just-in-Time, continuous improvement, and production led maintenance.

The majority of interviewees consider the Nissan Production Way to be easily implemented. Several of the production interviewees had the opinion that implementation would be easier in a new plant compared to an old plant. Issues

surrounding the quality, flexibility and commitment of staff as well as the training they receive were key concerns for office interviewees. At the time of interview a new Nissan plant was being built in Russia. All office interviewees were confident that the implementation of Nissan Production Way in a new Nissan Russia plant will work given the right support and the hiring of a good quality workforce. It is vitally important to not deviate from the Nissan Production Way otherwise the system will not work. All employees need to pull in the same direction.

Interviewees believe that initial hurdles related to culture (e.g. different mentalities) can be overcome through quality training. *Many thought that due to a clash of cultures in Japan and the UK the Japanese method of working would not translate successfully to a UK workforce. This was proven wrong"* (Office Interviewee). Before the Nissan Sunderland Plant opened there were jokes that employees would have to do Tai Chi every morning. In new implementations there may be some teething problems with staff acclimatising to a new way of working but the system is good and simple and is a common sense approach for managers to adopt.

The Trim and Chassis Line 2 Manager was of the opinion that it is healthy for each plant to have its own identity; each culture and country has its unique elements and Sunderland is no different in this sense. Interestingly it was claimed that different plants find different elements of the Nissan Production Way harder to cope with than others. For example, Japanese workers find the keeping work stations clean easier than the Nissan Sunderland Plant's workers. The manager was asked if the Nissan Production Way is a rule book. The response was to classify the Nissan Production Way as either a boundary or a framework. *"Generally speaking it is the constants that lay down the standards. I think that there is always scope for variation as long as you do not step outside the boundaries."* An example provided to support this point was of Nissan

Sunderland Plant slightly modifying Quality Control Stories, a fundamental tool of the Nissan Production Way. The tool was introduced as an eleven step process but the Nissan Sunderland Plant felt that one or two steps could be combined and made the decision to use an eight step process (four for minor problems). The Nissan Sunderland Plant has not stepped outside the boundaries of what makes Quality Control Stories work. Their changes are just *"one of the benefits of having a flexible system."*

When the Nissan Sunderland Plant first opened production staff would often stay back for twenty minutes to replenish stock and tidy up. However, the mentality of the workers at the plant has changed and this no longer happens (Production Interviewee). Workers in Japan have the attitude that staying late after work doesn't harm even though they are not getting paid. Whilst visiting a Nissan plant in Japan *"we used to come on to shift and there used to be lads still there working... You wouldn't get many people doing that here."* The plant used to be smaller and more like a family but *"it's a different environment we are working in now. When the buzzer goes the mentality is right I am getting paid now I am going out the door"* (Production Interviewee). One production interviewee claimed that the type of person employed by the plant has now changed as there is no longer as much chance to pick and choose. *"It's great to say this is how we are going to do this but when a lad is coming in straight away and sees others not doing it he says hang on why am I doing it if he is not doing it? You always get those who conform to it straight away and say that's my job and I will do it [and] will always get the ones who don't. It's difficult trying to get them doing it. Hard trying to motivate people to do it. You disagree with a lot of the things that happen now but you have to try and persuade people that its right even if you don't think that's right as it's your job."*

The following table (Table 4-7) provides an overview of the interviewees' insights and opinions regarding the Nissan Production Way.

Staff		What do you think makes the Nissan Production Way different to other car production systems?	What do you think are the biggest challenges in implementing the Nissan Production Way?
Production	TM	• It works • Workers are involved • Lots of training courses • Encouraged to put ideas forward	• Initial struggle as it is not easy • Have to involve everyone • Don't think management commitment will be a problem
	TL	• Most productive plant in Europe • Lots of improvement activities on the line • Continuously looking to improve • Probably similar tools but no other production system can be the same as we are doing better	• Easy to implement in a new plant • Keeping it going is often more difficult than implementation • Staff need to fully understand the system • Culture could have an impact • All we worry about is will they be taking our work off of us?
	S	• Everyone is involved • Synergy • We find the route of the problem • Standardisation and best practice • Staff can have an impact and make improvements • Some suggestions get through but often come forward as they think it is a waste of time	• Not a problem as long as people are trained well • All Nissan Production Way does is group all of the best practices under one banner • Would be more difficult in a brown field site than a green field site • Cultural problems was always the fear here but it works • It's difficult to maintain – you need to have people trained and setting the standards
	M	• We always try to develop, improve and benchmark • Nissan Production Way office in Japan plus regional employees responsible for the Nissan Production Way • Global information and idea sharing • Staff should be able to suggest areas for improvement but a recent survey suggests that they don't feel this way • Always scope for variation	• Have to be agile • Need to really understand the system • Quick responses • If you do not stay faithful to the production system you will fail • Temptation will be to take shortcuts • Healthy for plants to have their own identity
Office		• There may be similarities with other systems • Focus on the customer • Delivering the customer what they want when they want it • Widely recognised as the most productive plant in Europe • Mantra is quality driven, waste free • Differences are probably on a local level • Staff can have an impact and use their own ideas to benefit the Nissan Production Way	• Cultural hurdle – different methods may be used. Would other countries be as accepting of working weekends or short notice overtime? • Need good training • Culture isn't a 'stopper' – it worked here! • Need to buy into the system • Sells itself as good sense • Nissan Production Way is rigorous and well planned • Need good staff and proficient trainers

Key: TM (team member n=2), TL (team leader n=3), S (supervisor n=1), M (manager n=1)

Table 4-7 Nissan Production Way Overview

4.7 SUMMARY

The initial interview findings provide a good insight into the Nissan Production Way and the Nissan Sunderland Plant from an employee perspective. The Nissan Sunderland Plant is a successful exemplar Lean operation. The production system and the workforce appear to have contributed towards the plant's success. Nissan has become more cost focused since Carlos Ghosn became CEO of Nissan. The continuous strive to cut costs in a competitive market and the additional impact of the current economic climate may have taken its toll on the Nissan Sunderland Plant. A key Nissan Production Way principle is to reduce Non-Value Added Activities however underlying human issues would suggest that the Nissan Sunderland Plant may not be reducing Non-Value Added Activities in the workforce. Production workers appear to be coming increasingly negative towards the plant and its production system. Office interviewees appeared to be separated from the realities of the production line – production interviewees appeared to find it much easier to talk about the Nissan Production Way.

The Nissan Production Way is praised for being clear, straightforward and flexible. The interviewees do not consider culture to be an issue when implementing the Nissan Production Way. The main criticism of the Nissan Production Way at Nissan Sunderland Plant was that it works its employees very hard. There also appears to be issues with the training production staff are offered. Interviewees felt that the training was not always useful and lessons learned could not be used in practice as they were too busy and/or increasingly tied to the production line. Whereas the majority of interviewees have a 'general liking' for the products the plant builds the key decision factor for driving a Nissan was the deal.

The following chapter provides the results of in-depth interviews with Nissan Production Way Experts.

5 RESULTS: EXPERT INTERVIEWS

The initial interview findings suggested that the Nissan Production Way was primarily focused on technical elements rather than human factors. Office staff remained separated from the realities of working on the production line and those working on the line were increasingly tied to it. This chapter provides the findings from a detailed set of semi-structured interviews with the Nissan Sunderland Plant's experts on the Nissan Production Way. The methodology for this chapter is provided in Section 3.5.3 (p76). Interview transcripts (in note form) are provided in Appendix C (p252).

5.1 RESOURCE REDUCTION

Resource reduction is a crucial element of the Nissan Production Way. *"The Nissan Production Way promotes manufacturing with minimum resources"* the Nissan Production Way Handbook's opening gambit is to *"only give the customer what he is willing to pay for"* (Expert 1). The Nissan Production Way focuses on matching customer needs and providing the right specification, in part made possible by mass customisation; a high number of end derivatives are available to customers. Anything above the right specification is considered waste and surplus to requirements. The Nissan Production Way seeks to not only provide customers with exactly what they want, but to also provide it exactly when they want it. The Nissan Sunderland Plant's build-to-order percentage at the time of interview was over 90%. Their target is 100% build-to-order. Expert 1 claimed that build to order was at the forefront of the plant's business especially due to efforts to increase market share despite the economic downturn. The financial benefits of build-to-order compared to non-build-to-order could be around €348 per vehicle (Expert 1).

Build-to-order forms part of Douki-Seisan the Nissan Production Way's *ideal manufacturing system*. There are several Key Performance Indicators within Douki-Seisan. One of these is Delivery Schedule Time Achievement Ratio which compares delivery time against build time plus or minus a two-hour window. Delivery Schedule Time Achievement Ratio is measured daily. If performance against Delivery Schedule Time Achievement Ratio is below the required level an investigation takes place to identify reasons for failure and to put in place countermeasures. *"In effect that does reduce resources in building a car right first time – saves a lot of wasted resources such as time and materials to repair the vehicles"* (Expert 1).

The Nissan Production Way's main objective is to reduce the Total Delivered Cost, the overall cost of a completed vehicle. To do this the Nissan Production Way places a heavy emphasis on removing Non-Value Added Activities. This can include anything from costs to time and materials. The Nissan Production Way identifies a total of 17 wastes (table 5.1) which fall into three categories; (i) process waste (problems with paperwork, information, or time), (ii) business waste (non-value adding process time), and (iii) pure waste (waiting time, rework and faulty materials / processing). *"The key is to continuously examine the norm and not to rest on our laurels"* (Expert 3). One method of removing waste is Integrated Factory Automation which has a dedicated team focused on reducing headcount through use of low cost automation. Integrated Factory Automation tries to reduce Non-Value Added Activities by taking advantage of both volume increases and automation. This can include shuttles, part selection systems or Automated Goods Vehicles. This is measured through Design Standard Time Ratio which compares allotted time for a vehicle's build against actual build time. Design Standard Time Ratio is benchmarked with sister plants in the Renault-Nissan alliance.

Seven 'Original' Wastes	
Over Production:	Manufacturing too much; too early; or 'just-in-case'
Waiting:	Time not used effectively (working time, delivery time etc)
Waiting:	Unnecessary movement of product and people
Inappropriate processing:	Over engineering; over processing (adding too much value)
Unnecessary Inventory:	High lead times; excess working capital; poor layout; excess movement
Unnecessary Movement:	Ergonomics etc Relates closely to 5S workplace organisation
Defects:	Scrap; rework; delay; warranty costs; repairs
Ten 'Additional' Wastes	
Untapped Human Potential:	When you hire a pair of hands you get a free brain
Inappropriate Systems:	Waste automated into the operation through the management system or utilising computer systems such as ERP that may create Muda
Data Waste:	Waste caused by untimely, incomplete or inaccurate information (may be a root cause of many other types of waste)
Wasted Utilities:	Excessive or inefficient use of energy – electricity, oil, gas and water. Poor environmental impact
Wasted Materials:	(linked to 4 above) – waste created by inappropriate or inefficient design or engineering or over-processing
Wasted Space:	(linked to 1,3,5,6 and 7 above) – activities expanded into excessive space so impacting on costs and environment
Service and Office Waste:	Wasteful service and administrative processes
Waste of Customer Time:	Delayed delivery; customer queuing; repeated requests for information (e.g. telephone answering cascades). Invoicing errors
Waste of Defecting Customers:	Loss of existing customers. 'It costs 5 times more to acquire a new customer than to keep an existing customer'.
Culture Waste:	Waste caused by poor training or attitude of individuals (including managers and supervisors), high absenteeism and/or accident rates

Table 5-1 Nissan Production Way 17 Wastes

Non-Value Added Activities in production can be identified through process mapping which is used in the form of Douki-Seisan improvement. Within the Nissan Sunderland Plant there are a number of Improvement Engineering experts who are specially trained (in Japan) to perform this role. *"To us it is essentially Just-in-Time… that is quite often the starting point for whatever we do"* (Expert 2). The Nissan Production Way also utilises Statistical Process Control in addition to performing regular layout adjustments to reduce Non-Value Added Activities. For example, the Nissan Production Way Office has changed location within the plant every two years due to the previous space being valuable for other purposes.

Whereas inside the production environment the Nissan Sunderland Plant uses Just-in-Time, Kaizen and seven quality tools (cause-and-effect, control chart, Pareto chart, stratification, scatter diagram, histogram and check sheet), off the production line the Nissan Sunderland Plant has V-Up (Value Up) which Expert 3 likens to Six Sigma. V-Up is split down into two tools; (i) V-Fast, and (ii) V-Decide. V-Fast looks at issues that only require low levels of statistical analysis and are cross-functional. The focus is on the rigour of getting people together to collect data, brainstorm, create countermeasures and share information. V-Decide is more complex, can last between 3 – 6 months, and requires higher levels of statistical analysis, significant support and resources V-Decide is comparable to Six Sigma's D-make process and deals with cross-functional breakthrough issues with the aim to identify the problem, create a team to tackle the problem, identify the root cause and develop and evaluate a set of countermeasures.

Production supervisors have a high degree of responsibility for reducing Non-Value Adding Activities. The Nissan Production Way is *"about trying to get everything as tight as we can putting in the minimum and getting out the maximum to give it to the customer"* (Expert 2). There is a general focus within the Nissan Production Way to reduce resources by improving quality, minimising stock (including safety stock), and lower work-in-progress and reduce lead times. Expert 2 views the Nissan Production Way as a series of inputs, processes, and outputs. *"If you don't use the right system in the middle you are not going to be successful and we are not going to be here"* (Expert 2).

In 1985 when the Nissan Sunderland Plant opened Just-in-Time, Total Preventative Maintenance, Quality Control Stories, and Genba Kanri were already in use but today these tools, and other Nissan Production Way tools, are considered to be part of the Nissan Production Way toolbox. An emphasis is placed on using the right tool for the right job. At the lowest level the Nissan Production Way uses 2-hour Kaizen activities,

or a 2-day Kaizen which will focus on resolving a small problem. Quality Control Stories are either 8 step or 11 step processes that incorporate various tools and techniques based around Plan-Do-Check-Act. The basic concept is that a team is brought together (can be cross-functional depending on problem) to tackle an identified problem and go through the rigour of Plan-Do-Check-Act to create a solution. *"Quality Control Story is not a Nissan technique – almost every company in Japan uses it along with the seven tools"* (Nissan Production Way Expert). All of the tools and techniques present in the Nissan Production Way are considered to be part of the Nissan Production Way Toolbox. Employees have the right tools inside the toolbox to allow them to follow the Nissan Production Way. There is a big emphasis on using the right tool for the right job. *"We match the tools to the level and significance of the problem and this is key to how it all works and pulls together. We do not use Six Sigma to do everything – we know which is the right tool to respond to each issue but of course you must still be able to identify the issues in the first place"* (Expert 3).

Kaizen / Continuous improvement[1]	Work force reduction
Just-in-time[24]	Root cause analysis (5 Whys)[31]
Setup time reduction	Value stream mapping / flowcharting
Small lot production	Lead-time reduction
Waste elimination	Kaizens / Kaizen events
TPM / preventative maintenance	Profit over employee welfare[38]
Improvement circles[30]	Build-to-order[40]
Employee involvement[32]	17 Wastes[41]
Teamwork[28]	Internal competition between plants
Layout adjustments	Ergonomics[45]
Takted production	Six sigma[47]
Autonomation (Jidoka)[33]	Toolbox thinking[48]
Statistical quality control / SPC	Genba Kanri[51]

Figure 5-1 Resource Reduction NPW Elements
See Appendix A (p241) for notes

5.2 PRODUCTION MANAGEMENT

The Nissan Production Way is a cellular manufacturing system working on a pull (rather than push) system. *"It's a bit of a weird one as we have continuous production lines but in true theory its cellular in the sense that people would understand it"* (Expert 3). Production is organised into shops which are further broken down into zones (cells). The main shops are Press, Body, Paint and Trim and Chassis. Each has their own structures and specialised process but they all know the customer requirements (delivery, quality etc.). Production is smoothed and levelled across 24 hours. One problem prevalent at the time of interview was the disparity between diesel and petrol engines. This is further complicated by multiple engine variants when one (or both) of the production lines are building multiple models.

Visual management exists at all levels of the Nissan Sunderland Plant. An importance is placed on employees understanding where they contribute to the overall plant objectives (Hoshin Kanri). The Nissan Production Way tries to give ownership to employees through employee participation. In the Genba Kanri audit conducted before the interviews *"one shop had a list of 70 ideas in a zone they were going to try and implement for improvements"* (Expert 2).

The Nissan Sunderland Plant maintains on-site human resources, engineering, production control, maintenance and quality departments along with a small amount of local purchasing and finance. Purchasing is primarily based at Nissan Technical Europe (Nissan Technical Centre Europe) in Cranfield which Nissan considers to be close and interlinked with the Nissan Sunderland Plant. IT services are based in Nissan Europe, France. Within the Nissan Sunderland Plant there are working level groups, steering groups and steering committees which *"discuss performance indices relating to the Nissan Production Way"* (Expert 1). Expert 1 conducts monthly meetings with production shop managers specifically related to Nissan Production Way activity.

Most the production line is synchronised, viz, parts arrive on the line Just-in-Time and in the correct sequence. For example, on mixed-model lines the correct exhaust will be ready in sequence for the worker to pick up and fit. The exception to this rule is the plant's limited number of batch shops, some of which are unable to be synchronised with the line. A recent Nissan Sunderland Plant expert training course in Japan focused on how to improve batch shops to work more in sequence with the main line. There was a focus on information, timing, reducing stocks and delivering to the main line. Although synchronisation is part of Douki-Seisan (ideal manufacturing system), in practice there are barriers. Expert 2 is involved with sharing ideas, and reporting the status of batch shops in company global e-rooms. Global e-rooms exist to share information across Renault-Nissan plants on Nissan Production Way, and other issues. *"The sharing of our position is something that is monitored on a regular basis in the batch shops where we have to define what level we are at and how we sequence with the main line. So it's something all plants are evaluated on essentially"* (Expert 2).

Just-in-Time is described as being *"one of the most used tools on the shop floor because it can be very simple"* (Expert 2). The Nissan Sunderland Plant maintains very low levels of inventory and receives frequent deliveries Just-in-Time with sequenced parts (i.e. door pads and seats) delivered by local satellite suppliers. *"You are looking at no more than two hours' worth of stock on site"* (Expert 3). A number of the Nissan Sunderland Plant's suppliers are classed as CAT3; they make to order rather than making to stock. These CAT3 suppliers are based both in the UK and abroad. Parts not originating from local suppliers are delivered into the plant from local warehouses owned by third party logistics companies. In most cases the stock is not owned by the Nissan Sunderland Plant until it is delivered to the site. *"That means we do not have high stock levels, don't have to pay for all of that. From a supplier point of view they are still shipping in batches…*

our whole methodology with supply is truly Just-in-Time. The way we run all of our internal shops is truly Just-in-Time as well" (Expert 3).

Kanban / pull system	Cellular manufacturing
Production leveling (Heijunka)$_{25}$	Policy deployment (Hoshin kanri)
Inventory reduction	Process Synchronisation$_{34}$
Visual control and management	Limited batch production$_{49}$
Employee involvement$_{32}$	Genba Kanri$_{51}$
Time/work studies$_{27}$	

Figure 5-2 Production Management NPW Elements
See Appendix A (p241) for notes

5.3 SUPPLY CHAIN MANAGEMENT

Nissan Sunderland Plant's suppliers are offered support and training to learn Nissan Production Way management techniques. *"We give them encouragement, do benchmarking with them, offer them the training and tools but can't force them to do it"* (Expert 3). Suppliers have to commit to cost reduction - they play a large role in the Nissan Production Way's effort to reduce Total Delivered Cost. *"I think an interesting thing is that in the last few years with the squeeze on ourselves to make things cheaper the squeeze goes onto suppliers to make things cheaper"* (Expert 1). The Nissan Sunderland Plant's supplier support programme, Alliance Supplier Improvement Programme, helps first tier suppliers to improve their processes, develop their product, deliver a cheaper product and meet their productivity costs and targets. "*We don't just demand it from them we go in and help them achieve it as well"* (Expert 1).

The Alliance Supplier Improvement Programme has included transferring practices to first tier suppliers. For example, Calsonic Kansai was introduced to Improvement Diagnostic System. *"You could see they all knew places around their workplace where these opportunities were but they obviously struggled to get them down on paper and convince the powers that be in their organisation that actually if you can let us invest the*

time, manpower and cost into this we will get the savings out of it" (Expert 2). The Improvement Diagnostic System is a computerised measurement system which identifies capability of manufacturing a product as well as focusing on the role of the supervisors and their capability to deliver. All manufacturing Kaizen activities are managed through the Improvement Diagnostic System. Results are logged and shared across the Renault-Nissan alliance. *"It is a proper family sharing information"* (Expert 3). Calsonic Kansai and Unipress are examples of long-term suppliers who have embraced the Nissan Sunderland Plant's way of working and have developed their own versions of the Nissan Production Way. *"They have embraced it [Improvement Diagnostic System] as a measurement tool they can use to quantify performance"* (Expert 1).

0.5 tier suppliers are those who are based on-site and integrated into the production process. This includes suppliers who are based in the centre of the production line. 0.5 tier suppliers work the same hours as Nissan Sunderland Plant staff and adopt Nissan Sunderland Plant practices including 5S and visual signage. It is considered important to implement 5S in all areas on-site including on-site suppliers. *"If we tidy our areas and they don't what's the point in doing it? Our staff will instantly see that their staff are not doing it and say why are they not doing it if I have to do it – it won't work"* (Expert 2). 0.5 tier suppliers can also take part in courses run by the Nissan Sunderland Plant's training department and in many cases, have actively participated. The interviewees acknowledged the risk suppliers take in relocating to the Nissan Sunderland Plant. The plant works hard to accommodate the suppliers ensuring that there are adequate staff facilities. Most Nissan Sunderland Plant staff view 0.5 tier employees as part of the Nissan Sunderland Plant team, rather than employees working for another company.

The Nissan Production Way includes its own version of value stream mapping *"but it is not the type of value stream mapping say you would see if you went out and bought a*

book" (Expert 2). Expert 1 claimed that the Alliance Supplier Improvement Programme team perform value stream mapping and flow-charting. *"Improvement Engineering experts really live within the Alliance Supplier Improvement Programme function"* (Expert 1).

5S/Housekeeping	Global idea and information sharing
Supplier involvement	0.5 tier (on-site) suppliers
Visual control and management	Joint supplier-plant training[42]
Value stream mapping / flowcharting	Decision Analysis[44]

Figure 5-3 Supply Chain Management NPW Elements
See Appendix A (p241) for notes

5.4 STANDARDISATION, DEFECTS, AND IMPROVEMENT

A large degree of emphasis is placed on standardisation. The Nissan Production Way aims to identify best practice and standardise across the plant. Standard operations are created to ensure that tasks are carried out in the safest and most efficient manner. Standardisation also helps in ensuring working practices across the site are uniform and allow for easy movement of staff. *"We look for standardisation continuously"* (Expert 3). For example, 5S (workplace organisation) and Genba Kanri (workshop management) is cited as a standardisation tool implemented plant-wide (including 0.5 tier suppliers). Standard Operations exist to inform operators and document how to build Nissan Sunderland Plant's vehicles. There is a standard format and method to be used when writing standard operations. *"For example in terms of splitting the operation up into its main steps, identifying key points by underlining them, putting the reasons for these key points in brackets, all of that is a global standard"* (Expert 1). All supervisors are trained to write standard operations to global standards and are issued with a three year standard operations licence. 5S also has a standard training plan, standard criteria and evaluation system for maintaining 5S. "*I think it is down to the fact that we have very clear policies and guidelines for everything we do and those are reflected away from*

manufacturing areas in Indirect Operations Sheets" (Nissan Production Way Expert). Indirect Operation Sheets provide the process flows of what you should do and who you should contact. Clear communication is considered vital and this includes using language, and terms, understood by all employees. For example, on objective deployment boards the Nissan Sunderland Plant tries to ensure that the language used is understandable to all who read it.

Training both on and off the production line is standardised. New operators, including temporary staff, are trained using a standard 21-day model. Trainers are trained using standardised documents and training programmes. Guidelines exist for how long it should take to fully train an operator (approx. 10 – 15 shifts) but it does not matter if training takes longer. *"At the end of the day if they are capable and confident [that's all that matters]"* (Expert 1).

Nissan Production Way improvement tools and techniques include Total Preventative Maintenance. Just-in-Time, Quality Control Story, and Kaizen activities. *"To promote and maintain these tools we tend to say keep your tools sharp"* (Nissan Production Way Expert). An example of which is the annual Quality Control Story competition where winners flew over to Japan to present their activity in a global competition. On a bigger scale Nissan Production Way includes Hoshin Kanri (policy deployment) part of which is the development of strategies and the identification of key business objectives. These objectives are typically breakthrough items Nissan Sunderland Plant need to do over 12 months. To support these efforts Nissan Sunderland Plant can use any of the tools from the Nissan Production Way toolbox including brainstorming and affinity diagrams.

The Nissan Management Way is a subsection of the Nissan Production Way and *"is essentially Total Quality Management"* (Expert 1). The Nissan Management Way focuses on customer satisfaction, a key measure of quality for the Nissan Sunderland Plant. Real time systems involving both customers and dealers provide information about vehicle concerns to a European database. This database also gives the plant access to information on trends. Faulty components are retrievable for inspection, the results of which are discussed with the supplier or internal plant area which caused the problem. *"From a customer point of view we have our finger on the pulse, know exactly what is happening out there and we can react to that very very quickly and get robust countermeasures in place"* (Expert 3).

All vehicles are put through a comprehensive evaluation system at the end of the production line. This includes a series of road test checks on an outside surface road and inside a roller booth. Visual and dynamic inspections also take place. Vehicles are also selected at random and checked *"against a known set of standards of expectations of a customer. [Results are] fed back in real time across the plant"* (Expert 3). The Nissan Production Way also includes vehicle and process quality assurance, inspection standards and on-going audits (includes audits for torque and appearance). Due to the number of parts Nissan Sunderland Plant receives there are no goods inward inspections. The plant does however have the ability to intercept known defect deliveries. The Nissan Sunderland Plant relies on high quality suppliers meeting, or exceeding, stringent ratio targets to ensure that components are of a high quality. Suppliers are monitored on scorecards and are subject to rigorous capability type audits which look at their quality management systems, capability to develop products, capability to continuously improve their own systems, and their focus and ability to analyse warranty and customer complaints.

One of the initiatives Nissan Sunderland Plant are currently looking to introduce is a quality assurance matrix. This was highlighted in a global Genba Kanri audit. The quality assurance matrix will have details all of the quality checks carried out within the plant. This would include general information and characteristics, how important it is (i.e. Important A can it cause death), how it is checked and by whom, where and how is it checked (Standard Operations) and how many times should it be checked (Important A should be checked three times or 300%). The Nissan Sunderland Plant states that it is also important to recognise that an operator can only physically carry out a certain number of checks before it becomes impossible to complete tasks or perform checks correctly. Quality checks should therefore be reduced by using measures including Poka-Yoke and closed loop fault detection. The ideal is for automation to take away the need for an operator to perform checks. For example, when fitting wheels, the machine puts a yellow die on the wheel when the torque is achieved. If the torque isn't achieved the line is stopped.

Neighbourhood checks are an important Nissan Production Way quality check. The following operator will check to see if the part is fitted and functioning correctly. At the end of each zone a check and repair operator examines all of the components fitted in the zone. Where possible defects are fixed on the spot or are otherwise flagged for repair. The check and repair operator job rotates between different team members.

The Nissan Sunderland Plant uses Andon cords and help cords. *"In the majority of shops the first port of call is the help line which pulls off a siren – the operator does that"* (Expert 2). A team leader or supervisor will then come to assist the operator. In most cases the team leader or supervisor will take over the job on the problem car whilst the operator starts on the next job. The team leader or supervisor can then decide to stop the line if needed. Any operator can stop the line if there is any health and safety issue.

There are two team leaders and a supervisor on each shift for each zone and all members of staff are made very clear of their roles when things do go wrong.

There are several measures in place to identify, stop and fix defects. Quick Response Quality Confirmation is the Nissan Production Way's quality management activity on the shop floor. *"We have lots of policies and procedures for managing outflow of quality defects more importantly for monitoring occurrence and effectiveness of countermeasures"* (Expert 1). As previously mentioned Poka-Yoke and low cost closed loop fault detection are also measures to prevent defects. Examples include the plant's robots which have proximity sensors to ensure parts are picked up correctly and the use of closed loop measurement systems in the machining environment (if tolerance levels are not met the machine will stop). Similar systems to the machining environment can be found in the axle shop. Most of the automation is directly linked to maintenance which is informed of any problems and reacts accordingly. Expert 3 classed Nissan Production Way's automation as "autonomation" (automation with a human touch).

Kaizen / Continuous improvement[1]	Root cause analysis (5 Whys)[31]
Just-in-time[24]	Policy deployment (Hoshin kanri)
5S/Housekeeping	100% inspection[29]
Poka yoke[4]	Customer focus/involvement
Standardised work[26]	Total Quality Control
Andon	0.5 tier (on-site) suppliers
TPM / preventative maintenance	Ergonomics[45]
Improvement circles[30]	Production methodology used in indirect areas[46]
Education / cross training (OJT)	Toolbox thinking[48]
Autonomation (Jidoka)[33]	Genba Kanri[51]

Figure 5-4 Standardisation, Defects, and Improvement NPW Elements
See Appendix A (p241) for notes

5.5 HUMAN RELATIONS

There are a small number of job titles used at the Nissan Sunderland Plant. These refer to an employee's seniority rather than the job itself. The plant is split into two distinct areas; (i) direct / production, and (ii) indirect / office. Where plant functions require staff to work both directly and indirectly these jobs are considered to be semi-direct. All staff have a yearly appraisal linked to merit payment and a mid-year (6 month) review. This process includes a Continuous Development Plan where both employee and manager suggest opportunities for improvement and further training. Performance is measured against the 5 mind-sets and 5 actions of the Nissan Way which include motivation, commitment and targets performance, being fugal, transparent and cross-functional. Continuous Development Plans generally include the specific skills needed for a particular role or function. Through this process employees can request to attend additional training or revisit training courses. Opportunities also exist to study for job relevant external higher education courses including degrees, masters or research degrees. The Nissan Sunderland Plant funds 80% of the course fee but the employee must study in their own time; no paid study leave is given. The interviewees did not indicate whether the funded higher education opportunity was also available to direct staff.

There are no opportunities for extended leave for travel. All three interviewees agreed that such an opportunity doesn't exist. *"It's quite frowned upon really as we are quite Lean on headcount so we don't want anybody out although we are quite flexible and we do job share and things like that... We tend to not encourage people going on year sabbaticals and things like that – it is frowned upon to be honest"* (Expert 3).

The Nissan Sunderland Plant's disciplinary procedure is administered by the Nissan Sunderland Plant Human Resources department in line with Nissan Sunderland Plant

terms and conditions. Both the single union and company council (which is formed of elected representatives) have a degree on input in the disciplinary process. A fact-file system allows superiors to record both negative and positive employee observations on a monthly basis. This fact-file builds a picture of employee's achievements and is used at appraisal.

To effectively manage staffing levels (and reduce idle working hours) the Nissan Production Way has a flexible workforce. This allows the plant to both stand-down at times of low demand and stand-up at times of high demand. This includes short-notice overtime after their main shift or on a Saturday. Overtime / stand-ups can be offset, to a certain extent, by stand-downs. The flexibility the plant has is governed by an agreement with its employees which, at the time of interview, had been recently reviewed and made more flexible in light of the challenging economy. There is also a mix between permanent and temporary staff. The levels of temporary staff are adjusted according to demand with previous workers' details kept on file to allow hiring at short notice if needed.

In the first quarter of 2009 Nissan Sunderland Plant announced that they were to shed 1200 jobs as a result of the economic downturn. Six months prior to this decision the plant had hired between 1000 – 1200 employees and extended production on its popular Qashqai model from two shifts to three shifts. Expert 1 was asked for the reasons behind this decision and how it was carried out. *"We ended up with a surplus and had to embark in what we call right sizing for the business environment"* (Expert 1). The process of lowering staff levels was primarily focused on early retirement and voluntary redundancies with the exception of temporary staff with fixed term contracts. The process was described as being *"very very difficult"* (Expert 1). Surplus labour was kept for up to six weeks. *"This particular incident (the economic downturn)*

caught us unaware – we probably wouldn't have released the number of people we released if we had known about the scrappage allowance incentive scheme" (Expert 1). The Nissan Sunderland Plant had to rehire 400 employees in a short space of time to cope with the increase in demand caused by the incentive's introduction. The high level of resources needed to train these new people meant that the task was *"quite painful [and] very very difficult"* (Expert 1). Whereas Expert 1 had no direct experience with the layoffs it was his/her opinions that for many permanent employees it offered early retirement, or a lump sum voluntary redundancy, and the opportunity to move onto something new. However, it was acknowledged that the situation for temporary staff was not good. There were many emotional discussions with temporary workers focusing on their financial commitments. *"It is not a good situation but unavoidable"* (Expert 1).

The current and previous MD of Nissan Sunderland Plant both rose through the ranks. There are promotion prospects within the Nissan Sunderland Plant however, the high potential of many of its employees, particularly those hired in the initial intake, has resulted in a high degree of competition for promotion. There are also fewer opportunities as employees often work for the Nissan Sunderland Plant for a large portion of their careers. *"Clearly you are not going to recognise all of that potential as the jobs are just not going to be there"* (Expert 3). The Nissan Sunderland Plant uses succession management planning and offers the opportunity for employees to demonstrate their potential in a temporary position. If a position is becoming vacant temporary positions (at any level of seniority) allow interested employees to test-run the job to see if they can cope and also enjoy the position. Temporary positions also give managers the chance to see an employee in the role before making a decision on a suitable candidate. As a result of this system promotion generally comes from within. The Nissan Sunderland Plant recognises potential by giving employees additional

responsibilities or standing them into a higher profile position. High potential people are moved around departments to aid in their development and overall knowledge of the plant.

Full employee value is achieved through clear communication of job roles, the Nissan Production Way and a focus on an employee's actual contribution. Operators are unlikely to know everything about the Nissan Production Way but will fully understand their job role and what is expected from them. *"Having that right character is key to it all working. What you don't want is someone with a PhD working on Trim 1 fitting headlamps – it just doesn't make sense – that person would very quickly be bored out of their mind"* (Expert 3). Supervisors are responsible for choosing new recruits which will fit into their team. Teams also need to be dynamic and include high potential staff who can think outside of the box. Those who have high potential are often challenged to find a solution to a current problem. The key is to develop these individuals by through moving them around, building skills, business acumen, Lean acumen, and product knowledge. *"I think [getting the full value from employees] is about involvement, managing expectations, selecting the right people, being realistic in what they can achieve because ultimately we build cars – we are not building rockets and we are not going to Mars"* (Expert 3).

Employees are primarily rewarded through merit payments awarded during annual appraisals. Whereas individual rewards for ideas do not exist there is team based recognition where a team is rewarded with nights out or new rest area equipment for solving problems or performing well. *"I don't think we are like in Japan where I have heard tales of competitions and if [they use your idea] you get 10% of the savings. We are not about that – it's about the way you are working – you are here to work for the company and you will get recognition in other ways for doing what you do"* (Expert 2).

The Nissan Sunderland Plant does not have a formal rolling suggestion scheme. Instead suggestion schemes are launched sporadically due to the volume of suggestions received and the work required to deal with these suggestions. There is a call for suggestions annually which coincides with company objective setting. Each operator is expected to generate ideas for improvement and has a target for the number he/she should raise.

Further rewards have been made through 5S application and Quality Control Story competitions. The global Quality Control Story competition was however stopped due to the global financial crisis. Workers can be recognised through the company magazine, intranet articles, idea sharing, and through turning their solutions into best practice. *"To some people that is enough to be honest"* (Expert 3). Recognition can also be made through the company's monthly DVD communication, team photographs and certificates.

Quality Circles are included in other initiatives such as Quality Control Stories. The Nissan Production Way makes good use of cross-functional teams and views the supervisor as *"the MD of his zone"* (Expert 2). The supervisor is responsible for everything from hiring to firing, quality and cost. Team atmospheres vary as supervisors have their own management styles, preferences and personalities. Manufacturing staff are involved in Kaizen activities at a local level focusing on identifying possible improvements for their zone, cell or team. *"That tends to be the main involvement from an operator point of view"* (Expert 3). Team leaders and supervisors are involved in larger scale Kaizen activities. 5S audits and Quality Control Stories also include the involvement of manufacturing staff in addition to the Zero Injury Programme (ZIP). ZIP involves weekly behavioural audits in which staff are taken around processes to identify unsafe behaviour. Staff involvement in Quality

Control Stories was *"not just involvement for the sake of involvement – they do add value to a lot of the activities they are involved in"* (Expert 1).

"We have seen over the years that you can have the most cynical guy [but when] his idea gets implemented all of a sudden he is over the moon and takes ownership and will be telling the lads on the other shift... you don't be messing that!" (Expert 2). The Nissan Sunderland Plant aims to involve employees in all Nissan Production Way activities however it is difficult to find time to involve staff and conduct improvement exercises. The Nissan Sunderland Plant builds a lot of cars and staff often work overtime. The problem with working lots of overtime is that *"guys don't get the time... it's either done through overtime on the weekends or not done at all. So you tend to find that the team leaders and supervisors are the ones that do the majority of the project and improvement work. Although even when they are doing it they still have regular discussions with the operators to get their views"* (Expert 3).

Kaizen / Continuous improvement$_{1}$	Single / no unions
5S/Housekeeping	Employee development$_{50}$
Education / cross training (OJT)	Performance appraisal for all$_{37}$
Root cause analysis (5 Whys)$_{31}$	Flexible working agreements$_{39}$
Kaizens / Kaizen events	Few job titles
Managerial job rotation	Team based recognition$_{43}$
Job rotation	Decision Analysis$_{44}$
Seniority	Line experience for indirect employees
Company council or similar	

Figure 5-5 Human Relations NPW Elements
See Appendix A (p241) for notes

5.6 Other Features / Components

Interviewees were asked whether any Nissan Production Way components are recognised as add-ons rather than being part of the core production system. *"Total Quality Management was an add-on in the sense that we already had some of the pillars of Total Quality Management but we didn't recognise it as a Total Quality Management*

methodology so a lot of the add-ons, a lot of the pillars were not linked" (Expert 3). V-Up was also claimed to be an add-on and not a companywide understood component. Tools which were not initially part of Nissan Production Way have been added on, incorporated and often become common sense everyday tools integral to the system. Improvement Diagnostic System and Integrated Factory Automations could be seen as add-ons but are in fact central to the Nissan Production Way's objective of transforming inputs into a valuable output. *"The Improvement Diagnosis System is something that was developed within Nissan Sunderland Plant and blended into Nissan Production Way. It does not exist in any other Nissan plant. It is a variation of Just-in-Time – a little bit more detailed"* (Expert 1).

Not all of Nissan Production Way's current components have been part of the system from the introduction of Nissan Production Way at Nissan Sunderland Plant. Whereas tools including Just-in-Time/Kaizen, 7 tools and Plan-Do-Check-Act were *"the tacit knowledge that our Japanese gurus brought over"* (Expert 3) tools such as Improvement Diagnostic System, Hoshin Kanri and Total Preventative Maintenance were only fully implemented at a later date. *"So it has been a growing, developing, nurturing type of approach. We have put things in place, standardised them, got them to work and progressed further – we don't progress further until we know what we have put in place works. I think that is the way that we have developed"* (Expert 3). Genba Kanri for example has been in the Nissan Production Way for around 15 years but was re-launched and re-packaged six to eight months prior to the interviews taking place. One interesting point was raised about the addition of an expert training course in Japan 10 – 15 years ago. Previously *"it relied on people who had been in the company 30 – 40 years just having the knowledge"* (Expert 2). A 3S system was also in place for over 15 years before it was replaced by 5S.

Just-in-time$_{24}$	Total Quality Control
TPM / preventative maintenance	Decision Analysis$_{44}$
Policy deployment (Hoshin kanri)	Genba Kanri$_{51}$

Figure 5-6 Other Features / Components NPW Elements
See Appendix A (p241) for notes

5.7 ADDITIONAL INFORMATION

The Nissan Production Way is largely standardised across plants with some modifications to suit culture. The types of differences could involve changing the frequency of an activity *"but essentially it is the same"* (Expert 1). Nissan's Russia plant, under construction at the time of interview, will not be implementing Douki-Seisan or building synchronously. Chinese plants may have a higher staff count due to lower wage costs. *"There are various bits and pieces where ideals and methods will change but as a concept, as a logic, it is the same pretty much globally"* (Expert 2).

The Nissan Sunderland Plant's company council is elected by its employees. Elected members do not need to be a member of the union. Union membership is optional for all Nissan Sunderland Plant employees. Membership is around 30 – 35% of the workforce. *"From a negotiation point of view the company council does all of the negotiations. They do not have the traditional impact that unions have"* (Expert 3).

Interviewees were asked if they would like to share any of their personal opinions with regards to the Nissan Production Way's long term viability. All spoke passionately about the Nissan Production Way and were positive of a long term future for the system. There are still some real issues that need to be resolved. There is a danger of the plant believing the hype surrounding the Nissan Sunderland Plant and that does require a reality check. *"There are some elements of our business that I think we are not very good at... I am not comfortable that everything is rosy in this garden – far from it"* (Expert 3). The negativity shown throughout the pilot interviews for this research

around recognition and training was discussed with Expert 3. *"That's the type of thing I am saying about change management and when you get into that you realise that there are pitfalls and issues"* (Expert 3). It was agreed that there is a lot of negativity some of which was attributed to the high degree of competition for promotion and the feelings of those who don't manage to secure the promotion. However, it was also acknowledged that in terms of negativity at Nissan Sunderland Plant *"there is much more than that - it goes deeper than that"* (Expert 3).

The high degree of competition between internal plants and competing manufacturers has made it essential for the Nissan Sunderland Plant to remain competitive. *"We have to continue to compete otherwise we will not be here and don't forget ten years ago we have been at the brink of survival – I mean we have learnt some valuable lessons from that"* (Expert 1). Expert 1 felt that the plant was the strongest it has ever been. Paraphrasing Carlos Ghosn (current CEO and President of Renault and Nissan) Expert 2 quoted a speech made by Ghosn in reference to the recession. *"He almost said it's not going to be pretty, it's not going to be nice but at the end of this recession there will be some companies that aren't there and there will be some companies that come through it Leaner and we have to make sure that we are one of the companies that is Leaner*." Flexible working hours is not a popular policy as it can require staff to work on Saturdays during the summer when it is hot and stand-down on Fridays in the winter when the weather is not good. *"It is not ideal but as a company we are Leaner and doing more with what we have got and obviously not everyone is going to be happy but I think overall it is a positive situation we are in at the moment – touch wood everything keeps going right"* (Expert 2).

Single / no unions	Flexible working agreements[39]
Profit over employee welfare[38]	Internal competition between plants

Figure 5-7 Additional Information NPW Elements
See Appendix A (p241) for notes

5.8 SUMMARY

The whole Nissan mantra is focused on a high degree of competitiveness and the focus on survival. Competitiveness extends from external companies to plants within Nissan and Renault. There is a need at one level to survive as a firm and share information for the good of the company but on another level survive as a plant. Results from the three interviews would suggest that this leads to a strange situation where interplant sharing is encouraged and wilful but at the same time used as a way to showcase achievements and, ultimately, compete. At the time of interview a 130 item list of the best ideas every plant should consider implementing was published. *"Instantly the first thing everyone did was to look down and see how many of them are ours, how many they (other plants) have got – why have we not got as many as them – oh we have got more than them so that's alright then isn't it?!"* (Expert 2).

The expert interview findings focused on extrinsic motivators including team-based rewards and merit payments made through appraisals. The findings also suggested that Nissan Sunderland Plant's staff received a highly competitive wage, a reason why employees remain with the plant for the long-term. However, the interviewees did not discuss intrinsic motivators in any detail. Similarly, the initial interviews (Chapter 4) also found there to be a lack of focus on intrinsic motivators. This raised the question as to whether the Nissan Production Way is intrinsically motivation which forms the basis of the Motivation Survey the findings of which are detailed in the following chapter.

6 RESULTS: MOTIVATION SURVEY

Garrahan and Stewart (1992) argue that there is a human cost to the Nissan Production Way and a strong focus on fighting for job security. Similarly other academics have also argued that Lean can be 'mean', creating an illusion of employee empowerment, whereas decisions to increase efficiency can be to the detriment of employee welfare (Mehri 2006; Carter et al. 2011b; Jones et al. 2013). The initial and expert interviews highlighted a potential focus on extrinsically motivators with little focus on intrinsic motivation. This is in contrast to our current knowledge of Lean which posits intrinsic motivation, or respect-for-humans, as a key element of Lean. The opportunity to further exploit the access granted, and to obtain a more rounded view of Lean at the Nissan Sunderland Plant, resulted in a small-scale exploratory survey, using an adapted version of the Job Classification Model and Job Diagnostic Survey (see section 3.5.4: p81), to further understand the levels of intrinsic motivation at the plant. This chapter details the findings of the motivation survey. A full copy of the survey can be found in Appendix D (p263). The raw data is provided in Appendices E (p265) and F (p277).

6.1 BIOGRAPHICAL DATA

Out of a total of 40 participants 5 were female and 35 were male. The majority of participants classified themselves as either working directly on the line, or indirectly working on the line (73%). Of those surveyed 38 were team members with the remaining two holding the ranks of Team Leader and Senior Supervisor.

The majority of participants fell into the 16 – 25 and 26 – 35 age brackets. There were no participants aged 56+ in this survey. 42% of participants had worked for the plant for under 5 years, 35% for between 6 and 10 years, and 23% had a tenure of over 10 years. The correlation between age range and tenure at plant is shown in figure 6-1.

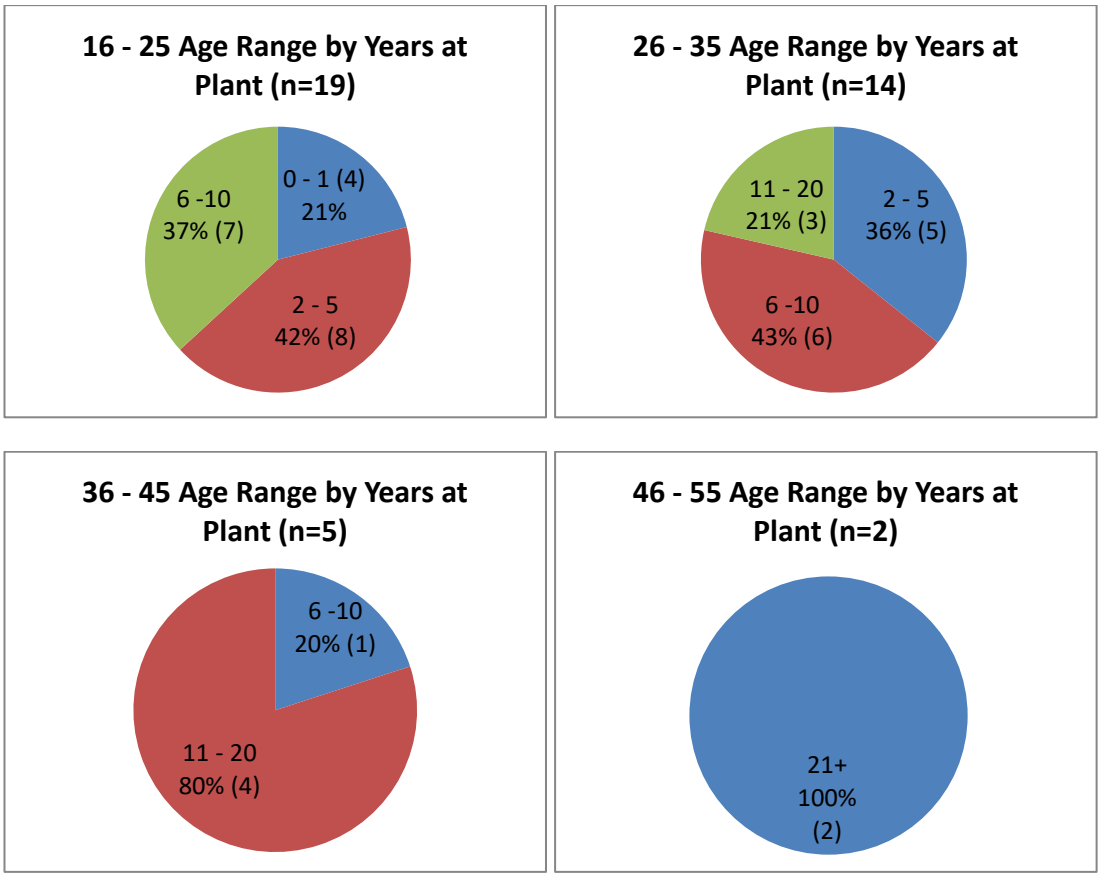


Figure 6-1 Participant tenure compared to age range

6.2 Core Job Dimension Findings

The core job dimension findings (skill variety, task significance, task identity, choice autonomy, responsible autonomy, and feedback) are presented in the following subsections. For each variable there is a positive and negative statement. The scores for both of these statements are combined and presented as mean scores for the variable. Overall scores for the construct are detailed and discussed in Motivating Potential Score calculations. Appendix E (p265) provides the raw data for both the individual statements and combined values.

6.2.1 SKILL VARIETY

The following four statements were included in the survey to assess Skill Variety.

SV1. The job requires me to use a number of complex or high level skills

SV2. My job is repetitive

Note: Opposite / negatively worded version of SV1

SV3. There is a lot of variety in my job

SV4. My job is the same and never different

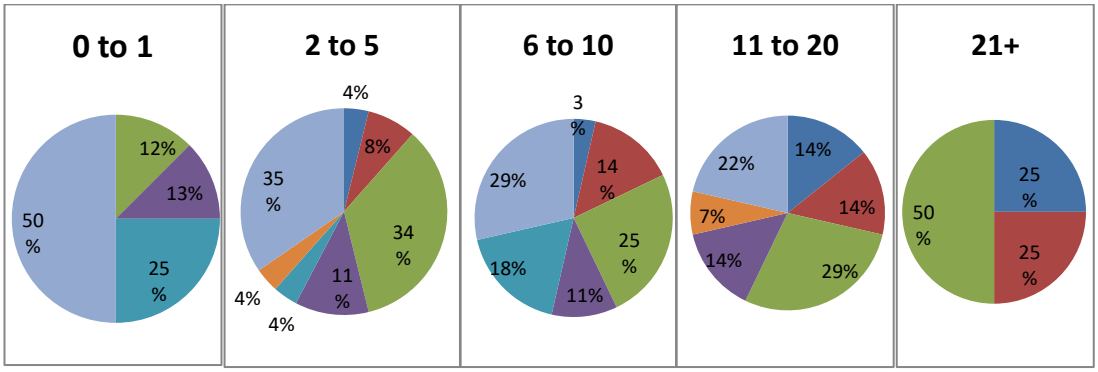
Note: Opposite / negatively worded version of SV3

SV 1&2 aimed to identify the extent to which participants agree that their jobs are not repetitive. 43% agreed that their jobs are not repetitive, 46% disagreed, and the remaining 11% were neutral or of no opinion. Participants with shorter tenures found their jobs to be more repetitive than those with longer tenures. Similarly younger participants were more likely to disagree that their jobs were not competitive than their older colleagues. This could be due to the employees' need to undergo training and gain experience before increasing the variety of jobs they are able to perform. Additionally, there could be an element of adjustment whereby employees' expectations are adjusted over time to better match the realities of the plant.

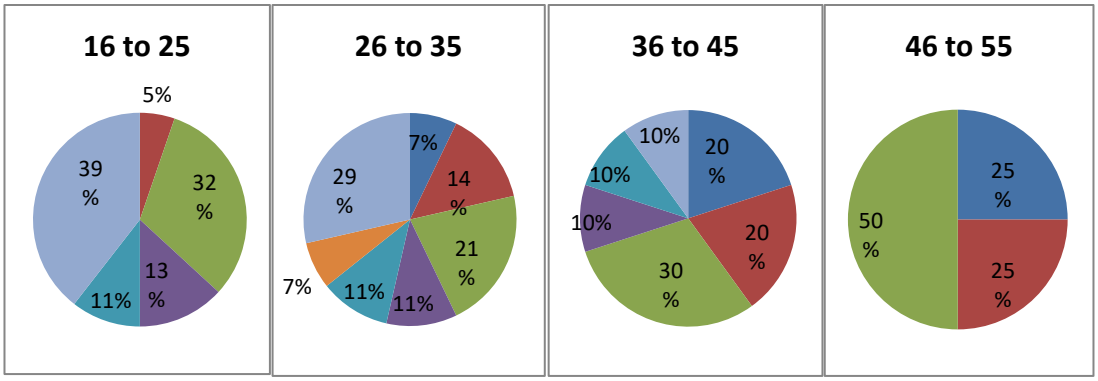
Finally, those working directly on the line were more likely to disagree that their jobs were not repetitive. Semi-direct employees on the whole agreed that their jobs were not repetitive whereas Indirect employees unanimously agreed that their jobs were not repetitive. This suggests that as involvement with the actual production line increases perceptions of repetition increase. This correlates with the initial interviews where direct staff claimed that they were increasingly stuck to the line and therefore unable to partake in offline training. Figure 6-2 provides an overview of the results.

Key:

Tenure:



Age range:



Area of work:

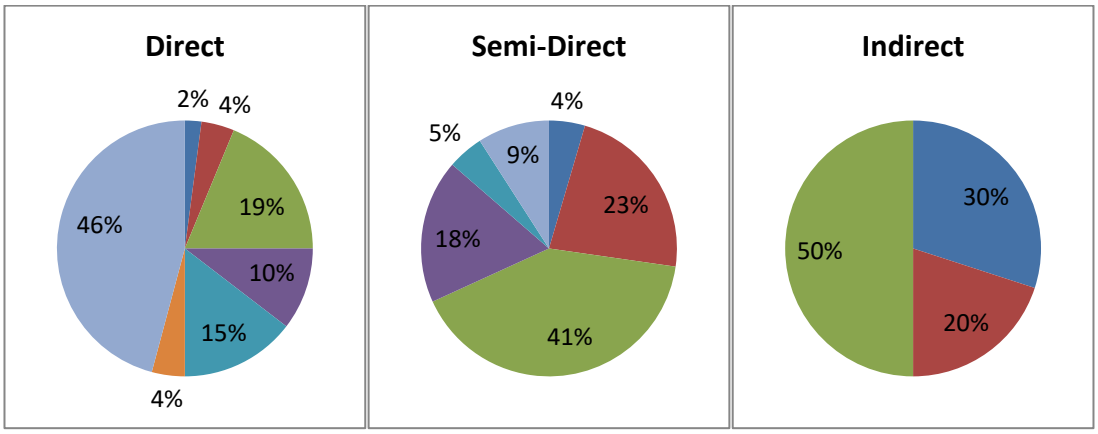


Figure 6-2 Skill Variety Questions 1&2

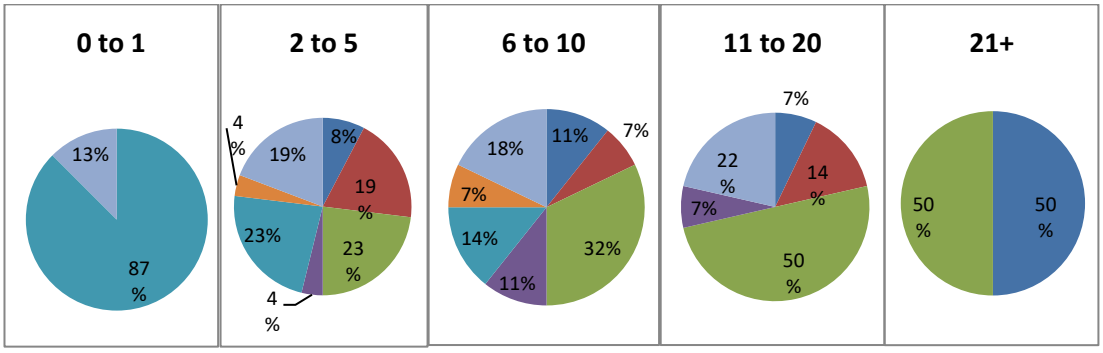
SV 3&4 aims to identify whether workers agree (or disagree) that there is variety in their job. 51% of participants agreed that there was variety in their jobs whereas 42% disagreed. 6% were neutral. Results by tenure suggest that the longer you work for the company the higher the perceived job variety. Similarly, perception of job variety increases with age range. This could be attributed to a longer period within which to learn new skills, progress, and develop.

In-line with results from SV 1&2 those working directly on the production line gave mostly negative (~62% disagree that there is job variety) responses when asked if they have job variety. Semi-direct staff are largely positive (~72% agree there is job variety) whereas indirect staff were completely positive. This seems to support the view uncovered in the interviews that staff are increasingly tied to the line with limited chance to participate in improvement activities. Participation in these activities would likely have had a positive impact on the skill variety score.

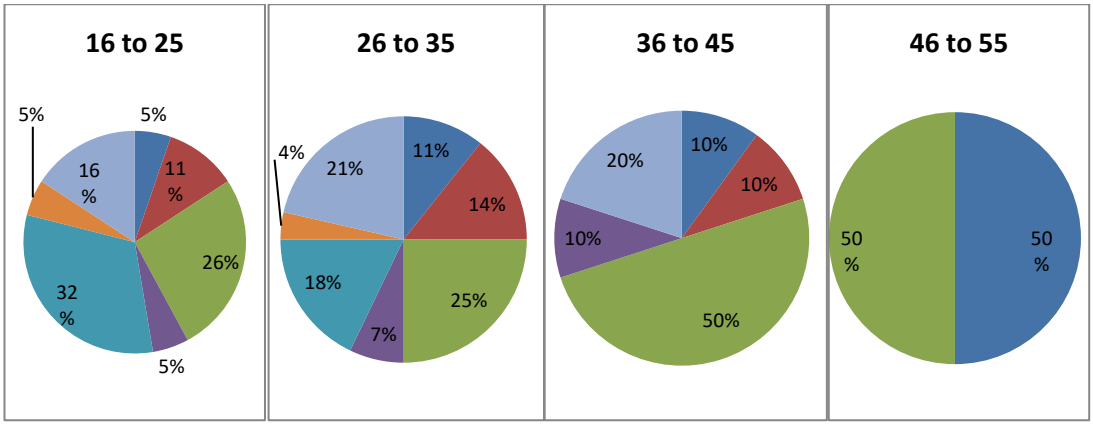
Figure 6-3 provides an overview of the responses for SV 3&4. When all of the four statements are combined together it is evident that those working directly with the production line perceive their jobs to be repetitive with little job variety. This improves as the worker gets further away from the line.

Key:

Tenure:



Age range:



Area of work:

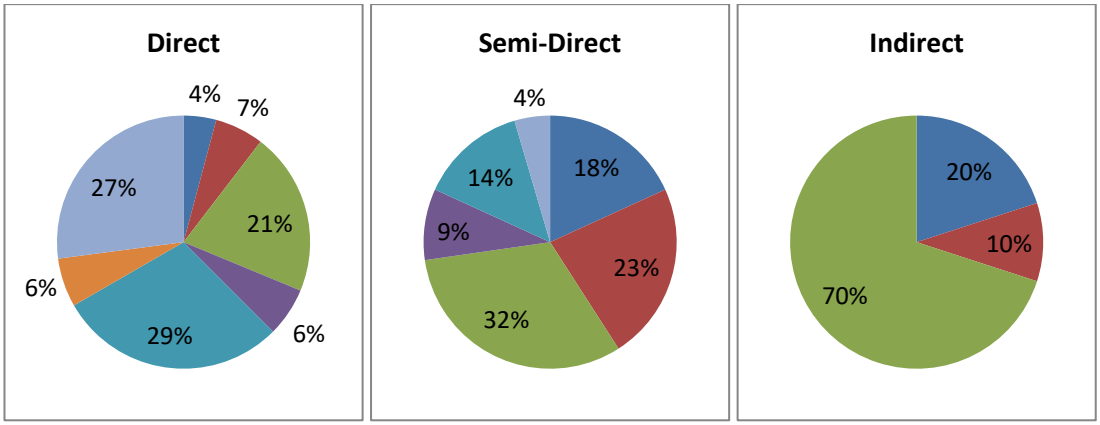


Figure 6-3 Skill Variety Questions 3&4

6.2.2 TASK SIGNIFICANCE

The following four statements were included in the survey to assess task significance in line with the original Job Diagnostic Survey:

TS1. My job is one where a lot of other people can be affected by how well the work gets done

TS2. The job itself is not very significant or important in the broader scheme of things

Note: Opposite / negatively worded version of TS1

TS3. The results of my work are likely to significantly impact the well-being of other people

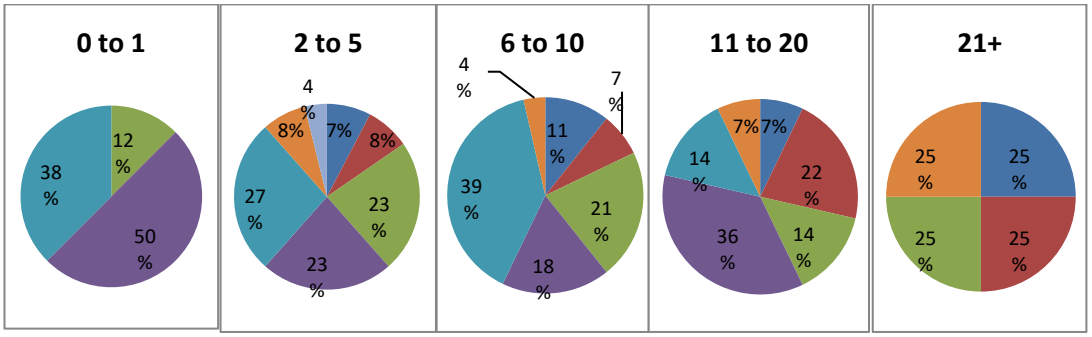
TS4. My job performance has no impact on anyone else

Note: Opposite / negatively worded version of TS3

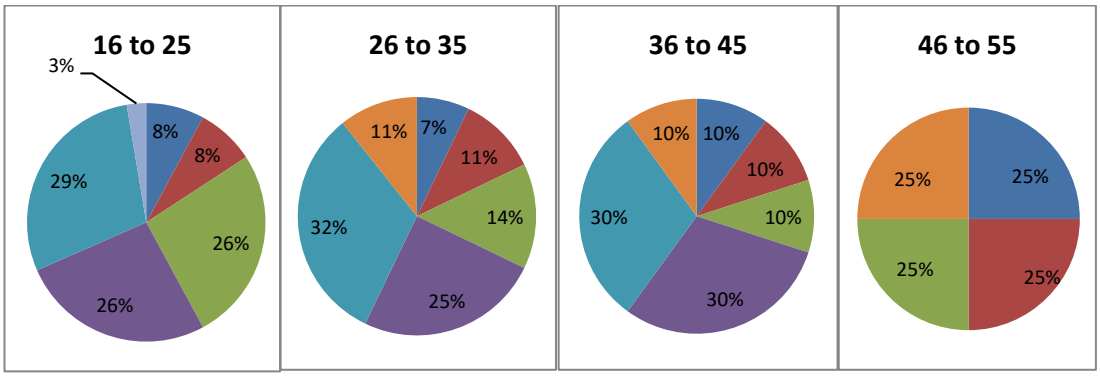
TS 1&2 both seek to identify whether employees consider their jobs to be important. 39% of participants felt that their job was important, 36% felt that their jobs were not important, with the remainder of participants being neutral. Those with a lower tenure had a tendency to award a lower score / express the feeling that their jobs were not important. The two most populous tenures (2-5yrs and 6-10yrs) were split between those who felt their jobs were important and those who did not feel that their jobs were significant. As previously mentioned there appears to be a link between tenure and age. The results viewed by age therefore show a similar result. The level of positive scores, viz workers indicating they agree that their job is significant, increases as the distance between the worker and production line increases (i.e. direct to indirect). This could be a result of indirect workers' ability to see the larger picture whereas direct workers are much more focused on their area of work.

Key:

Tenure:



Age range:



Area of work:

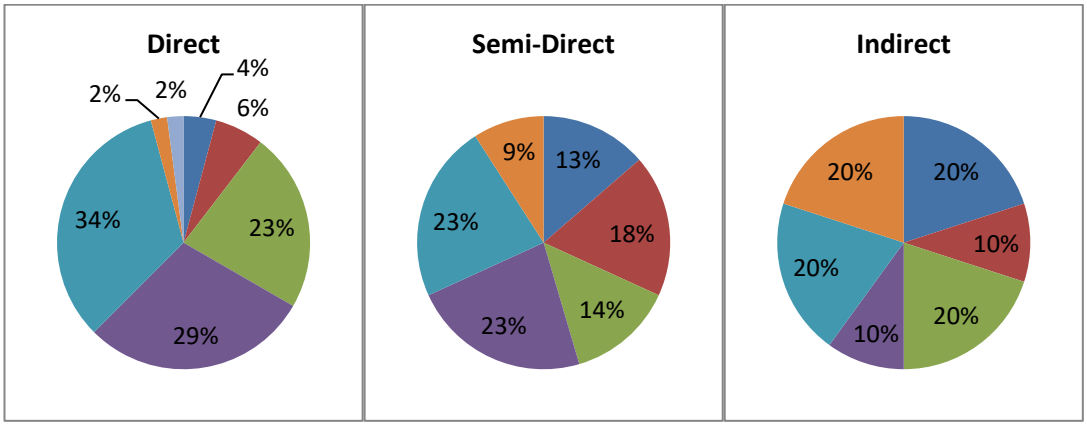


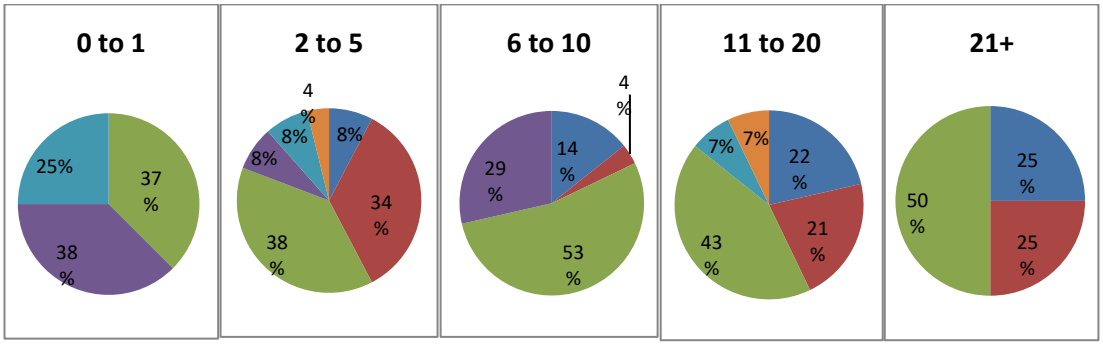
Figure 6-4 Task Significance Questions 1&2

TS 3&4 aimed to identify whether the participants believed that their roles had an impact on other colleagues. 75% of participants believed that their job performance had an impact on others, 9% felt that their job had no impact on others, and 16% were neutral. When looking at the results by tenure it is clear that those falling into the 6 – 10 category produced a higher neutral score than the other categories. Only the age ranges 16-25 and 36-45 provided negative scores. All age ranges were largely positive.

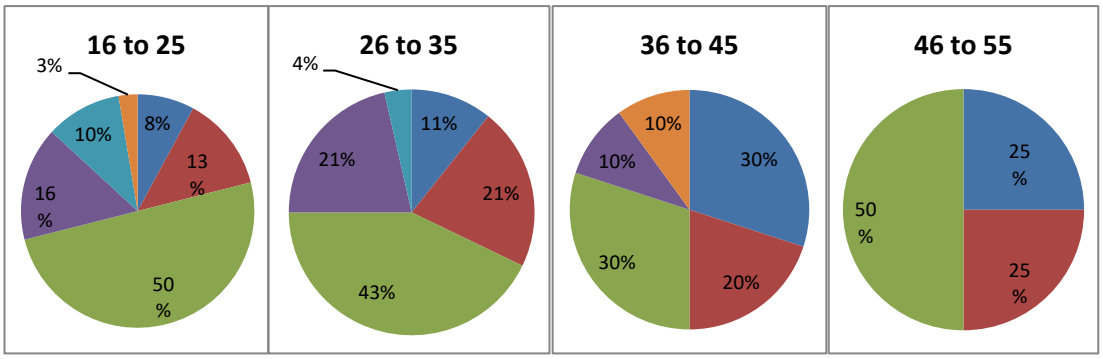
Participants largely felt that their jobs had an impact on others regardless of where they worked. However, it is evident that the negative, or neutral scores, were mostly made by those on the production line. This could be a result of these colleagues having less understanding of the bigger picture (as they are tied to the line) when compared to colleagues who are able to spend time off of the line.

Key:

Tenure:



Age range:



Area of work:

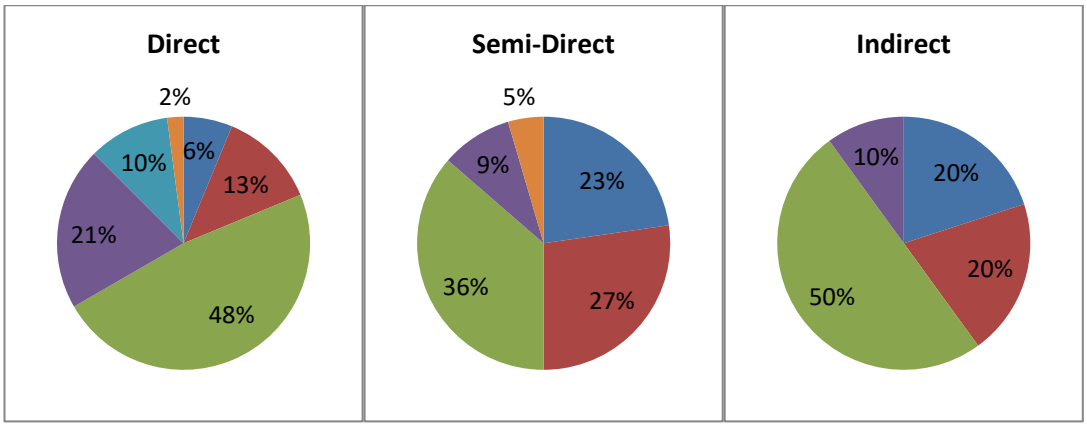


Figure 6-5 Task Significance Questions 3&4

6.2.3 TASK IDENTITY

The following two statements were included in the survey to assess task identity in line with the original Job Diagnostic Survey:

TI1. My job provides me the chance to completely finish the pieces of work I begin

TS2. My job is arranged so that I do not have the chance to do an entire piece of work from beginning to end

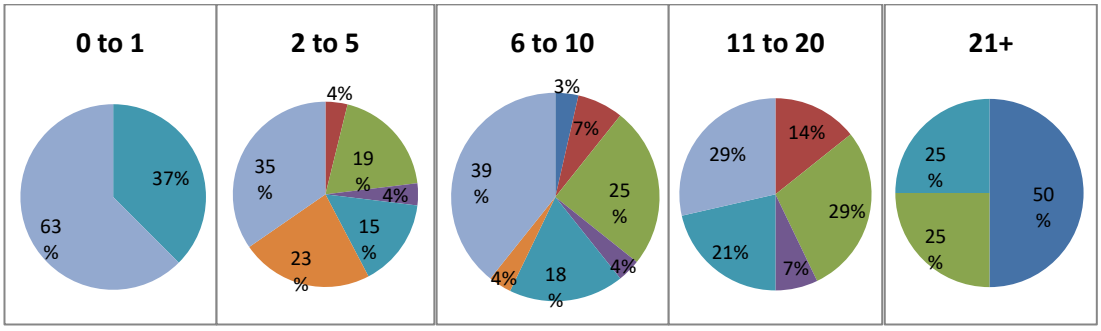
Note: Opposite / negatively worded version of TI1

The majority (65%) of participants disagreed that they were able to complete a whole and identifiable piece of work (figure 6.26). This compares to 31% who agreed that the results of their job were identifiable and 4% who were neutral or of no opinion. When viewed by tenure those with a longer tenure were more positive around their ability to completely finish the pieces of work they begin. All tenure groups were largely negative with the exception of the 21+ group which was largely positive. Most of the negative results appear to have come from the two lower age ranges (16-25 and 26-35) whereas the other age ranges were mostly positive. This could be due to the higher age ranges having additional responsibilities which allow them to identify with the task easier than their younger colleagues.

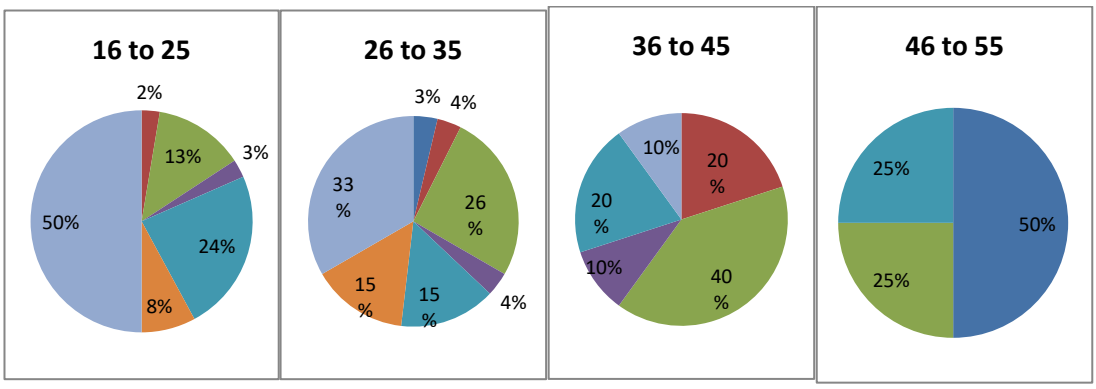
When viewed by area of work it 92% of direct staff did not feel that they completely finish a piece of work presumably as they are on the production line focusing on a specific task rather than the bigger picture which the semi-direct and indirect staff may be better placed to observe.

Key:

Tenure:



Age range:



Area of work:

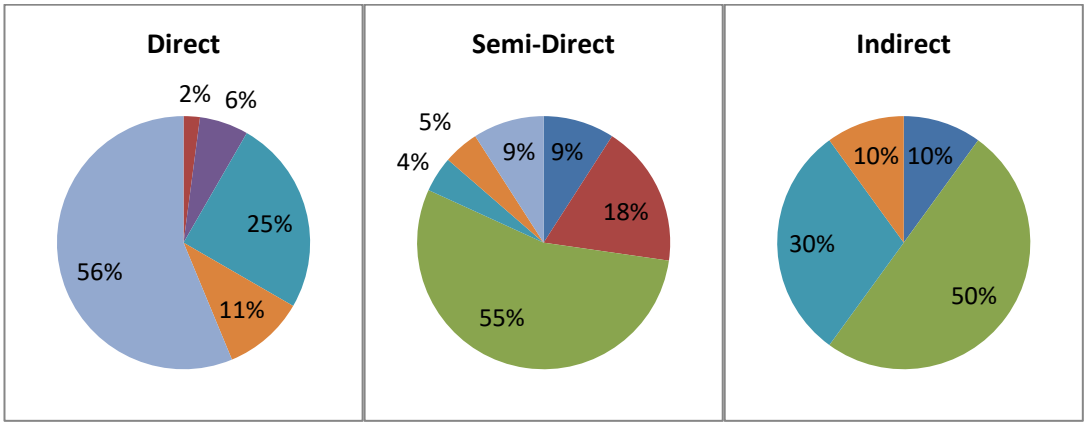


Figure 6-6 Task Identity

6.2.4 CHOICE AUTONOMY

The following two statements were included in the survey to assess choice autonomy. This core job dimension was called 'autonomy' in the original JCM but renamed in the Lean JCM due to the addition of responsibility and adopted in this research.

CA1. My job gives me considerable freedom in how I do the work

CA2. My job denies me any chance to use my personal initiative or judgement in carrying out the work

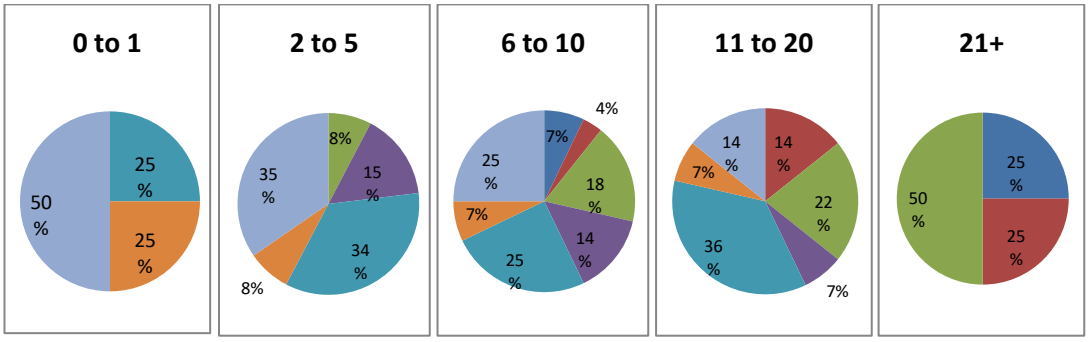
Note: Opposite / negatively worded version of CA1

65% of respondents indicated that they disagreed that they had choice autonomy in their jobs. Only 24% indicated that they agreed that they had choice autonomy in their jobs whilst 11% were neutral or of no opinion. When viewed by tenure it is clear that participants with lower tenures disagreed that there is choice autonomy in their jobs. Only the few participants with a tenure of over 21 years agreed that there was choice autonomy in their jobs. Similarly, as identified with years at plant, the level of disagreement decreases as age increases. This is probably due to the aforementioned link between years at plant and age range. Biographical data suggests that Nissan Sunderland Plant is the sole or primary career for the majority of those surveyed and therefore years at service and age range will be closely linked.

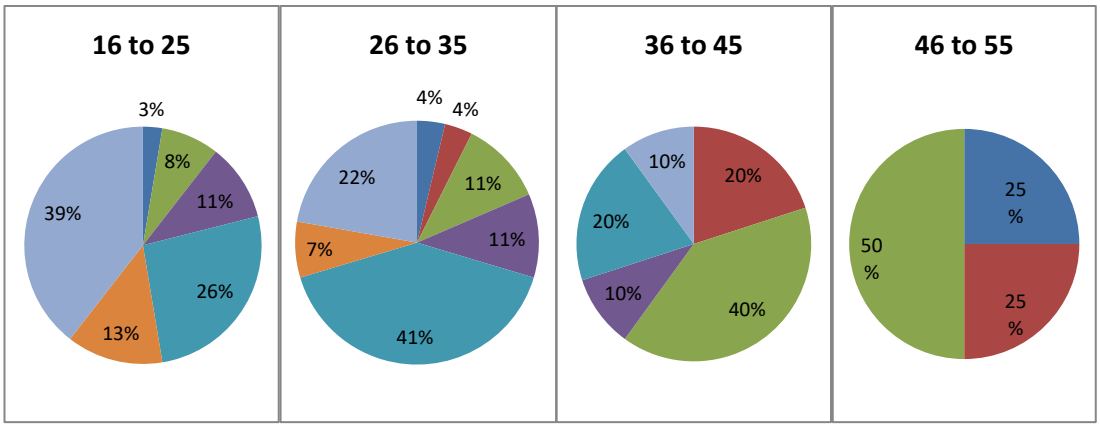
As perhaps expected direct staff largely disagreed (84%) that they had choice autonomy whereas indirect staff were largely positive. De Trevile and Antonakis (2006) claim that choice autonomy will be low in Lean operations due to standardisation, viz, the way in which employees do their work is largely dictated by standard procedures. This is particularly the case for the direct staff as standard procedures are designed to have minimal physical impact and ensure that worker tasks do not disrupt the flow of the production line.

Key:

Tenure:



Age range:



Area of work:

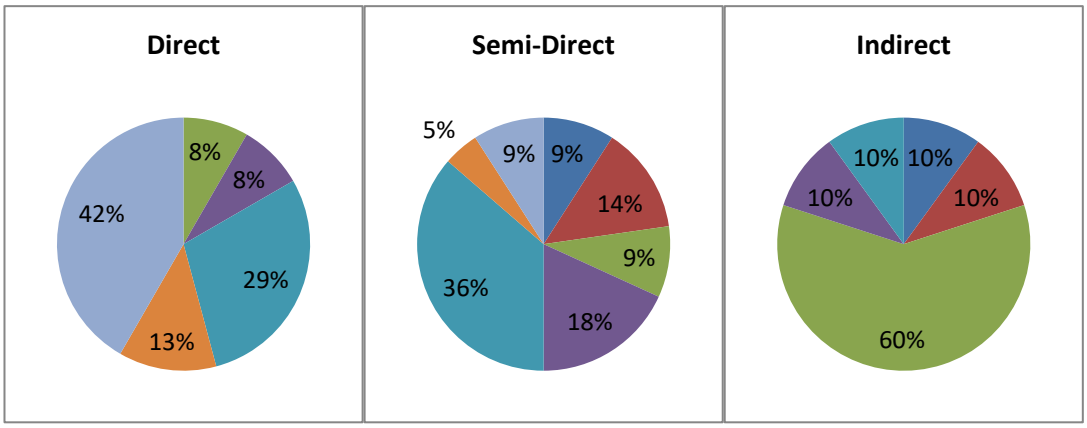


Figure 6-7 Choice Autonomy

6.2.5 RESPONSIBLE AUTONOMY

The following two statements were included in the survey to assess responsible autonomy. These questions were not included in the original Job Diagnostic Survey but added based on de Treville and Antonakis' (2006) reasoning:

RA1. I am responsible for continually improving my work area

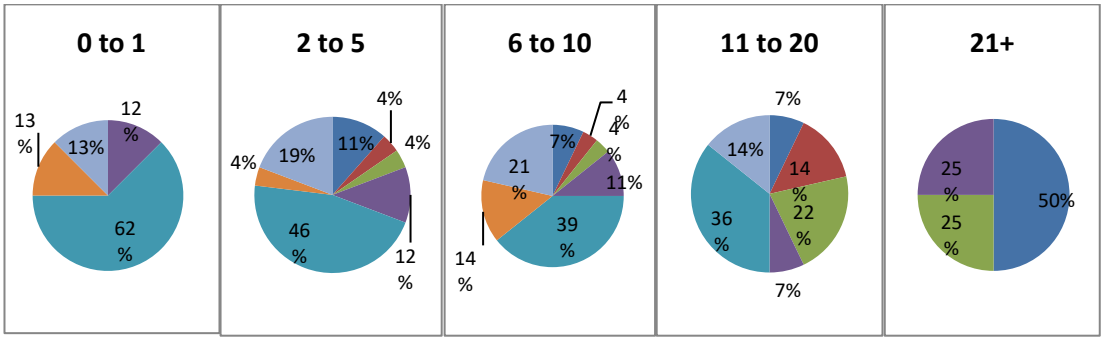
RA2. I do not have the authority to make decisions that affect my work area

Note: Opposite / negatively worded version of RA1

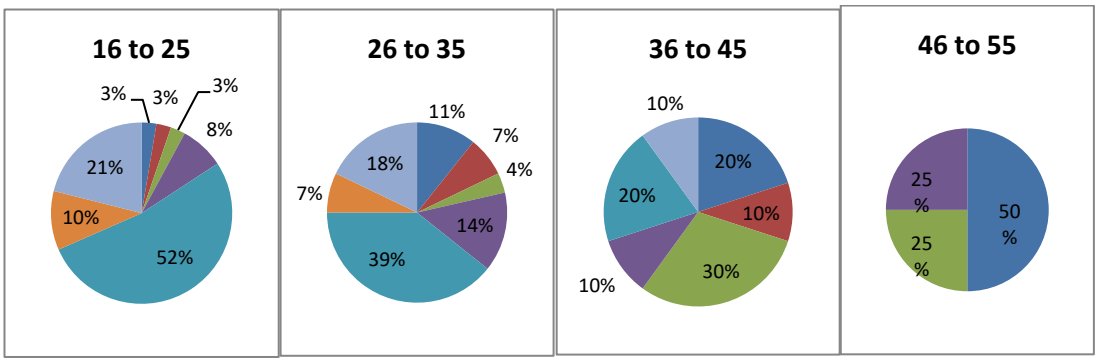
67% of scores were negative suggesting that the majority of participants do not believe that they have responsible autonomy in their job roles. Only 22% of scores were positive with the remaining 11% being neutral. When the results are sorted by tenure, and by age range, the results were also largely negative. Direct and semi-direct staff produced largely negative results with indirect staff producing a high percentage of neutral scores (30%), 40% negative and 30% positive.

Key:

Tenure:



Age range:



Area of work:

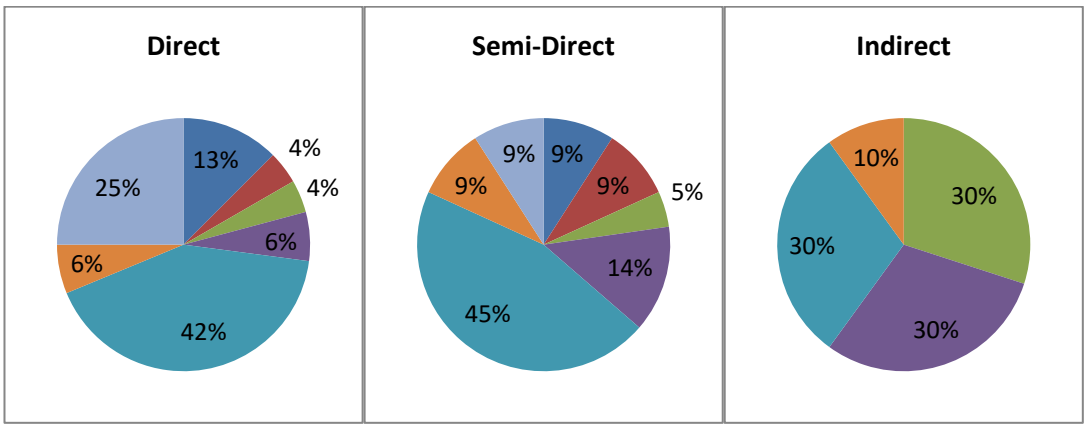


Figure 6-8 Responsible Autonomy

6.2.6 FEEDBACK

The following two statements were included in the survey to assess feedback:

FB1. My job is arranged so that I can judge for myself how well I am doing

FB2. I cannot tell how well I am performing just by doing the job

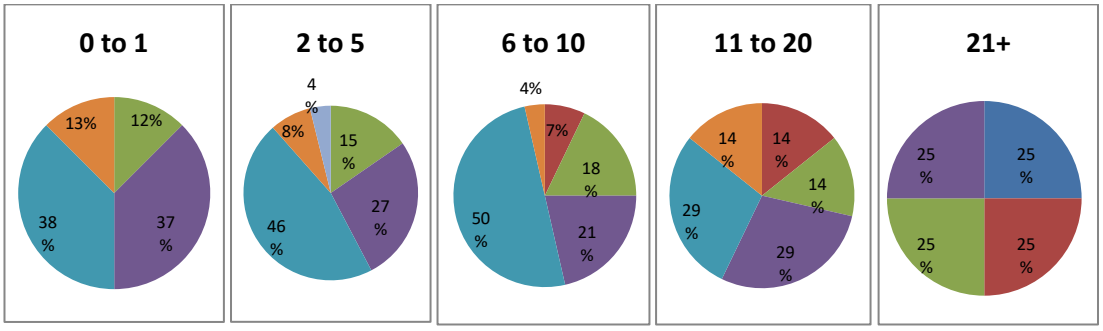
Note: Opposite / negatively worded version of FB1

A large percentage of the scores (26%) were neutral with the largest percentage of scores (50%) attributed to disagree categories. Overall only 24% agreed to varying degrees that their job roles included feedback. Tenure was linked to the ability to judge how participants were performing in their roles. As tenure increased so did the perception that workers were able to judge their performance themselves. Results sorted by age range show a similar picture.

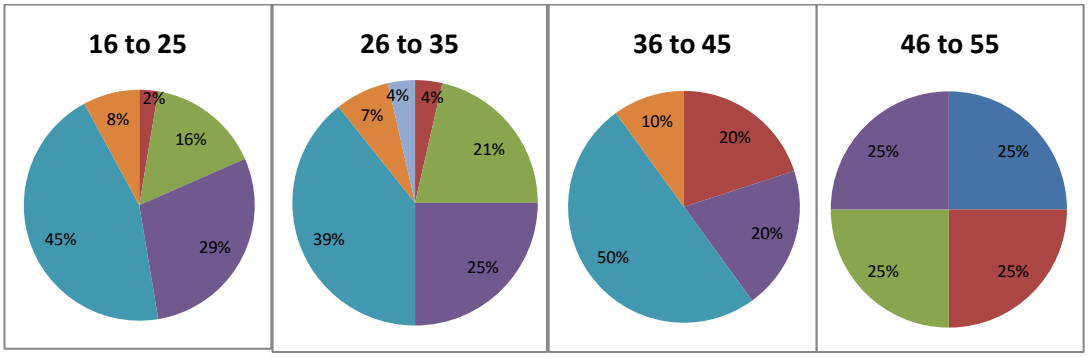
Once again it appears that there is a divide between those who work directly, or semi-directly with the production line and those employees that are office based (indirect). Whereas indirect staff were largely neutral or positive both the direct and semi-direct participants provided mostly negative scores.

Key:

Tenure:



Age range:



Area of work:

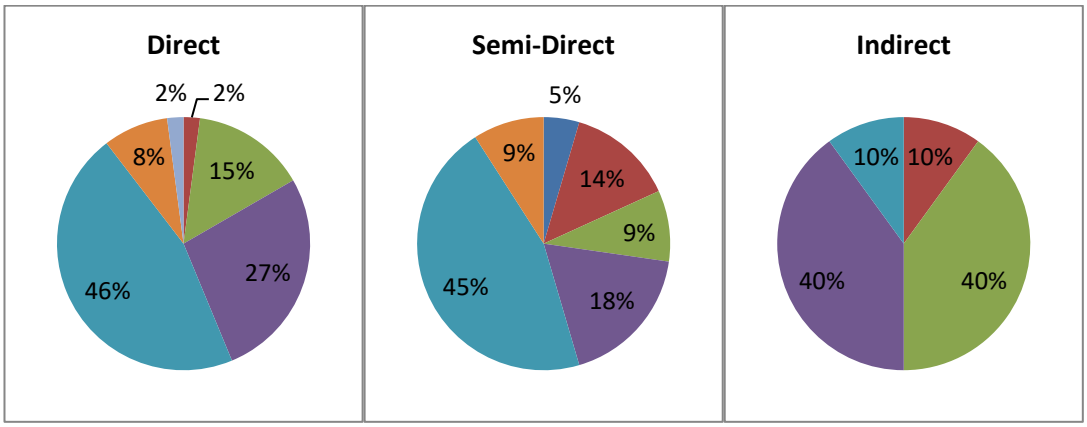


Figure 6-9 Feedback

6.3 MOTIVATING POTENTIAL SCORE CALCULATIONS

This section calculates a motivating potential score using an average of the results for each dimension detailed in the previous section. A score is provided at a high level, by tenure, by age range, and by area of work. Whereas there does not appear to be a clearly defined scale linking the results to the potential for motivation this study has created one based on both the 7-point Likert scale used for this survey and Hackman et al (1975)'s description of the scoring. Hackman et al (1975) claim that on average participants will have a low score of 125 whereas 260 would be very high. Figure 6-10 also includes a reminder of the equation for calculating the score as provided in the Methodology.

Motivating Potential Score = $\left[\frac{(SV + TI + TS)}{3}\right] \times (RA + CA) \times FB$

Motivating Potential Score Scale	
Extremely Low	1 - 49
Very Low	50 - 98
Low	99 - 147
Neutral	148 - 196
High	197 - 245
Very High	246 - 294
Extremely High	295 - 343

Figure 6-10 Nissan Motivating Potential Score Calculation and Scale
Adapted from: Leonard and Hilgert (2004), Hackman et al (1975)

Hackman et al (1975) state that you would examine the score of the target job and compare this against other jobs' score. Whereas the scale shown above (and the Motivating Potential Score) is open to interpretation it provides a logical approach that allows this study to draw conclusions based on the results. Furthermore, it must be understood that the reasons behind the achieved scores (e.g. influencing practices) are arguably more important than the Motivating Potential Score itself.

The overall Motivating Potential Score was extremely low (see table 6.8). The lowest score was 16.53 for the 0 – 1 years at plant grouping (table 6.9) whereas the highest score was 191.125 for both the 45 – 55 age range and 21+ years at plant group (table 6.10). Scores increase as both years at plant (table 6.9) and age range (table 6.10) increase. Similar to findings throughout this section the further you are away from the production line the higher the Motivating Potential Score (figure 6.11). Direct staff have an extremely low score of 25.108, semi-indirect staff have a very low score of 58.187 and indirect staff have a low score of 115.467.

Dimension Averages	
Skill Variety	3.863
Task Significance	4.738
Task Identity	3.025
Choice Autonomy	2.975
Responsible Autonomy	3.075
Feedback	3.488

Motivating Potential Score Calculation	
SV + TS + TI	11.626
SV + TS + TI / 3	3.875
* (CA+RA/2)	11.721
* FB = Motivating Potential Score	40.883

Table 6-1 Motivating Potential Score: High level

Dimension Averages					
	0 to 1	***2 to 5***	***6 to 10***	***11 to 20***	***21+***
Skill Variety	2.063	3.769	3.839	4.571	6.250
Task Significance	3.875	4.596	4.768	4.929	5.625
Task Identity	1.375	2.846	3.107	3.429	5.500
Choice Autonomy	1.750	2.346	3.286	3.357	6.000
Responsible Autonomy	2.250	2.923	2.750	3.643	6.000
Feedback	3.375	3.192	3.393	3.714	5.500

Motivating Potential Score Calculation					
	0 to 1	***2 to 5***	***6 to 10***	***11 to 20***	***21+***
SV + TS + TI	7.313	11.212	11.714	12.929	17.375
SV + TS + TI / 3	2.438	3.737	3.905	4.310	5.792
* (CA+RA/2)	4.875	9.846	11.784	15.083	34.750
* FB = Motivating Potential Score	16.453	31.432	39.981	56.024	191.125

Table 6-2 Motivating Potential Score: Tenure

Dimension Averages				
	16 - 25	***26 - 35***	***36 - 45***	***46 - 55***
Skill Variety	3.461	3.786	4.850	6.250
Task Significance	4.658	4.589	4.750	5.625
Task Identity	2.237	3.107	4.300	5.500
Choice Autonomy	2.395	2.714	4.300	6.000
Responsible Autonomy	2.368	3.071	4.600	6.000
Feedback	3.368	3.500	3.100	5.500

Motivating Potential Score Calculation				
	16 - 25	***26 - 35***	***36 - 45***	***46 - 55***
SV + TS + TI	10.355	11.482	13.900	17.375
SV + TS + TI / 3	3.452	3.827	4.633	5.792
* (CA+RA/2)	8.221	11.072	20.618	34.750
* FB = Motivating Potential Score	27.691	38.752	63.92	191.125

Table 6-3 Motivating Potential Score: Age range

Dimension Averages			
	Direct	***Semi***	***Indirect***
Skill Variety	2.958	4.909	6.100
Task Significance	4.469	4.977	5.150
Task Identity	1.729	5.136	4.600
Choice Autonomy	2.208	3.545	5.400
Responsible Autonomy	2.854	3.182	3.900
Feedback	3.250	3.455	4.700

Motivating Potential Score Calculation			
	Direct	***Semi***	***Indirect***
SV + TS + TI	9.156	15.023	15.850
SV + TS + TI / 3	3.052	5.008	5.283
* (CA+RA/2)	7.726	16.844	24.568
* FB = Motivating Potential Score	25.108	58.187	115.467

Table 6-4 Motivating Potential Score: Area of work

The above results suggest that staff are not intrinsically motivated. As a result, Nissan Sunderland Plant may not be achieving full value (or removing non-value adding activities) from its workforce. In this regard the Nissan Production Way appears to be deviating from one of the original Lean principles, respect-for-human (cf. Sugimori et al. 1977). Despite seemingly low intrinsic motivation Nissan Sunderland Plant continues to thrive. This suggests that there may be other factors at play which override the score / replace the need for low intrinsic motivation. This is explored in the following section.

6.4 INFLUENCING PRACTICES

This section provides the data for the practices that may provide insight as to the scores awarded to each of the core job dimension categories. Data is displayed as an overview, years at plant, age range and area of work in line with the analysis of core job dimension data. Raw data is provided in Appendix F (p277).

6.4.1 KAIZENS

The following two statements were included in the survey to assess whether Kaizens / small group improvement activities occur in practice:

K1. I regularly participate in improvement teams

K2. I do not often get the opportunity to participate in group problem solving activities

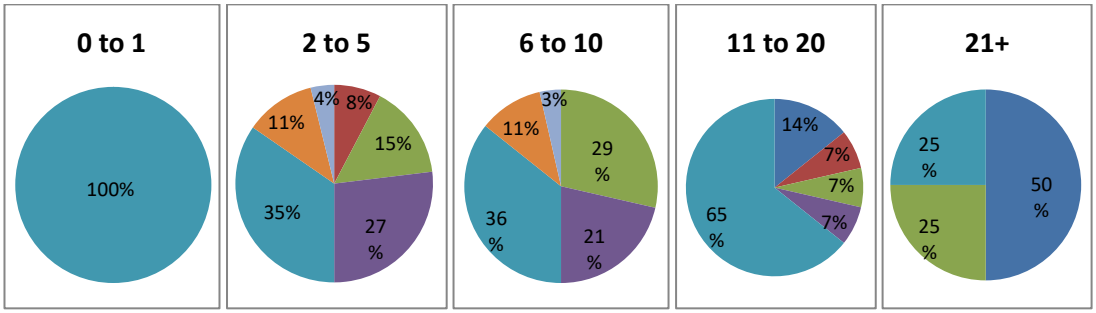
Note: Opposite / negatively worded version of K1

The majority (57%) of the survey participants disagreed (to some shape or form) that they have the chance to participate in group improvement activities. 17% of employees were neutral whereas only 26% of employees agreed (to varying degrees) that they did have the chance to participate in group improvement activities. When viewed by tenure all groupings were largely negative with the exception of the 21+ years tenure group. Similarly, all age ranges were also largely negative with the exception of the 46 – 55 group as these participants also form the 21+ years tenure group.

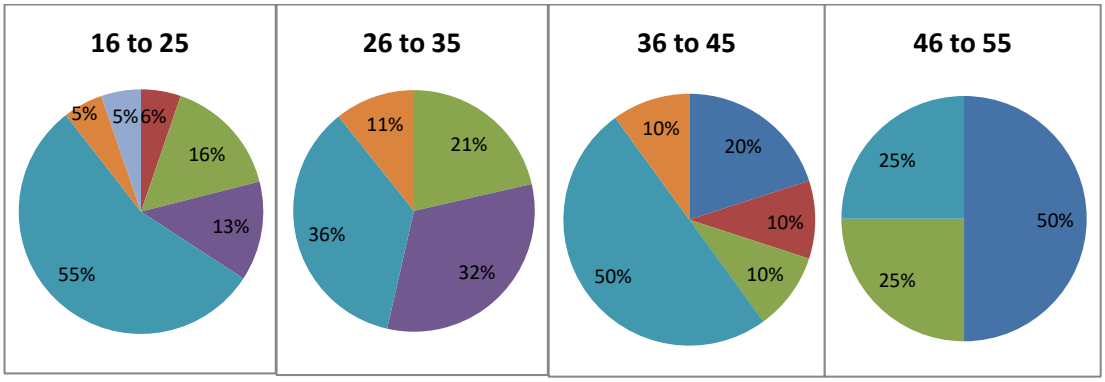
Area of work revealed that direct and semi-direct staff do not agree that they get chance to participate in improvement activities whereas the indirect staff largely agree that they participate in improvement activities.

Key:

Tenure:



Age range:



Area of work:

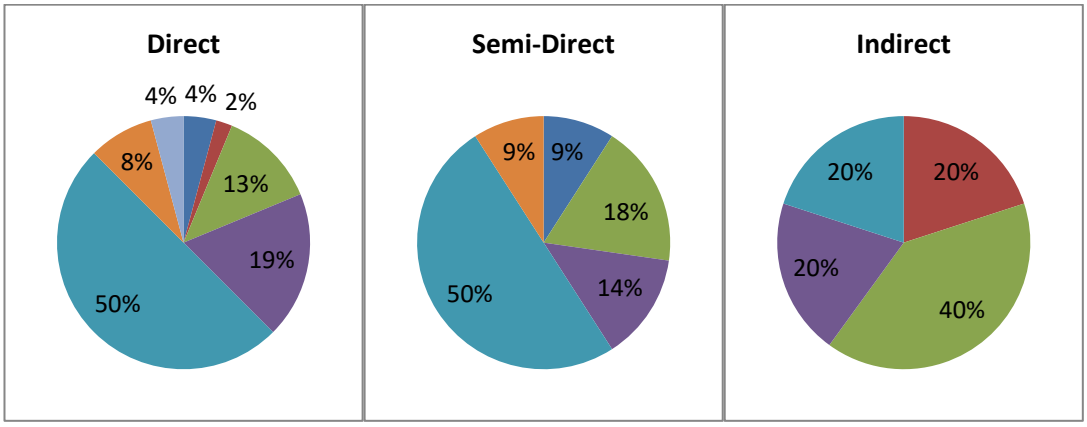


Figure 6-11 Kaizens

6.4.2 CROSS-TRAINING / EMPLOYEE DEVELOPMENT

The following four statements were included in the survey to assess whether cross training / employee development occur in practice:

CT1. I am trained to do several jobs

CT2. I have only received training to do one job in the plant

Note: Opposite / negatively worded version of CT1

CT3. I can attend relevant additional training courses with ease

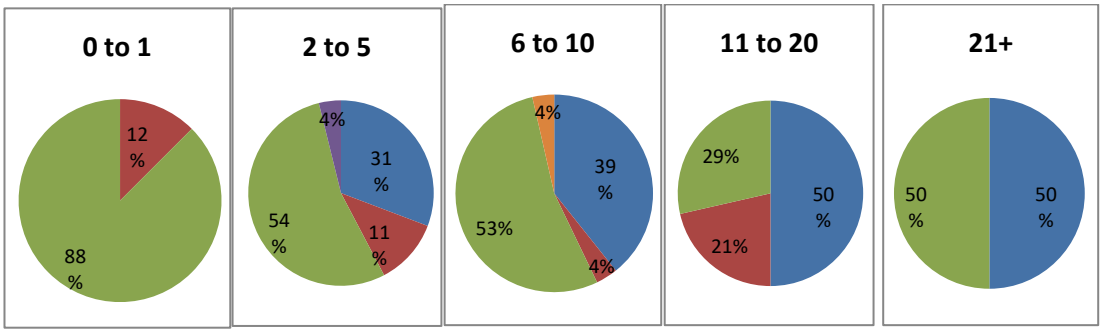
CT4. The plant's training courses are a waste of time

Note: Opposite / negatively worded version of C31

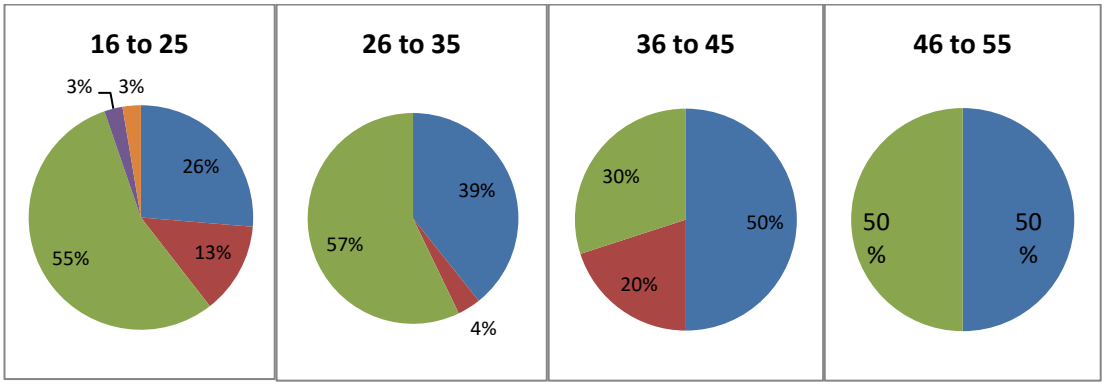
The results for CT 1&2 showed that only 1% of survey participants slightly disagreed that they were trained to do more than one job. 98% of scores were positive (agree to varying degrees) with the remaining 1% of scores being neutral. This was the same when viewed by tenure, age, and area of work.

Key:

Tenure:



Age range:



Area of work:

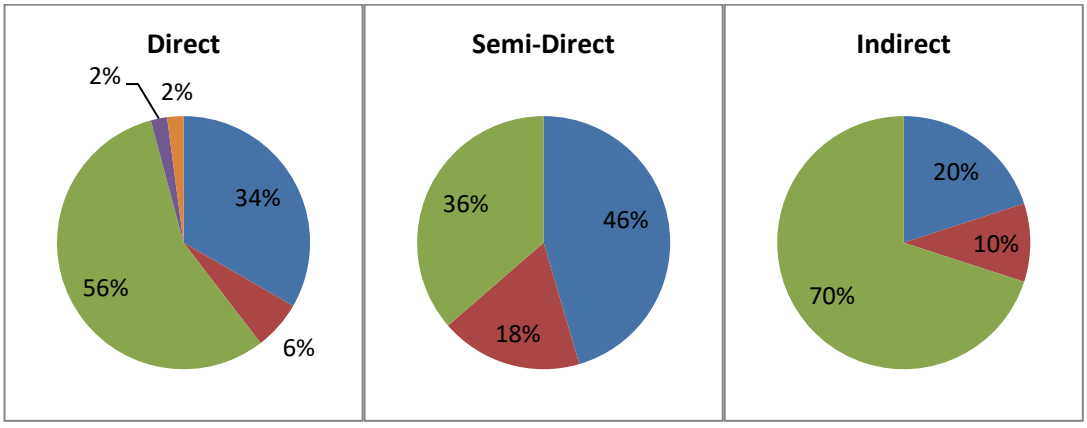


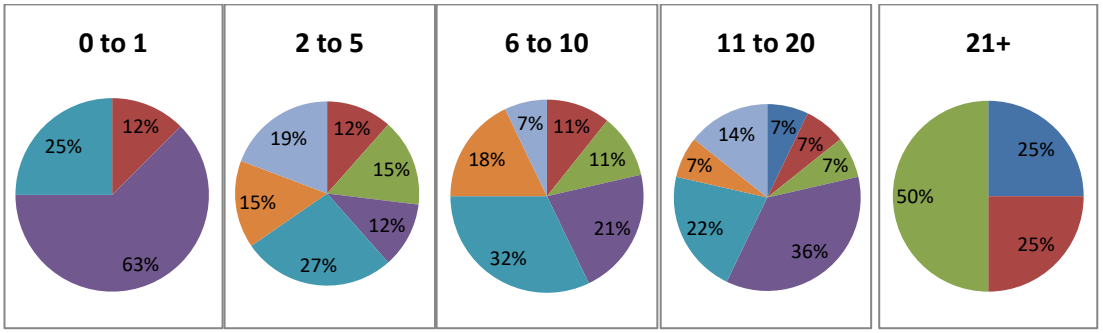
Figure 6-12 Cross-Training / Employee Development Questions 1&2

The results for CT 3&4 showed that survey participants were largely negative about their ability to easily attend relevant training courses. 24% of scores were neutral and 26% agreed (to varying degrees) with the remaining 50% disagreeing. When viewing the data by tenure it is instantly clear that those with a tenure of 0 to 1 years were primarily neutral (63%) with the 11 to 20 year group also containing a large number of neutral responses (36%). Age range showed a similar picture – when neutral responses are discounted the result is mostly negative with the exception of the 45 – 56 group.

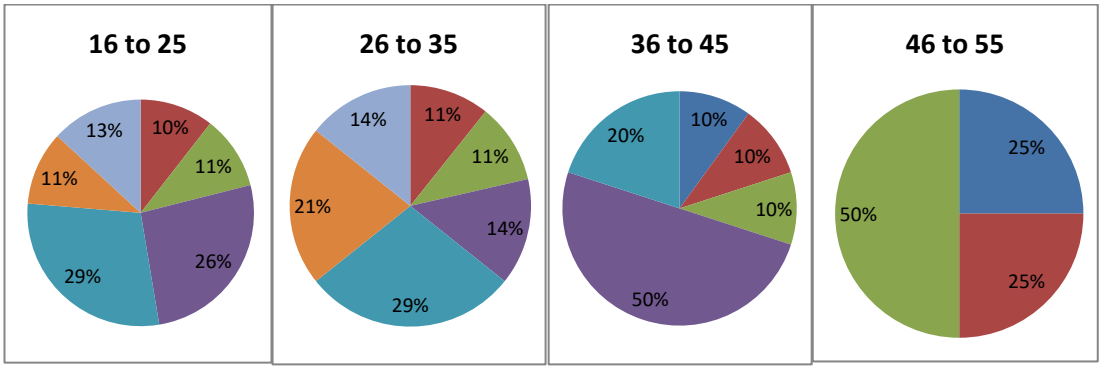
Indirect staff produced all agree (to varying degrees) scores. 57% of direct staff responses were negative, 14% were positive and 29% neutral. Semi direct scores were 59% negative, 9% neutral and 32% positive. This suggests that the closer you are to the line the harder it is to attend training courses.

Key:

Tenure:



Age range:



Area of work:

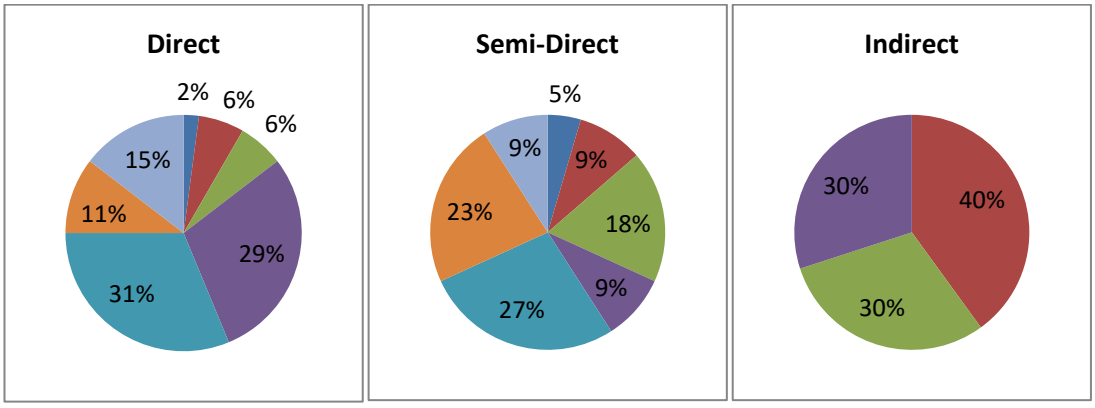


Figure 6-13 Cross-Training / Employee Development Questions 3&4

6.4.3 JOB ROTATION

The following two statements were included in the survey to assess whether job rotation occurs in practice:

JR1. I rotate between a number of different jobs

JR2. Job rotation doesn't occur in practice

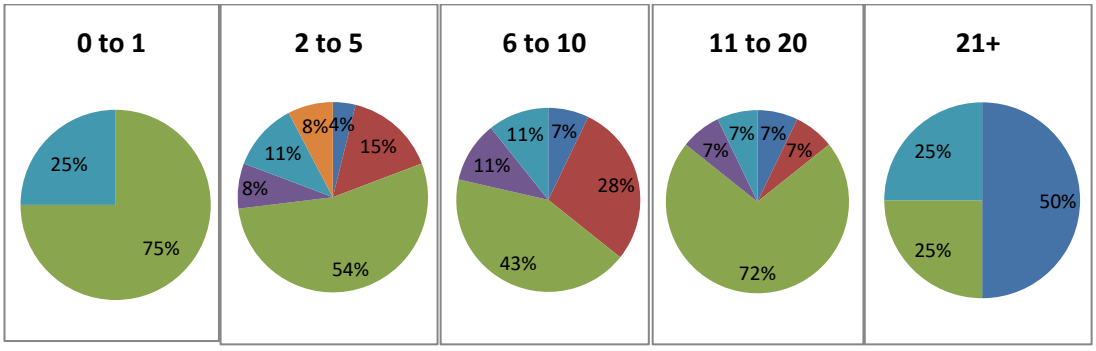
Note: Opposite / negatively worded version of JR1

The majority of participants agreed that job rotation occurs in practice with 77% responding positively. 7% of the scores were neutral whereas only 16% of the score was negative. Similarly all tenure groupings are positive (the majority of negative scores can be attributed to the 2-5 grouping) as are age range groupings.

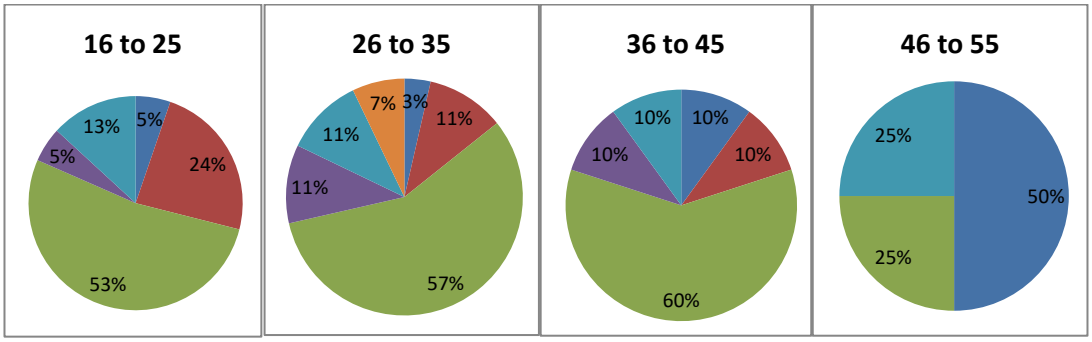
Interestingly when the data is viewed by area of work negative scores are primarily found in the indirect and semi-direct categories. This would suggest that although direct workers feel increasingly tied to the line (as identified in the initial interviews) they do rotate between jobs. The further away you are from the line job rotation may occur less frequently in practice. This influencing practice may be helping the skill variety core job dimension in direct staff but hindering the dimension for the semi-direct and indirect staff.

Key:

Tenure:



Age range:



Area of work:

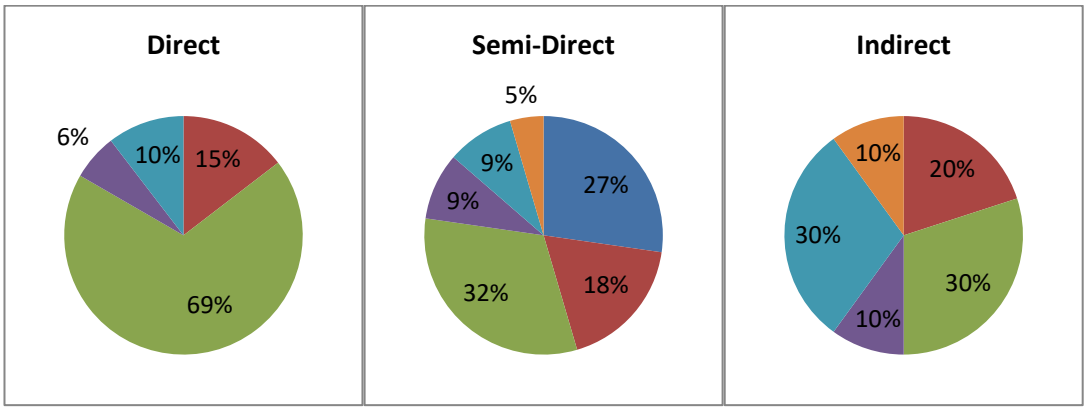


Figure 6-14 Job Rotation

6.4.4 FEEDBACK FROM OTHERS

Initial interviews indicated that supervisor and senior roles were attracting more responsibilities. Additionally, those working on the production line were becoming increasingly tied to the production line. This raised concerns as to whether staff had time to give and receive feedback within their teams. Hackman and Oldham (1974) includes feedback from agents, viz information about performance from team members and supervisors, in the Job Diagnostic Survey. Whereas this construct does not constitute a core job dimension (or job characteristic) it was included to provide further information for the feedback dimension. The following four statements were included based on those in the original Job Diagnostic Survey.:

FBO1. Supervisors often let me know how well they think I am performing the job

FBO2. My supervisors almost never give me any feedback about how well I am doing in my work

Note: Opposite / negatively worded version of TW1

FBO3. I frequently receive feedback from other members of my team

FBO4. My team never share work related tips or give each other advice

Note: Opposite / negatively worded version of TW3

The original Job Diagnostic Survey combined supervisors and co-workers into one set of statements. This could lead to confusion as staff may receive feedback from supervisors but not co-workers (and vice-versa). This study has therefore created two sets of statements. FBO 1 is exactly the same as in the original Job Diagnostic Survey. FBO 2 is the same but omits co-workers which were originally included in the statement. FBO 3&4 are new statements.

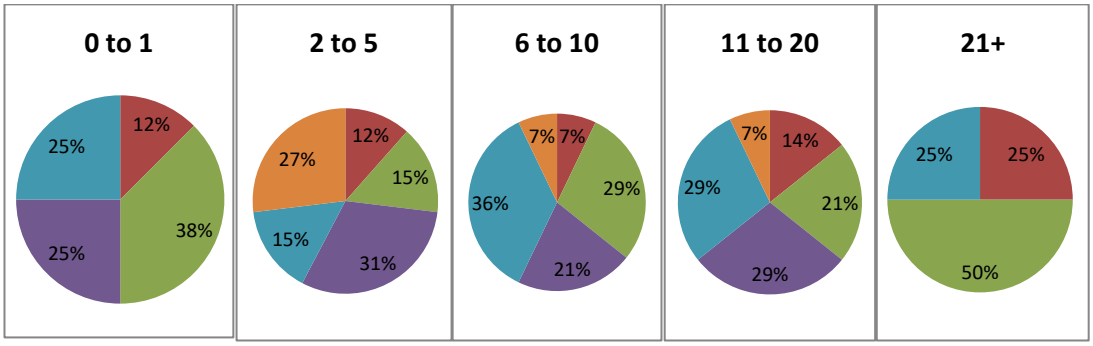
There was no consensus as to whether the participants received feedback on how they are performing from their line supervisor (FBO 1&2). 25% were neutral with the remainder split between agreeing that feedback was received and disagreeing. When the results are viewed by tenure 50% of scores for 0-1 years were positive. This compares to 27% for 2 to 5 years, 36% for 6 to 10 years, 35% for 11 to 20 years and 75% for 21+ years. The higher number of positive scores for 0 to 1 years at plant, in comparison to 2 to 5 years and 6 to 10 years, could be attributed to induction training and reduced support after this initial period. There were only two 21+ years participants, one of which was the senior in charge of Quality Assurance, which explains the high positive score for this construct.

Age range grouping also show a mixed response with relatively high neutral scores for most categories Whereas the results of each individual survey were confidential the senior of the department helped facilitate the distribution of the surveys. This may have resulted in participants being less willing to share an opinion on whether they felt like they received feedback from their superiors. Alternatively, participants may have not felt that they either agreed or disagreed in any shape or form. However, the results when viewed by age range suggest that they may not receive feedback on their performance from supervisors.

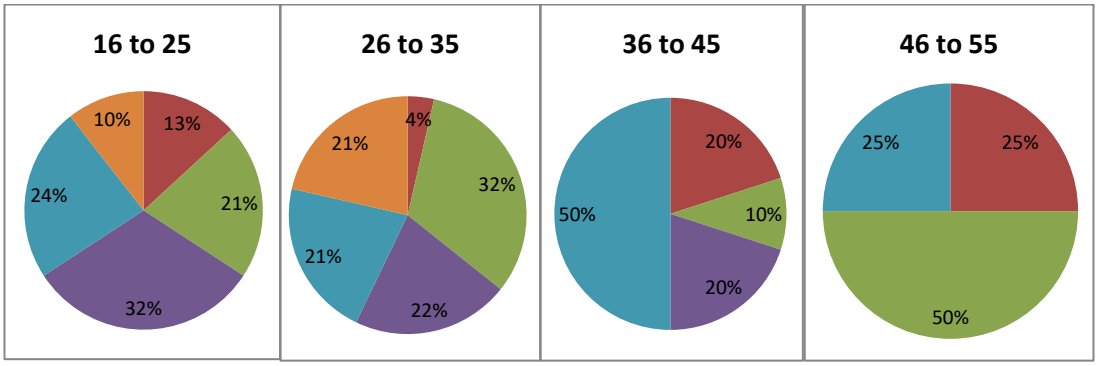
Data sorted by area of work shows that the levels of positivity regarding whether supervisors provide feedback increases as workers are working further away from the line. Direct positive scores are 33%, semi-direct positive scores are 36% and indirect positive scores are 50%.

Key:

Tenure:



Age range:



Area of work:

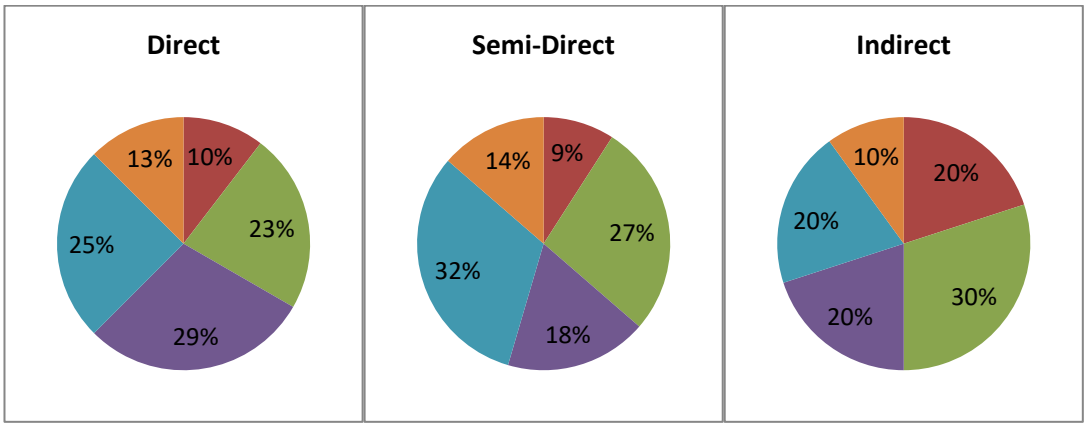
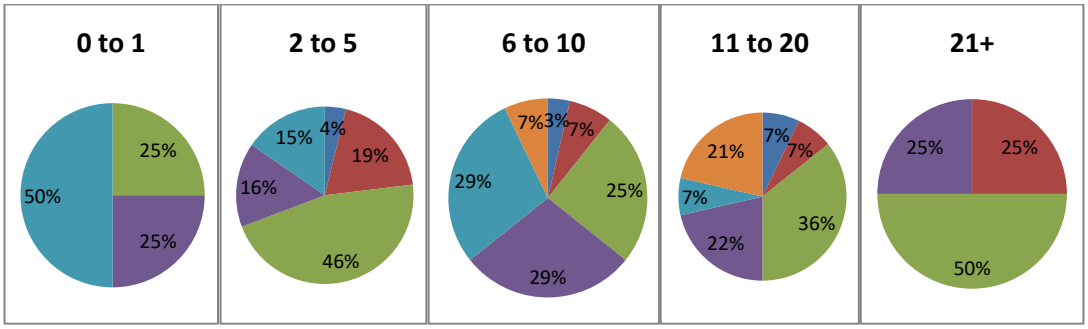


Figure 6-15 Feedback From Others Questions 1&2

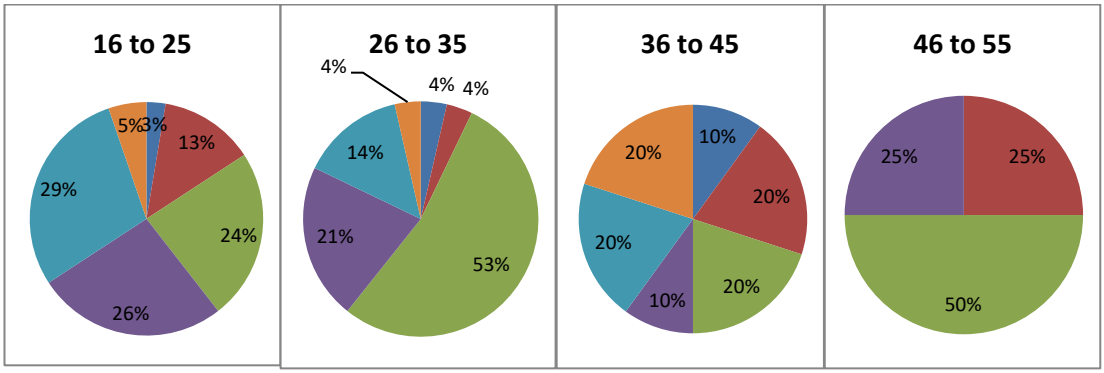
50% of participants agreed that they receive feedback from members of their team (FBO 3&4). 23% were neutral and 27% responded negatively. Tenures of 2-5 years, 11-20 years, and 21+ years were largely positive whereas participants with a tenure of 6-10 years had a split opinion (29% neutral, 36% negative, 35% positive). When neutral scores are discounted all majority of age ranges can also be seen to be largely positive. The same can also be said when looking at the data categorised by area of work.

Key:

Tenure:



Age range:



Area of work:

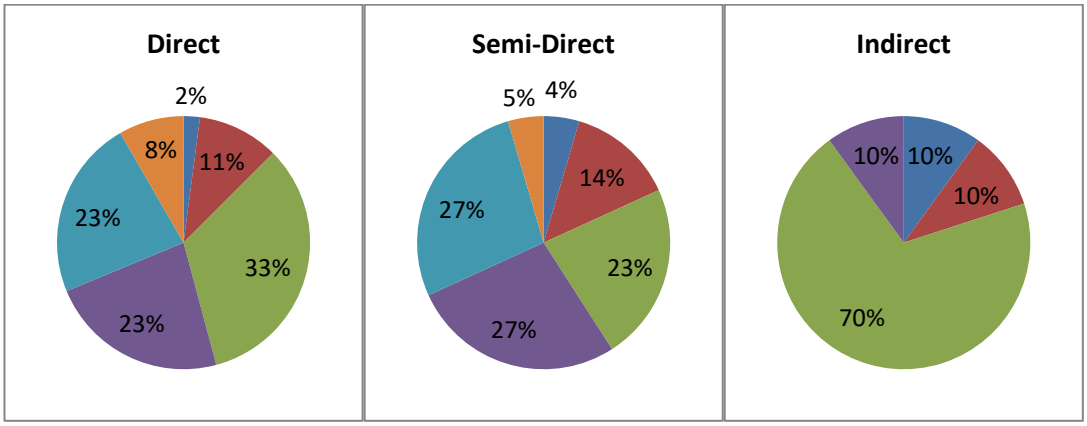


Figure 6-16 Feedback From Others Questions 3&4

6.4.5 HOSHIN KANRI

The following two statements were included in the survey to assess whether Hoshin Kanri occurs in practice:

HK1. I am able to clearly see how my job contributes towards achieving company objectives

HK2. My job does not contribute towards company objectives

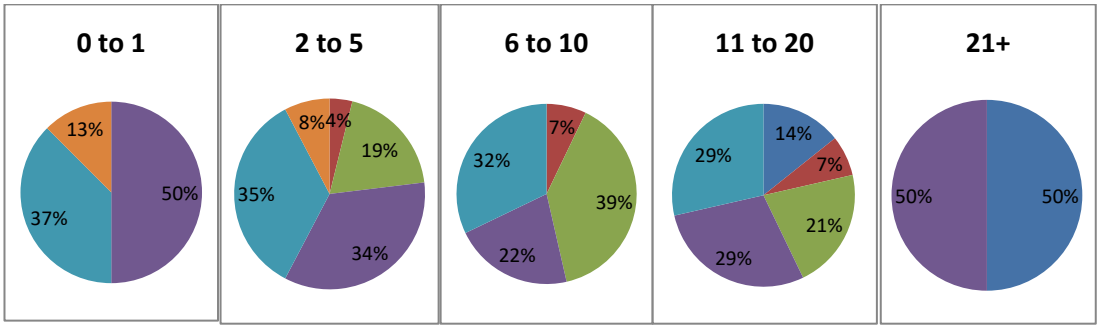
Note: Opposite / negatively worded version of HK1

When asked whether their jobs contribute to company objectives 31% of scores were neutral. 35% of scores were negative and 34% were positive suggesting that overall there is a fine balance between those who between those who feel that their jobs contribute to company objectives and those that don't. When the results are grouped by tenure the 6-10 years and 21+ years groupings were primarily positive whereas all other groupings were primarily negative. Scores by age range also highlight the large percentage of neutral responses. Participants under 35 were largely negative (they didn't believe their jobs contribute to company objectives) whereas those over 35 were largely positive

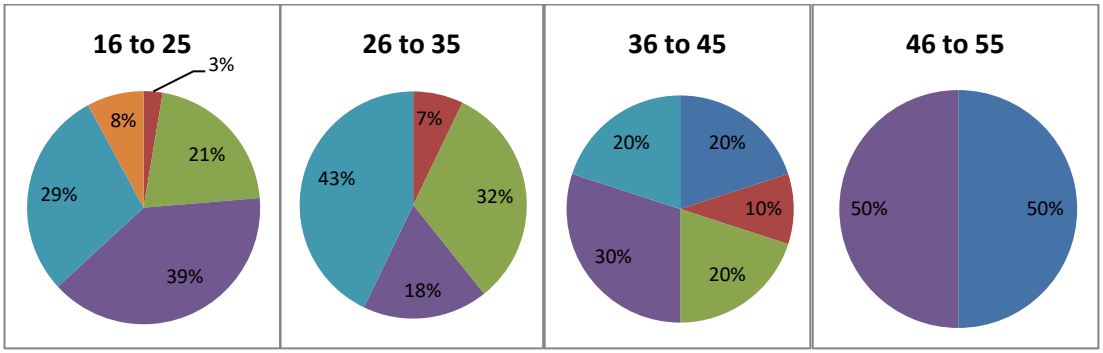
Direct staff were largely negative (46%), semi-direct staff were largely positive (55%) and indirect staff were also largely positive (50%). As semi-direct and indirect staff are not as tied to the line they may have a greater role in objective setting. Furthermore, semi-direct and indirect workers are likely to be able to regularly access the company intranet and/or internal communications channels which will likely discuss company objectives whereas direct staff's access and time to view these sources may be limited.

Key:

Tenure:



Age range:



Area of work:

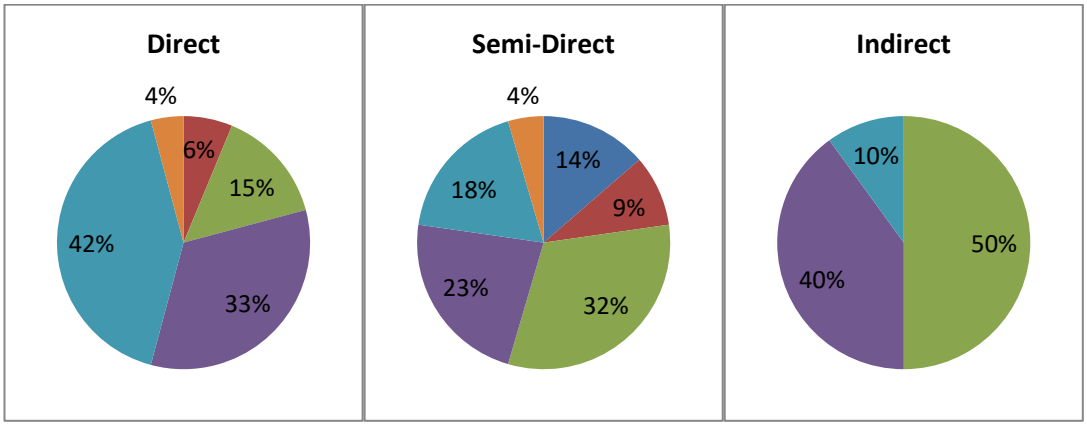


Figure 6-17 Hoshin Kanri

6.4.6 TEAM BASED RECOGNITION

The following two statements were included in the survey to assess whether team based recognition occurs in practice:

TR1. The team I work in receives recognition if we do a good job

TR2. My team's efforts normally go un-noticed

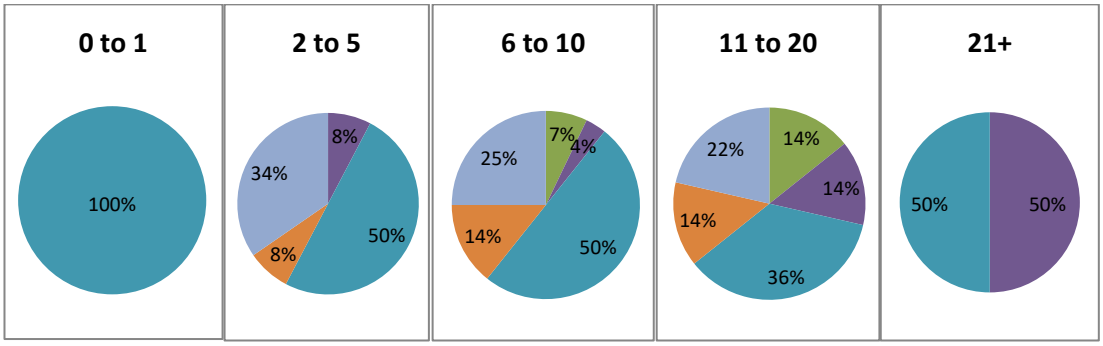
Note: Opposite / negatively worded version of TR1

When asked whether team based recognition occurs in practice 86% of scores were negative. Only 5% of scores agreed with the remaining 9% being neutral. Despite the Nissan Production Way experts claiming that team based rewards have been given in the past these scores overwhelmingly suggest that it is not a regular occurrence and may even have not have been awarded in recent memory.

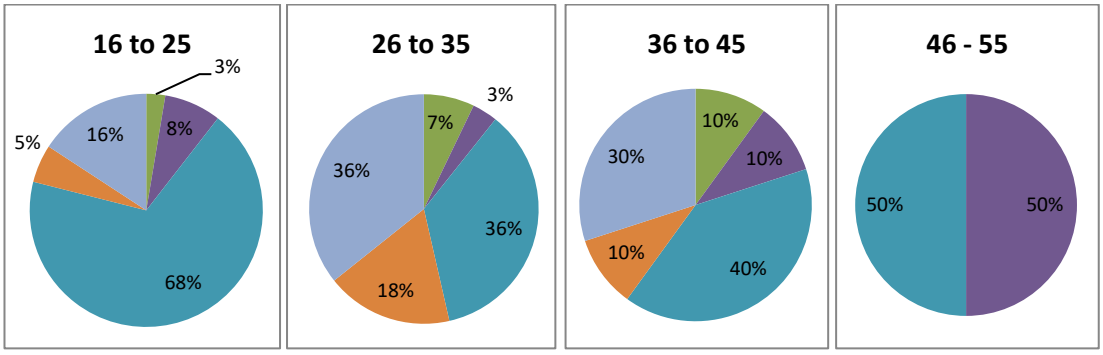
When the data is sorted by years at plant it is instantly clear that all groupings are primarily. Similarly, when grouped by age range scores are also overwhelmingly negative with 16 – 25 scoring 89% negative, 26 – 35 90%, 36 – 45 80% and 46 – 55 50%. The response is also overwhelmingly negative when looking at the work areas with 85% of direct staff scoring negatively, semi-direct staff 86% and indirect staff 100%. This data would suggest that employees feel very strongly that team based recognition does not occur in practice.

Key:

Tenure:



Age range:



Area of work:

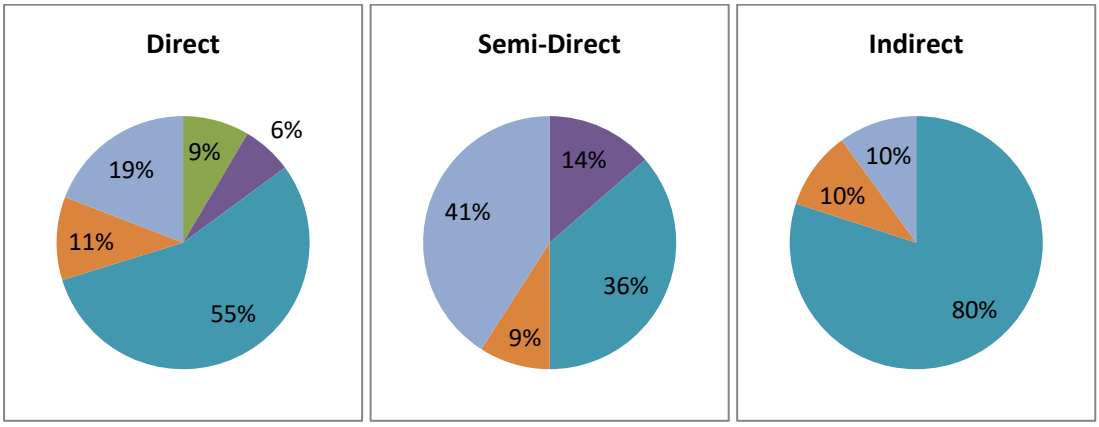


Figure 6-18 Team Based Recognition

6.4.7 COMPANY COUNCIL

The following two statements were included in the survey to assess whether employees feel that the company council has power to influence their workplace:

CC1. Company council has a big impact on me at work

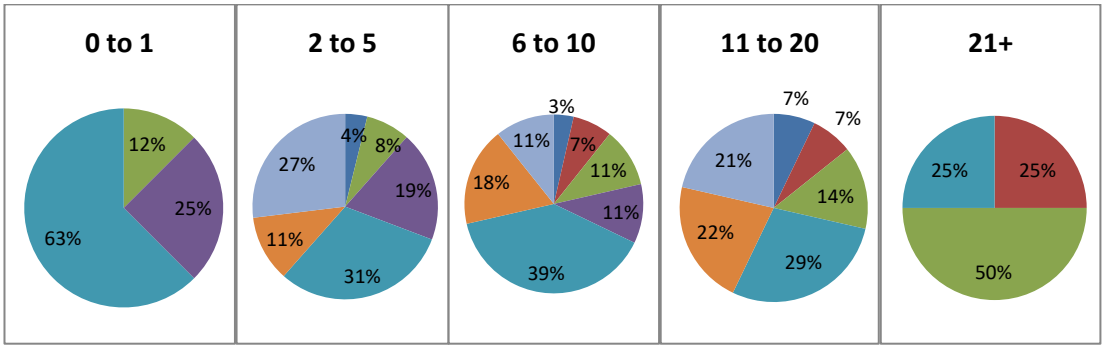
CC2. The company council has no real power

Note: Opposite / negatively worded version of CC1

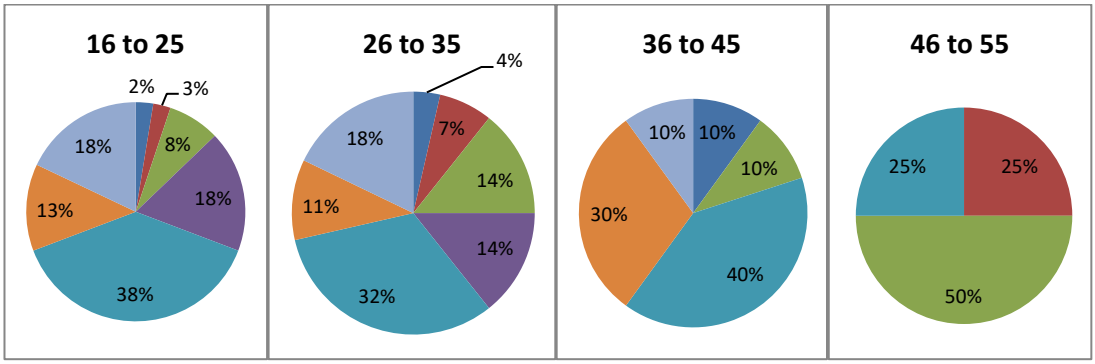
66% of scores were negative, 13% were neutral with the remaining 21% positive. When the results are viewed by tenure with the exception of the 21+ years grouping (75% positive, 25% negative) all groupings are largely negative as to the impact the company council has on their life at the plant. Similarly, with the exception of the 46 – 55 age range bracket (for which respondents also fall into the 21+ years at plant bracket) scores are also largely negative. Results are also primarily negative when data is viewed by area of work. This would suggest that on the whole staff perceive the company council not to have an impact on their jobs. This is despite the company council being a key forum for discussions between workers and plant management at the plant.

Key:

Tenure:



Age range:



Area of work:

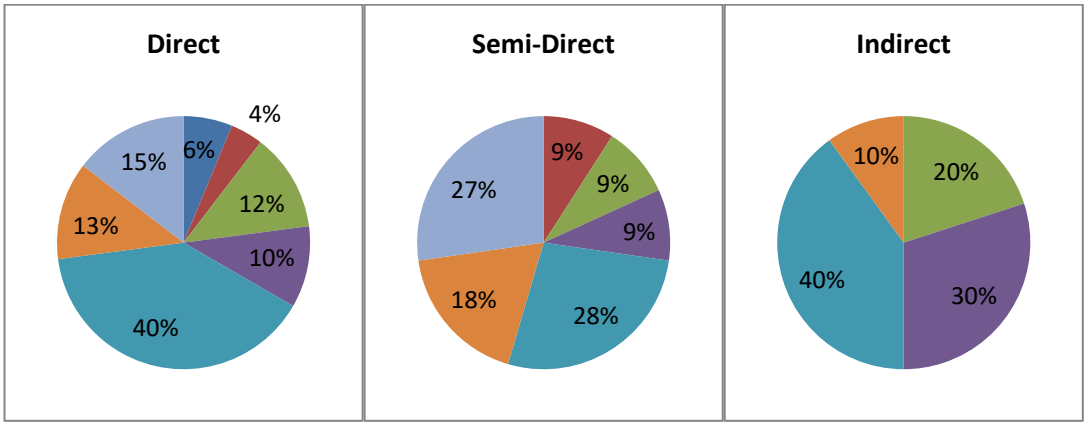


Figure 6-19 Company Council

6.4.8 FIGHT FOR SURVIVAL

This section provides the scores for fight for survival. The purpose of this section is to gain an insight into how strongly employees perceive their need to fight to secure the future of the plant. Whereas this construct is not one of de Treville and Antonakis' (2006) areas which could influence, or explain, the results it is important to the Nissan Sunderland Plant's particular context. In both the initial and expert interviews the need to fight for survival was regularly mentioned. It is possible that this threat could override any negative Motivating Potential Score. The impact of these results will be discussed in detail in the discussion and conclusions chapter.

The following four statements were included in the survey to assess fight for survival:

FS1. We do not have to compete with other Renault-Nissan plants

FS2. There is intense competition for new models between all the company's plants

Note: Opposite / negatively worded version of FS1

FS3. My job is 100% secure

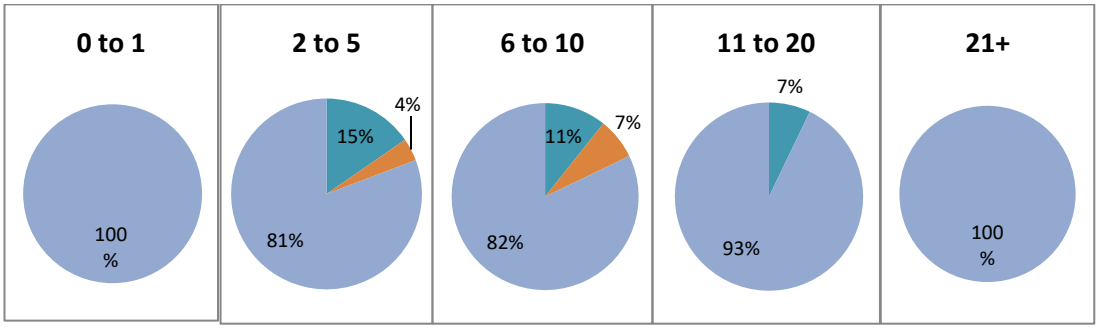
FS4. We are under constant pressure to keep improving the plant to secure our jobs

Note: Opposite / negatively worded version of FS3

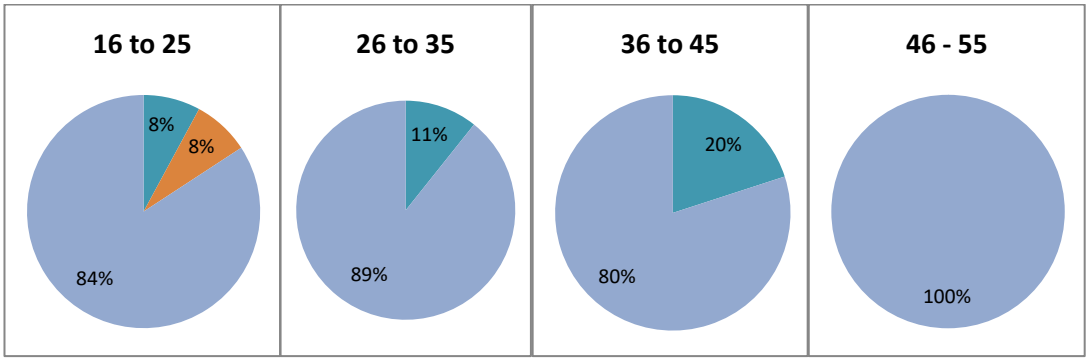
The results show participants to strongly disagree that they don't have to compete with other Renault-Nissan plants (FS 1&2). All 40 interviewees disagreed with 86% strongly disagreeing. The splits between tenures, age ranges, and areas of work were similar.

Key:

Tenure:



Age range:



Area of work:

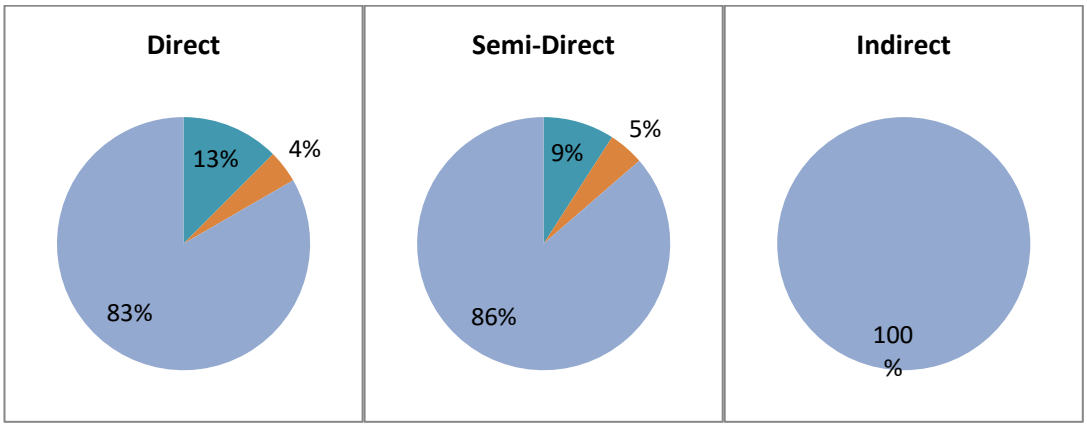


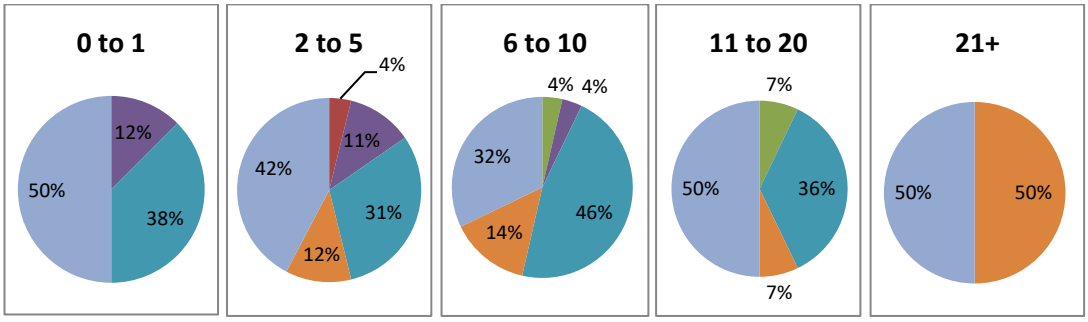
Figure 6-20 Fight for Survival Questions 1&2

Participants also felt, on the whole, that their jobs were not 100% secure. Only a very small percentage of participants believed that their jobs were 100% secure (4%) with 6% of participants having no view (neutral). The positive responses are attributed to those having worked at the plant for between 2 and 20 years. With regards to age range the positive results fall into the 16-25 and 36-45 age brackets. Direct and semi-direct staff produced a small percentage of positive and neutral scores with indirect staff being 100% negative.

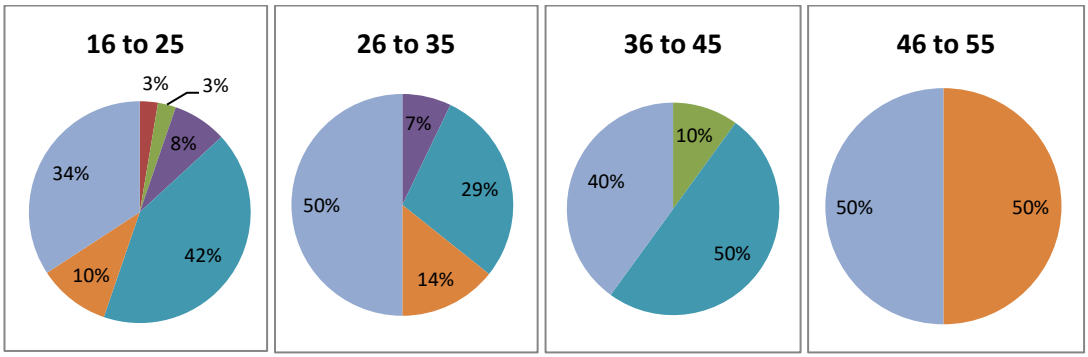
It is interesting to see FS 3&4 score noticeably less negative than FS 1&2 especially as the plant was on reduced production and employees were on stand downs at the time the survey was administered. It is possible that these scores would be more negative following the laying off of 1200 staff shortly after these results were gathered. The Nissan Sunderland Plant's continued success and track record up to this blip (the introduction of the car scrappage scheme saw production levels increase and people rehired less than 6 months after this incident) could have alleviated some employees' fears despite the rivalry with other Renault-Nissan plants.

Key:

Tenure:



Age range:



Area of work:

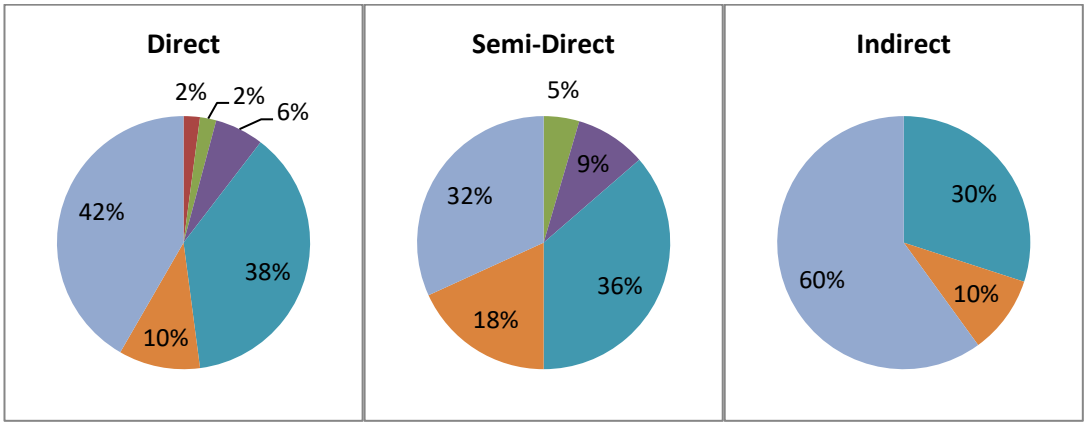


Figure 6-21 Fight for Survival Questions 3&4

6.5 SUMMARY

Despite Nissan Sunderland Plant's successful track record, and academia's view of intrinsic motivation being central to lean, the Motivating Potential Scores were low across all groups. The only exception was the two participants who were 44 – 55 years old and also formed the 21+ years tenure grouping. The average for all participants was 40.7 which is low.

Initial and expert interviews found that Nissan Sunderland Plant staff, both production and office based, are often employed by the plant for a long period of time. This suggests that there must be something offsetting the job's low potential to be intrinsically motivating. This offsetting factor could be construct fight for survival. The focus on survival, and pulling through as a team (task significance was, on the whole, above neutral) could override the low scores. Intrinsic motivation may simply be unimportant given the need to keep the plant going. However, there may also be a certain element of compromise, or lock-in as Nissan Sunderland Plant staff are paid competitive wages and training may not necessarily be transferable.

Contrary to the Nissan Production Way expert interview's statements the employees do not feel that they participate in group improvement activities but they do believe that they are trained to do several jobs. The initial interviews highlighted negativity towards the training offered and this was reflected in Cross-Training / Employee Development Questions 3&4 which found that employees largely did not believe that they could attend training courses with ease. This could be a practice influencing both skill variety and responsible autonomy. The employee would not easily be able to seek training to increase variety in their job role or perhaps even be responsible for their own training based on these results. The participants did however give primarily

positive (77%) scores for job rotation which, according to de Treville and Antonakis (2006), will have had a positive effect on the core job dimension skill variety.

Scores were relatively mixed for the construct Feedback From Others both in the co-worker and supervisor statements. Similarly, the overall core job dimension feedback score was low (3.488). This suggests that if 100% inspection does indeed exist (as discussed at the expert interviews) the practice is not being exploited to provide regular constructive feedback. Feedback from others is likely to have been influenced by Hoshin Kanri, viz whether employees can clearly see how their job contributes towards achieving company objectives. There was an even split between negative, neutral and positive scores for Hoshin Kanri. The inability for staff to be able to see where they fit into overall company objectives is likely to make providing feedback difficult and receiving feedback not as meaningful as they are unable to view this in light of the overall objectives. This may also be a reason why staff disagree that team recognition, as highlighted in the expert interviews, occurs in practice. Without clarity in assessing team and individual performance against company goals there is not an effective way to identify and reward team effort.

It is evident that this thesis now needs to draw information from all three empirical chapters to allow each research question and the overall objective to be effectively addressed. Themes have also emerged which can only be described and explained by bringing together all of this information. The following chapter will bring together all research phases and discuss key issues in further detail. Conclusions will then be drawn before this thesis is brought to a close.

7 DISCUSSION

This thesis aims to establish whether our current view of lean (academic views) is reflective of Lean in practice. As an initial point of departure, a thorough review of the literature which existed at the time the empirical data was gathered (2009) was conducted. This established that there is no commonly accepted definition of Lean. Our current views of Lean have thus far attempted to narrow the phenomenon to a set of key concepts, or to create a set of design principles to aid in implementing a Lean system, and are focused on technical elements rather than human factors. In response, this study created a Views of Lean Table which aimed to provide a collective view of Lean and the elements we currently believe may be attributable to this phenomenon. This was presented on pages 49-52.

The wide-ranging views of Lean, and a reliance on existing knowledge rather than new empirical studies, highlighted the need for the Views of Lean Table to include a view of an exemplar Lean facility. This study secured access to Europe's most productive car plant, Nissan Sunderland Plant, and was able to conduct a set of semi-structured interviews with office staff and production personnel (initial interviews) followed by more in-depth interviews with Nissan Production Way Experts (expert interviews). The interviews uncovered a lack of focus on intrinsic motivators which prompted an exploratory survey to understand the potential for jobs at the plant to be intrinsically motivating, and to establish whether intrinsic motivation is necessary for a successful implementation of Lean.

This chapter aims to bring all of the findings together to address the research questions which are as follows:

RQ1. What is our theoretical / academic view of Lean?

RQ2. What is the Nissan Production Way?

RQ3. How does practice compare to our theoretical / academic view of Lean?

RQ4. Is intrinsic motivation necessary for the success of a Lean implementation?

Research Question 1 was addressed through the creation of the Views of Lean table first detailed in section 2.5 (p49-52). Research Question 2 was addressed through the initial and expert interviews but is summarised, and added to the Views of Lean Table, to allow this discussion chapter to address Research Question 3. Finally, this chapter will address Research Question 4 through discussing the results of the Motivation Survey alongside the Influencing Practices which may have influenced the results.

7.1 How Does Practice Compare to Our Theoretical / Academic View of Lean?

Chapter 2 presented a Views of Lean Table which found a total of 63 Lean elements cited by 16 sources. The table combined Pettersen's (2009) study, which identified 33 Lean elements, with 6 additional sources. A further additional source, Moyano-Feuntes and Sarcristan-Diaz (2012), has been identified following completion of the empirical research. This is included in the full Views of Lean Table presented in this chapter. This article provides a detailed review of Lean Literature and identifies 25 elements of lean. One of these items, pay based on abilities not role, was a new addition to the table. This increased the total number of Views of Lean Table items from 63 to 64.

The Nissan Production Way expert interviews highlighted 62 features participants considered to be part of the Nissan Production Way. Whereas 45 of these features were already included in the Views of Lean Table 18 are new items. This has increased the

number of items in the Views of Lean Table from 64 to 82. Table 7.1 shows the latest version of the Views of Lean Table which includes both Moyano-Feuntes and Sarcristan-Diaz (2012) and the expert interviews' account of the Nissan Production Way at the Nissan Sunderland Plant.

Of particular note are build-to-order, Six Sigma, and Genba Kanri which the Nissan Sunderland Plant claims are central to their implementation of Lean. None of the sources included in the Views of Lean table cited these elements as being directly associated with Lean. The following sub-sections therefore discuss these elements in more detail.

Table 7-1 Views of Lean Table including the Nissan Production Way
See Appendix A (p241) for notes

			Additional Sources								Pettersen (2009)							
		NPW at NSP	Moyano-Feuentes & Sacristan-Diaz (2012)	Ohno (1988)	Schonberger (2007)	Aoki (2009)[10]	Mehri (1996)[11]	Lewis (2000)	Cusumano (1996)	Shah & Ward (2007)	Womack & Jones (2003) & Womack et al (1990)	Liker (2004)	Bicheno (2004)	Dennis (2002)	Feld (2001)	Shingo (1984)	Monden (1998)	Schonberger (1982)
1	Kaizen / Continuous improvement[1]	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
2	Just-in-time	●[24]	●	●	●		●	●	●	●[7]	●	●		●	●	●	●	●
3	Kanban / pull system	●	●	●	●		●	●	●	●	●	●	●	●	●		●	●
4	Setup time reduction	●	●	●	●				●	●	●	●	●	●	●	●	●	●
5	Production leveling (Heijunka)	●[25]	●	●	●			●[22]	●	●[6]	●	●	●	●	●	●	●	
6	Small lot production	●	●	●	●			●	●	●		●	●		●	●	●	●
7	Inventory reduction	●	●	●	●		●	●	●		●	●		●		●	●	●
8	5S/Housekeeping	●	●	●	●	●					●	●	●	●	●		●	●
9	Waste elimination	●	●	●	●	●		●			●	●	●	●		●		●
10	Supplier involvement	●	●	●[2]	●			●		●	●	●	●	●	●		●	
11	Poka yoke[4]	●		●	●				●			●	●	●	●	●	●	●
12	Standardised work	●[26]		●		●			●			●	●	●	●	●	●	●
13	Visual control and management	●	●	●	●							●	●	●	●	●	●	●
14	Andon	●		●	●		●	●			●	●			●	●	●	●
15	TPM / preventative maintenance	●	●	●	●					●		●	●	●	●			●
16	Improvement circles	●[30]	●		NO[3]	●	●	●[19]		●[8]		●		●			●	●

		NPW at NSP	Additional Sources								Pettersen (2009)							
			Moyano-Feuentes & Sacristan-Diaz (2012)	Ohno (1988)	Schonberger (2007)	Aoki (2009)[10]	Mehri (1996)[11]	Lewis (2000)	Cusumano (1996)	Shah & Ward (2007)	Womack & Jones (2003) & Womack et al (1990)	Liker (2004)	Bicheno (2004)	Dennis (2002)	Feld (2001)	Shingo (1984)	Monden (1998)	Schonberger (1982)
17	Education / cross training (OJT)	●	●	●	●	●	NO[16]		●	●[5]		●			●			●
18	Employee involvement	●[32]	●	●	●	●	NO			●	●	●		●			●	
19	Teamwork	●[28]	●	●		●	NO	●[20]			●	●		●	●			
20	Layout adjustments	●					●[12]	●	●	●				●		●	●	●
21	Time/work studies	●[27]		●							●	●	●	●	●		●	
22	Takted production	●		●								●	●	●	●	●	●	
23	Autonomation (Jidoka)[33]	●		●					●[23]			●		●		●	●	●
24	Statistical quality control / SPC	●						●		●	●		●	NO	●		●	●
25	Work force reduction	●		●				●						●		●	●	●
26	Root cause analysis (5 Whys)	●[31]		●	●	●					●	●	●					
27	Value stream mapping / flowcharting	●	●		NO			●[21]			●	●	●	●				
28	Cellular manufacturing	●			●			●		●			●		●		●	
29	Policy deployment (Hoshin kanri)	●					●				●	●	●	●				
30	Lead-time reduction	●	●					●				●		●			●	
31	Process Synchronisation	●[34]		●	●							●				●		●
32	Multi-manning	●		●							●					●	●	

Table 7-1 Views of Lean Table including the Nissan Production Way (continued)
See Appendix A (p241) for notes

		NPW at NSP	Additional Sources								Pettersen (2009)							
			Moyano-Feuentes & Sacristan-Diaz (2012)	Ohno (1988)	Schonberger (2007)	Aoki (2009)[10]	Mehri (1996)[11]	Lewis (2000)	Cusumano (1996)	Shah & Ward (2007)	Womack & Jones (2003) & Womack et al (1990)	Liker (2004)	Bicheno (2004)	Dennis (2002)	Feld (2001)	Shingo (1984)	Monden (1998)	Schonberger (1982)
33	100% inspection	●[29]										●		●		●		●
34	Customer focus/involvement	●	●							●								
35	Kaizens / Kaizen events	●	●			●												
36	Management disciplining workers					●	●											
37	Managerial job rotation	●	●					●										
38	Job rotation	●	●		●													
39	Total Quality Control	●				●				NO								
40	Employee and Employer need each other to survive	●					●											
41	Seniority	●					●											
42	Open office arranged by seniority	●[36]				●[18]	●											
43	Supplier reduction		●					●										
44	Company council or similar	●						●										
45	Single / no unions	●					●											
46	Employee development	●[50]	●															
47	Communities of Practice	?[35]				●[9]												
48	Culture of rules						●[13]											
49	Performance appraisal for all	●[37]						●										
50	Profit over employee welfare	●[38]					●[17]											

Table 7-1 Views of Lean Table including the Nissan Production Way (continued)
See Appendix A (p241) for notes

Table 7-1 Views of Lean Table including the Nissan Production Way (continued)
See Appendix A (p241) for notes

			Additional Sources								Pettersen (2009)							
		NPW at NSP	Moyano-Feuentes & Sacristan-Diaz (2012)	Ohno (1988)	Schonberger (2007)	Aoki (2009)[10]	Mehri (1996)[11]	Lewis (2000)	Cusumano (1996)	Shah & Ward (2007)	Womack & Jones (2003) & Womack et al (1990)	Liker (2004)	Bicheno (2004)	Dennis (2002)	Feld (2001)	Shingo (1984)	Monden (1998)	Schonberger (1982)
51	Bullying as form of control						●											
52	Promotion through being close to management						●											
53	Manager is parent, subordinate is child (hierarchical)						●											
54	Relentless line speeds						●											
55	Employees required to have work experience						●											
56	Design for manufacture				NO			●										
57	Innovation through copy and enhance						●											
58	Intense rivalry and resistance to co-operate between depts	NO					●											
59	Performance -related pay							●										
60	Profit-sharing scheme							●										
61	Inductive problem solving						●											
62	High levels of subcontracting								●									
63	Flexible working agreements	●[39]																
64	Build-to-order	●[40]																
65	17 Wastes	●[41]																
66	Internal competition between plants	●																

			Additional Sources								Pettersen (2009)							
		NPW at NSP	Moyano-Feuentes & Sacristan-Diaz (2012)	Ohno (1988)	Schonberger (2007)	Aoki (2009)[10]	Mehri (1996)[11]	Lewis (2000)	Cusumano (1996)	Shah & Ward (2007)	Womack & Jones (2003) & Womack et al (1990)	Liker (2004)	Bicheno (2004)	Dennis (2002)	Feld (2001)	Shingo (1984)	Monden (1998)	Schonberger (1982)
67	Global idea and information sharing	●																
68	0.5 tier (on-site) suppliers	●																
69	Joint supplier-plant training	●[42]																
70	Few job titles	●																
71	Team based recognition	NO[43]																
72	Decision Analysis	●[44]																
73	Ergonomics	●[45]																
74	Production methodology used in indirect areas	●[46]																
75	Six sigma	●[47]																
76	Toolbox thinking	●[48]																
77	Limited batch production	●[49]																
78	Line experience for indirect employees	●																
79	Pay based on abilities not role		●															
80	Tatemae/honne (private vs public)						●[14]											
81	Innovation from outside						●[15]											
82	Genba Kanri	●[51]																

Table 7-1 Views of Lean Table including the Nissan Production Way (continued)
See Appendix A (p241) for notes

7.1.1 BUILD-TO-ORDER

There are two never-endings within the Nissan Production Way; (i) never-ending synchronisation of manufacturing with customers (douki), and (ii) never-ending quests to identify and fix problems (Kaizen) (Nissan 2007). Build-to-order is the synchronisation of manufacturing with customers; providing customers with what they want and at the time they want it. The Nissan Sunderland Plant seeks to increase synchronisation of production with suppliers, internal functions and customers, viz the entire supply chain (Nissan 2007).

Despite build-to-order not being cited as a Lean feature by any of the Views of Lean Table's sources it should be considered as an element of Lean. Lean has progressed from its original focus on shop-floor techniques to its current focus on the entire value stream. From the beginning of the 21st century this has included looking beyond production to extend pull production to upstream and downstream entities (Hines et al. 2004). Whereas Hines et al (2004) do not explicitly connect the shift in focus to build-to-order, Holweg and Pils (2001) claim that build-to-order is part of the pull production strategy (see figure 7-1). It may therefore be inferred that where there is a mention of pull production being an element of Lean (cited by 14 Views of Lean Table sources), build-to-order is also a Lean feature. Similarly, where process synchronisation (cited by 5 Views of Lean Table sources) is cited as a Lean feature this may also imply that build-to-order is part of Lean as it involves customers in the synchronisation process (they effectively kick the process off). Insights gained from the expert interviews suggest that the Nissan Sunderland Plant is working towards true build-to-order; their build-to-order percentage was 90% at time of interview.

	PUSH				PULL
	Make-to-Forecast (MTF)	**Locate-to-Order (LTO)**	**Amend-to-Order**	**Hybrid Build-to-Order**	**True Build-to-Order (BTO)**
Goals	■ Produce standard products from long-term-demand forecasts ■ Manage stock reactively to allow for efficient production	■ Use MTF, but increase stock visibility (through the Internet, for example) to enhance customer choice	■ Provide custom orders when specifications of product in system can be easily amended	■ Rely on forecasting for high-volume, stable products, and build low-volume products to order	■ Build products only after the customer orders them ■ Make customer needs visible to all parts of the value chain
Benefits	■ Efficient production ■ Local optimization of factory operations	■ Higher chance of finding right product in stock ■ Inexpensive to implement	■ Higher degree of custom-built vehicles in production	■ Stable base production ■ Relatively short order-to-delivery times on average ■ Less inventory ■ Less discounting	■ No stock apart from showroom and demonstrators ■ No discounting
Weaknesses	■ High levels of finished stock in market ■ MTF requires alternative product specifications and discounting to sell aging stock ■ Customer orders compete with forecast for capacity ■ MTF loses sight of real customer demand	■ High stock levels remain ■ Discounting still required ■ Custom orders still compete with forecast for capacity ■ Extra cost to transfer product to location close to customer	■ Customer orders built only when they fit ■ Unsold orders are built anyway ■ High temptation to revert to MTF if demand drops	■ Stock is still in market ■ Still requires discounting to cope with forecast error ■ Danger of reverting to pure MTF when demand shifts	■ System is sensitive to short-term demand fluctuations, so will not work without proactive demand management ■ Active revenue management required to maximize profit

Figure 7-1 Push vs. Pull Strategies
Source: Holweg and Pils (2001)

7.1.2 SIX SIGMA

Six Sigma is a structured approach to improving processes developed at Motorola. The statistical measure gained popularity following its use at General Electric in 1995 (Pepper and Spedding 2010). Schonberger (2007) argues that Six Sigma is a western modification of Japanese production management which uses well-known existing tools presented in a positive way. *"Presentation – black belts and green belts honouring six-sigma experts – can make statistical process improvement, and the systematic six-sigma methodology taste good, and do good work"* (p413). Six Sigma can be viewed as an addition to Lean rather than a tool of Lean itself (Hines et al. 2004). Other additions to Lean (see figure 7-2) include Total Production Maintenance which was cited as a Lean tool by 9 Views of Lean Table sources.

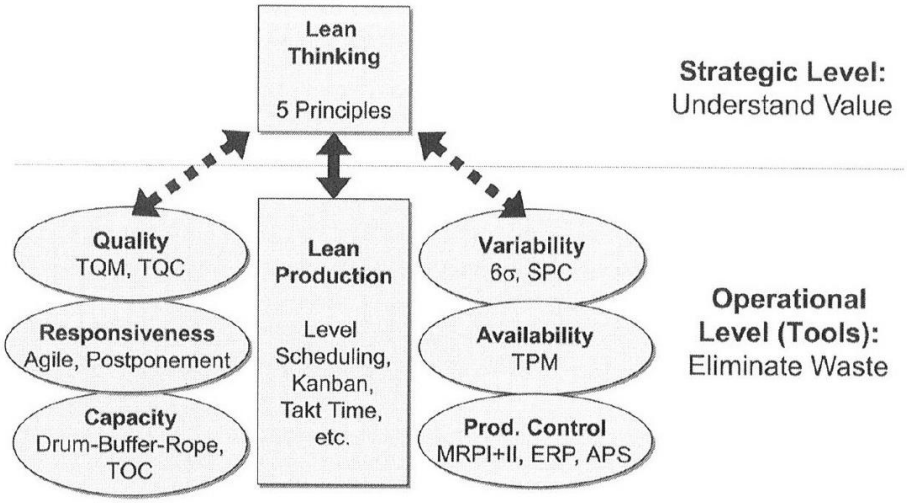


Figure 7-2 Lean Framework
Source: Hines et al (2004)

The phrase 'Lean Six Sigma' refers to the integration of the tool with Lean thus viewing Six Sigma as separate, but complementary to Lean Production (Pepper and Spedding 2010). Whereas *"Lean emphasises speed and waste… Six Sigma emphasises variation defects and process evaluation"* (Antony 2011: p185). Six Sigma is a quality management tool which supports Lean by helping to control production processes (Bayo-Moriones et al. 2008).

The expert interviewees claimed that Six Sigma is an element of the Nissan Production Way. When asked if there were any practices considered to be add-ons to the Nissan Production Way the only item considered to be an add-on was Improvement Diagnostic System (Improvement Diagnosis System). However, Improvement Diagnostic System was still described as a tool central to the Nissan Production Way at the Nissan Sunderland Plant. Whereas research considers Six Sigma to be separate to Lean (e.g. Hines et al. 2004; Bayo-Moriones et al. 2008; Pepper and Spedding 2010; Antony 2011) in practice at the Nissan Sunderland Plant there is no such distinction; Six Sigma is viewed as part of the Nissan Production Way Toolbox.

7.1.3 GENBA KANRI

The expert interviewees cited Genba Kanri as being a feature of the Nissan Production Way. Genba Kanri is a disciplined approach to managing the shop-floor which is viewed as the main battleground for quality and productivity. To be able to take action you must understand how the product and the plant (including human beings who by their very nature are imperfect) affect each other. Making improvements and resolving issues is a vital role for production staff. Decisions should be made instantly on the shop-floor by managers and supervisors who consult with their team (Handyside 1997). Genba Kanri is the *"foundation on which its better-known offshoot applications, such as Just-in-Time, Poka-Yoke, Total Preventative Maintenance and Kanban, are constructed. It makes clear assumptions about the management of the manufacturing process, which it regards as the source of all real improvement, and consequently also about the roles and responsibilities of manufacturing personnel, particularly its First Line Managers and their key tasks of defining, controlling and improving that process"* (Handyside 1997: p72).

Handyside (1997) implies that Genba Kanri is an element of Lean. There is limited existing research discussing Genba Kanri; a search for the term "Genba Kanri" using the ABI/Inform database yielded less than 10 results, none of which give a detailed account of the concept. There appears to be a degree of confusion as to whether the concept is spelt *Gemba* Kanri or *Genba Kanri*; searching the ABI/Inform database for the term "Gemba Kanri" also yielded less than 10 results. Nissan (2007) refers to the concept as Genba Kanri stating that shop-floor management follows a Plan-Do-Check-Act approach.

7.1.4 OTHER ELEMENTS

The Nissan Production Way refers to ergonomics as a method for reducing unnecessary movement, one of the seven original wastes (see table 5-1). Expert 3 cited ergonomics as being part of improving work flows along with workstation layout, low cost automation, lifting devices, actual automation and robotics. It is also logical to assume that ergonomics is also related to the plant's Zero Injury Programme which involves regular weekly behavioural audits in which staff are taken around processes to identify unsafe behaviour. Adler et al (1997) discussed the ergonomics problems (e.g. sprains and repetitive strain injuries) caused by ill-fitting parts on a new model introduced to New United Motors Manufacturing Inc, a joint General Motors-Toyota venture in the United States. Whereas their research did not cite ergonomics as a Lean element it was claimed that poor ergonomics can decrease safety levels and employee commitment. Worker safety is a crucial part of the Lean's respect for human system which also includes giving employees greater authority and eliminating excess worker movements (Sugimori et al. 1977). This would suggest that Lean literature implies the inclusion of ergonomics within Lean due to the focus on worker safety / well-being.

The Views of Lean Table sources did not explicitly cite 'decision analysis' as a feature of Lean however it is implied that decision analysis exists through the use of tools including Pareto charts, one of the seven basic tools of quality. Flexible working agreements which allow the Nissan Sunderland Plant to schedule overtime or non-production days, internal competition between plants and global information sharing are all features which the expert interviewees considered to be aspects of the Nissan Production Way. Whereas the expert interviews have highlighted features we may not explicitly attribute to Lean, the inclusion of other tools and practices as elements of Lean may imply their existence. For example, it may be implied that joint supplier-plant training is a Lean element through inclusion of supplier development. It would be

logical for a system that focuses on removing non-value adding activities to seek cost efficiencies in how they organise training courses attended by both suppliers and plant staff.

7.1.5 SUMMARY

Current attempts to define Lean appear to be narrow. The average number of features cited by each of the Views of Lean Table sources is 20. In comparison, this study identified 62 elements of Nissan Sunderland Plant's implementation of Lean – the Nissan Production Way. 18 of these 62 elements were not cited by any other sources.

The sources citing the most amount of Lean features were Ohno (1988), Dennis (2002) and Moyano-Fuentes and Sacristan-Diaz (2012) all with 25 items. The Nissan Production Way incorporates most features we consider to be stereotypically Lean (e.g. Just-in-Time, Kaizen). Compared to our current view of Lean the Nissan Production Way is a more complex system incorporating a wider array of interrelated features. The Nissan Production Way is a process of continuous development, additions and refinement. Neither the initial interviews nor the expert interviews highlighted a set of core Nissan Production Way elements. Nissan Production Way tools form part of the Nissan Production Way Toolbox, a collection of tools and techniques which are used when appropriate. Forming a core set of Lean components focuses researchers and practitioners on what is a very small area of Lean Production. This may prevent researchers and practitioners from being able to identify the tools and practices within real-life facilities if protocols are based on very specific Lean definitions. It is for this reason this research formed the Views of Lean Table and built the expert interviews protocol based on a collection of Lean views.

7.2 ARE NISSAN SUNDERLAND PLANT STAFF INTRINSICALLY MOTIVATED?

The motivation survey found Motivating Potential Score results for the majority of categories to be low, very low, or extremely low. Only the 21+ years at plant and 45 – 55 age range categories had neutral scores. Both categories were only represented by two survey participants who were the same for both categories (hence the identical scores). One of these participants was a senior supervisor whilst the other was a team member. The higher score could be due to the staff members having more responsibilities because of their 21+ years' experience at plant or due to lowered expectations. Their scores were also above Hackman and Oldham's (1974) average Motivating Potential Score of 125 suggesting that there was the potential for their jobs to be motivating.

The Motivating Potential Score is calculated from the core job dimension scores. De Treville and Antonakis (2006) claimed that the outcome of the core job dimension scores, and subsequently the Motivating Potential Score, can be explained by a number of influencing practices. The Nissan Production Way Job Diagnostic Survey therefore included an assessment of elements which may influence the Nissan Production Way core job dimension results. The following sections discuss the average results for each of the core job dimensions and their influencing practices. Additional information from insights gained during the initial and expert interviews is also provided. Results were scored by participants on a 7-point Likert scale.

7.2.1 SKILL VARIETY

The Nissan Production Way Job Diagnostic Survey assessed three skill variety influencing practices; (i) Kaizen, (ii) cross-training, and (iii) job rotation. De Treville and Antonakis (2006) argued that these practices influence skill variety positively, viz a

high score (above neutral) for one of these practices may result in an increased skill variety score. Full details are provided in chapter 6.

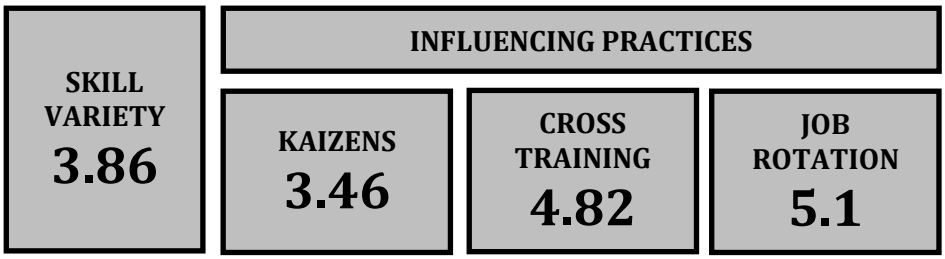


Figure 7-3 Skill Variety & Influencing Practices Scores (n=40)

Figure 7-5 (above) shows the average scores for skill variety and the construct's influencing practices. Skill variety's score indicates that employees slightly disagreed that there was variety in their jobs (4 is neutral). Similarly, employees slightly disagreed that they were involved in Kaizens but were more positive with cross-training (slightly agreed) and job rotation (agreed). Whereas Kaizens score may have a negative impact on skill variety, de Treville and Antonakis (2006) claims that cross training and job rotation should have a positive impact. Given that employees agree that both job rotation and cross training occurs in practice why does skill variety fall below neutral?

Job rotation does not necessarily indicate skill variety. Employees may move between jobs but these jobs may be very similar in nature. This could be due to the standard procedures and operations set in place. Initial interviews suggested that production staff are increasingly tied to the line. Job rotation for these employees is therefore unlikely to involve offline activities. This is also a likely factor behind the slightly negative Kaizens score. Two of the production interviewees described the Nissan Sunderland Plant working environment as repetitive. It was acknowledged in both the initial and expert interviews that there are fewer and fewer opportunities for

promotion due to employees staying in their roles for a relatively long term. When opportunities for promotion do arise there is a high degree of competition. This could also affect the skill variety result as employees have less ability to move up the corporate ladder and assume new responsibilities. However, progression in the eyes of a production team leader comes at a cost. He had been offered a supervisor role but declined due to the high expectations placed on supervisors and the increasing amount of time they spend on the production line. He believed that the original meaning for supervisor roles had been lost.

Whilst cross-training might be expected to increase skill variety, the evidence from this research suggests that in practice, within the Nissan Production Way at Nissan Sunderland Plant, this may not be happening. It is evident that cross-training exists but employees may be trained to do multiple, but virtually similar jobs. Whereas the expert interviews suggested that employees can actively request additional training they might not physically have time to attend. Initial interviews suggested that training is often carried out for the benefit of the company in seeking government grants rather than increasing their own skills. Furthermore, one production team leader claimed that they never have chance to implement ideas gained through training as there is never enough time. Training is also viewed by one of the initial interviewees to be a waste of their time. *"It's just a waste of time – I have to go and write things down – I come back put the folder in my locker and it doesn't see the light of day again."*

The skill variety score is very close to neutral. To improve the overall score, the Nissan Sunderland Plant may see benefit in ensuring job rotation includes jobs that are varied and dissimilar. Managers need to give employees time to implement ideas learnt through training to ensure that there is a payoff for the time and resources invested. This could also add variety to the employee's job role. Similarly, the inability to

participate in Kaizens also reduces skill variety. For office staff regular contact with the line could increase variety whilst also ensuring these staff are more in touch with the realities of the production line. *"I don't think that people realise how much we are tied to the line now"* (Production Team Leader).

7.2.2 TASK SIGNIFICANCE

The Nissan Job Diagnostic Survey assessed four practices that may influence the task significance score; (i) feedback from others, (ii) Hoshin Kanri, (iii) Kaizens, and (iv) team recognition. The average task significance score was 4.74. This indicates that the survey participants agree that their jobs have a *"substantial and perceivable impact on the lives of other people, whether in the immediate organisation or the world at large"* (Hackman et al. 1975: : p59). Whereas employees slightly agree that feedback from others and Hoshin Kanri occurs in practice, Kaizens and team recognition have produced negative scores (see figure 7-4).

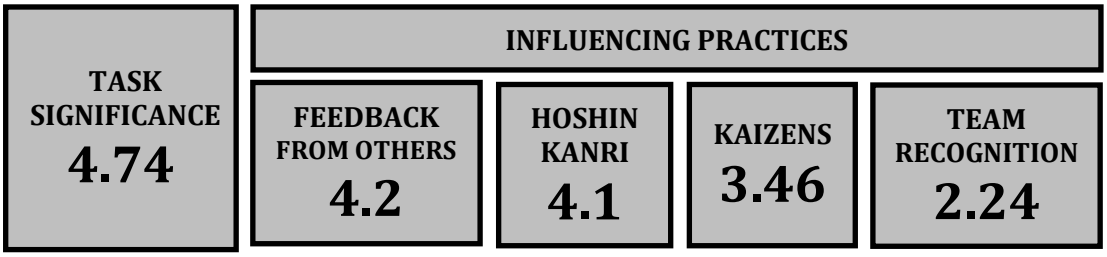


Figure 7-4 Task Significance & Influencing Practices Scores (n=40)

Initial interviews found production staff to be increasingly tied to the production line. This may have resulted in fewer opportunities to participate in Kaizens (improvement activities), hence the slightly negative score. Hoshin Kanri (policy deployment) scores were just above neutral (neutral = 4) suggesting that employees do not necessarily see where their job fits into the company objectives. Feedback from others, including both supervisors and work colleagues, was also just above neutral. This would suggest that

the participants feel that they don't receive enough feedback or support which is supported by an internal survey which revealed that employees didn't feel that the company listens to what they say. The Trim and Chassis Line 2 Manager expressed disappointment in these results whilst stating that although it should be as easy as approaching a supervisor with an idea it is impractical to act on every suggestion. *"It is essential that we give feedback to suggest why an idea may not have been acted upon… the opportunity is there; we have just got to make it happen perhaps better than it does at the moment."* One of the initial interviewees was of the view that some suggestions are dismissed due to internal politics and *"ridiculous reasons"*. This is possibly a reason for the slightly negative Kaizens score.

Team recognition was the lowest scoring influencing practice. A score of 2.24 indicates that on average motivation survey participants firmly disagreed that team recognition occurs in practice. The Trim and Chassis Line 2 Manager stated that *"it is important that their efforts are appreciated and recognised."* However, the emphasis was placed on rewarding staff through their overall competitive pay package. A production supervisor who had worked for the Nissan Sunderland Plant for over twenty years claimed *"if you are talking of something they can recognise as a reward there's not much lying around to be honest."* The expert interviews suggested that team based recognition had occurred in the past. This result suggests that team based recognition is not a key feature of the Nissan Production Way and is a rarity, rather than a regularly occurring phenomenon.

Given the neutral to low scores of task significance's influencing practices it would be logical to expect the construct to have gained a lower score. However, there would appear to be other factors in play. The camaraderie between staff and the strong support for the company could have a positive effect on the task significance score. Production staff participating in the initial interviews were unanimous in their view of the workforce being the key success factor for the Nissan Sunderland Plant. However,

one team leader argued that *"there is always going to be a bit of resentment [from the employees] that the company makes them work so hard."*

7.2.3 TASK IDENTITY

Hackman et al (1975) describe task identity as the *"degree to which the job requires completion of a whole and identifiable piece of work – doing a job from beginning to end with a visible outcome"* (p59). The Nissan Job Diagnostic Survey assessed one practice which may influence the task identity score; cross-training. De Treville and Antonakis (2006) claim that cross-training can have a positive effect on task identity as it helps employees to fully understand and be able to undertake their tasks. Despite employees slightly agreeing that cross-training occurs in practice (4.82) the task identity score was low (3.02) as shown in figure 7-5 (below).

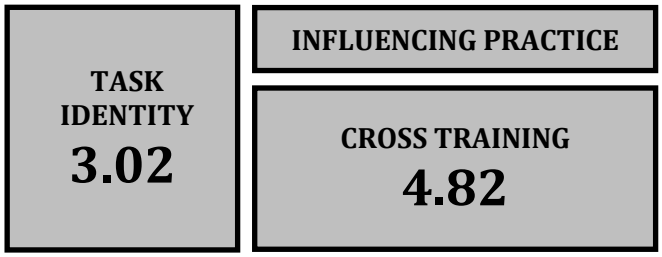


Figure 7-5 Task Identity and Influencing Practice Scores (n=40)

In the motivation survey cross-training statements asked participants if they were trained to do more than one job and if they were able to easily attend relevant training courses. Whereas participants agreed that they were trained to do more than one job they slightly disagreed that they were able to attend relevant training courses with ease. This suggests that staff are not finding it easy to proactively attend courses that could allow them to increase the number of tasks they are able to perform (i.e. employee development). One team leader suggested that *"the company obviously thinks that they are developing people… most of them lads are saying that they don't want to go*

to training today as they would rather be working. Training is a long day. Most of the lads are not office / training minded. Time goes quicker on the line". The comment was in light of the factory's stand-down due to lower demand and subsequent use of employee time by sending them on training courses. According to de Treville and Antonakis (2006) this would have a negative impact on both skill variety and task identity.

The vast amount of work required to build a car, and the cellular production system utilised within the Nissan Production Way makes it impossible for production line workers to be involved in all stages of a car's build. It is therefore possible that task identity is low as employees find it hard to perceive their task as completing an entire piece of work. The repetitive nature of their task, and low cycle times would also make it harder for production line workers to score highly for task identity.

Whereas production line staff scored an average of 1.9 for the construct (pushing the score low) those working in-between the line and the office (semi-direct) scored 5.1. This was higher than the 3.9 average score for office based staff. The higher score for semi-direct staff may be due to their ability to see a holistic picture, easier access to information, and regular view of progress on the production line. In comparison office based staff may not have as deep of an understanding as to the current state of the production line resulting in a lower task identity score.

7.2.4 Choice Autonomy

De Treville and Antonakis (2006) define choice autonomy as freedom over procedures and timing. This construct is identical to Hackman and Oldham's (1974) core job dimension 'autonomy'. De Treville and Antonakis (2006) argued that choice autonomy is likely to be low due to the heavy use of standardisation and standard operations.

They did not cite any influencing practices. The average choice autonomy score was 2.97 which suggests de Treville and Antonakis' (2006) claim to be correct.

7.2.5 RESPONSIBLE AUTONOMY

Responsible autonomy is *"related to the degree to which the worker plays an active role in setting the rules by which he or she is bound"* (de Treville and Antonakis 2006: : p110). The construct's influencing practices are Hoshin Kanri and Kaizens. The average score for responsible autonomy was slightly negative (3.08). Similarly the scores for Kaizens and Hoshin Kanri were also relatively low (see figure 7-6).

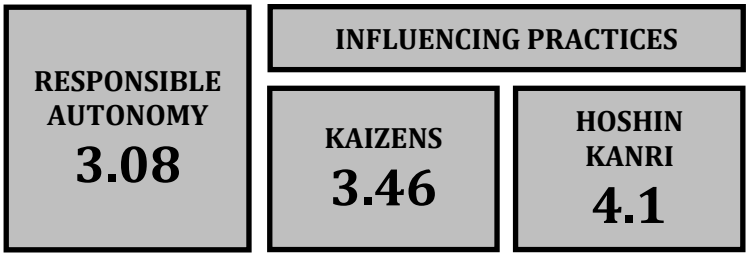


Figure 7-6 Responsible Autonomy and Influencing Practices (n=40)

Production staff provided a more negative score (2.9) than their office counterparts (3.9). Staff who work in-between the two areas gave responsible autonomy an average score of 3.2. This indicates that all survey participants, regardless of work location, feel that they don't have the responsibility or power to improve their work area. Production staff are likely to provide a low score based on the initial interview evidence that they are increasingly stuck to the line and thus unable to participate in these activities. However, this is not the case for office staff who are likely to have more freedom. The initial interviews suggest that bureaucracy may be preventing valid suggestions, or ideas, being used in practice.

Hoshin Kanri can have a positive impact on responsible autonomy if staff can clearly understand how personal objectives contribute to company goals. This could help employees understand any improvement targets and appreciate the potential value of meeting those targets. One of the initial interviewees who worked in the offices suggested that Nissan Production Way *"is there way of having a good working relationship where everyone is kept informed, everyone appreciates the main elements and this way of working is also used in our appraisals."* Whereas *"the key is to continuously examine the norm and not to rest on our laurels"* (Expert 3) these results suggest that employees feel unable to influence their own work area rules (or standard procedures).

7.2.6 FEEDBACK

Feedback is *"the degree to which a worker, in carrying out the work activities required by the job, gets information about the effectiveness of his efforts"* (Hackman et al. 1975). The motivation survey included five feedback influencing practices; (i) feedback from others, (ii) Hoshin Kanri, (iii) Kaizens, (iv) team recognition, and (v) company council. Company council may have a positive impact on feedback. If it is deemed to have a strong influence on others this could be seen as a credible feedback mechanism. The average feedback score was slightly negative (3.49). Similarly, the construct's influencing practices are also either negative or close to neutral (see figure 7-7).

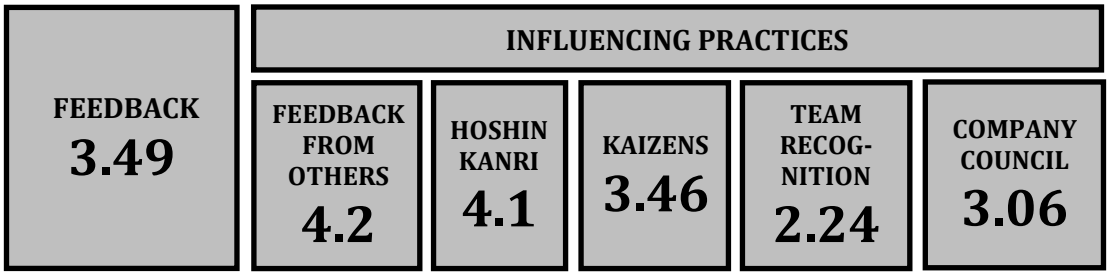


Figure 7-7 Feedback and Influencing Practices Score (n=40)

The feedback score indicates that the survey participants disagree that they are able to tell how they are performing by just doing their job. Chapter 6 suggested that if the company council is deemed to have a strong impact on other staff there may be a somewhat positive effect on feedback. According to the average company council score survey participants do not agree that the council has any real power, or impact on themselves. In contrast expert interview participants claimed that the company council is elected by the Nissan Sunderland Plant employees and has a degree of input into the disciplinary process. However, *"they do not have the traditional impact that unions have"* (Expert 3).

Standard operations and procedures should result in staff feeling that they are able to assess their own progress. If the staff member is consistently not adhering to, or meeting, standard operations and procedures this is an indicator of their performance. The lack of rewards (both intrinsic and extrinsic) and focus on the 'competitive package' does not allow for positive reinforcement. According to Expert 3 staff may be recognised in the company magazine, intranet, or through turning their solutions into best practice. *"To some people that is enough to be honest"* (Expert 3). Whereas the appraisal process can also provide feedback and recognition in either the yearly appraisal or mid-year review if, as the initial interviews suggest, production staff are increasingly tied to the production line they may not have time to consider their progress and needs for development. The focus for rewards appears to be on the competitive package and merit payments. This does not necessarily help in positively influencing the feedback score.

7.2.7 MOTIVATING POTENTIAL SCORES

Motivating Potential Score results (figure 7-8) suggest that the potential for Nissan Sunderland Plant staff to be intrinsically motivated is low, viz, Nissan Sunderland Plant employees have a low likelihood of being intrinsically motivated. Motivating Potential Score increases as both time at plant and age range increases. This could be due an increase in responsibilities for higher age range / time at plant ranges or due to employees having more accurate job expectations. Motivating Potential Score also increases as participants work further away from the production line. Employees working on the line have commented on being increasingly tied to the line, and having little spare time to implement training teachings or to be involved with Kaizens. This could be a reason why the Motivating Potential Score increases as participants work further away from the production line. The majority of results are low and fall under Hackman et al's (1975) average Motivating Potential Score of 125.

OVERALL 40.9						
	TIME AT PLANT	0 – 1 16.5	2 – 5 31.4	6 – 10 40.0	11 – 20 56.0	21+ 191.1
	AGE RANGE	16 - 25 27.7	26 - 35 38.8	36 - 45 63.9	46 - 55 191.1	
	AREA OF WORK	DIR 25.1	SEMI 58.2	INDIR 115.5		

Note: DIR (direct) work directly on the production line, SEMI (semi-direct) work between the production line and offices, and INDIR (indirect) work in the offices.

Figure 7-8 Motivating Potential Score by Categories (n=40)

Adler and Cole (1993) argue *"when products are fairly standard and mass produced, and when automation is still not cheap enough to eliminate labour-intensive methods of production, then efficiency requires narrowly specialised job assignments and formalised standard methods – a form of work organisation that precludes the very high intrinsic*

work satisfaction that would, for example, stimulate workers to come in without pay on a day off to tackle a production problem" (p91-92). When the plant was first opened employees would stay back twenty minutes to stock up and tidy up. However, *"it's a different environment we are working in now. When the buzzer goes the mentality is right I am not getting paid now I am going out the door… You disagree with a lot of the things that happen now but you have to try and persuade people that it's right even if you don't think that's right as it's your job."*

De Treville and Antonakis (2006) argued that Lean Production has the potential to be intrinsically motivating but will differ significantly depending on Lean configuration. They suggest that Lean configurations can fall into three categories; (i) too Lean, (ii) somewhat right, and (iii) just right (see figure 7-9). Excessive implementations of Lean will result in a negative impact on the critical psychological states and work outcomes (performance, absenteeism, satisfaction). Whereas these configurations provide a valuable discussion point they are also somewhat confusing. What is considered to be a 'low' score and a 'high' score? Figure 7-3 shows the Nissan Production Way's skill variety score. At 3.89 the score slightly low but only 0.11 away from being neutral (4). If we assume that low equals <4 and high equals >4, skill variety is low but only 0.12 away from being considered to be high. All core job dimensions with the exception of task significance would also be classed as low in which case it is unclear whether de Treville and Antonakis (2006) would consider the Nissan Production Way to be too Lean, or perhaps not Lean at all.

TOO LEAN	SOMEWHAT RIGHT	JUST RIGHT
SV = LOW	SV = HIGH	SV = HIGH
TI = HIGH	TI = HIGH	TI = HIGH
FB = HIGH	FB = HIGH	FB = HIGH
RA = LOW	RA = LOW	RA = HIGH
CA = LOW	CA = LOW	CA = LOW
WF = LOW*	WF = HIGH*	WF = HIGH*

Key: SV (skill variety), TI (task identity), FB (feedback), RA (responsible autonomy), CA (responsible autonomy), WF (work facilitation).

Notes: WF was not included in this study (cf. chapter 6).
De Treville and Antonkais (2006) did not include task significance in their JCM whereas this study does (cf. chapter 6).

Figure 7-9 Lean Configurations
Adapted from: de Treville and Antonakis (2006)

It would appear that tatemae (what you are supposed to feel or do) and honne (what you actually feel or do) exists within the Nissan Sunderland Plant (Mehri 2006). One of the Nissan Production Way's 17 wastes (table 5-1) is untapped human potential which would include active involvement in improvement activities (Kaizens score was slightly negative – 3.46). However, in practice the Motivating Potential Score results suggest that the Nissan Sunderland Plant is not maximising the value it gains from employees, viz there appears to be untapped human potential. Initial interviews suggested that production staff don't necessarily believe that current training courses are useful to their development. According to a production team leader there are a large number of training courses but the 'lads' have no interest in them. *"It's an exercise more for the company than the staff… it's just a waste of time"*. Where courses provide staff with ideas to take back to their work areas there often isn't actually any time to implement or explore using these ideas in practice. This may lead to narrow skillsets and limited potential for innovation which Mehri (2006) cited as key criticisms of Lean.

Lean is not inherently stressful. Low job control (choice / responsible autonomy) can actually decrease stress by removing frustrations caused by the inability to locate correct parts. Stress levels are however affected by management decisions concerning the design and operation of production systems (Conti et al. 2006). Within the Nissan Production Way stress could be caused by the constant fight for survival and intense competition between plants. Figure 7-10 shows the motivation survey's fight for survival results. Survey participants firmly stated that they **do not agree** that their jobs are 100% secure and that there is little competition between Renault-Nissan plants.

OVERALL 1.58						
	TIME AT PLANT	0 – 1 1.38	2 – 5 2.04	6 – 10 1.64	11 – 20 1.46	21+ 1.5
	AGE RANGE	16 - 25 1.67	26 - 35 1.45	36 - 45 1.6	46 - 55 2.0	
	AREA OF WORK	DIR 1.58	SEMI 1.7	INDIR 1.25		

Note: DIR (direct) work directly on the production line, SEMI (semi-direct) work between the production line and offices, and INDIR (indirect) work in the offices.

Figure 7-10 Fight for Survival Results (n=40)

Given the low potential for jobs to be intrinsically motivating why do people work for the Nissan Sunderland Plant and why do they stay with the plant for the long term? The constant fight for survival could outweigh the low Motivating Potential Score scores. The initial interviews and expert interviews identified not only negative opinions of the plant and its production system but also pride and determination. For many employees the Nissan Sunderland Plant is a long-term employer or sole job. As previously mentioned this is a reason behind reducing opportunities for promotion however, it may also explain the camaraderie and apparent focus on the plant's future rather than individual job security. This has led to a scenario where workers may forgo certain

liberties for the good of the plant. It is a mutually beneficial relationship where both employee, and employer, needs each other to survive.

Another possible explanation is the pay scheme. Expert interviewees focused on the 'competitive pay package' which, coincidentally, was the key factor in choosing to work for the Nissan Sunderland Plant cited by the majority of initial interviewees. It is possible that staff become locked-in and are not prepared to move to a new employer who may offer an inferior pay package which will lower their standard of living. Their personal financial commitments and the money they save using the company's car leasing scheme are also factors to consider. One manager stated that the benefits are second to none and include excellent pension scheme, healthcare scheme, gym and car lease scheme. However, one employee suggested that this might not be widely applicable as he rhetorically asked *"do you want a job or private healthcare?"*

7.3 SUMMARY

The Nissan Production Way is a complex, context-based production system which incorporates a wide range of tools and practices academia considers being associated with Lean. The expert interviewee's definition of the Nissan Production Way includes 62 items, a much higher figure than the Views of Lean Table sources' average number of cited features – 20. The main purpose of the Views of Lean Table was to collate multiple Lean definitions to increase accuracy in studying Lean in practice; the Views of Lean Table does not claim to represent the gamut of views existing in Lean literature. Sources included in the Views of Lean Table typically provide a relatively detailed definition, or description of what Lean entails. Articles were also included which didn't necessarily provide a holistic view of Lean, but provided an alternative view of the phenomenon (e.g. Mehri (2006)).

This discussion suggests that the presence of one Views of Lean Table item may infer the presence of another. For example, supplier development may also infer that joint supplier-plant training is a Lean feature. This could be a reason why a number of the items cited as part of the Nissan Production Way were not explicitly described as a Lean element in the Views of Lean Table. The expert interviewees consider the Nissan Sunderland Plant's manifestation of Lean (Nissan Production Way) to be more inclusive than our current view of Lean. There was no emphasis on a set of core elements or mention of any tools being viewed as an add-on (separate to the Nissan Production Way but complimentary) with the exception of the Improvement Diagnostic System which was still considered to be a central component.

The motivational survey results found there to be a low potential for intrinsic motivation amongst Nissan Sunderland Plant workers. The exceptions to this rule were the two participants who both fell into the 21+ time at plant and 45 – 55 age range bracket. Despite the low Motivating Potential Score scores Nissan Sunderland Plant staff continue to stay with the plant for the long term. Moyano-Fuentes and Sacristan-Diaz (2012) suggest that social relationships form the basis for worker motivation. This may be the case for Nissan Sunderland Plant whose staff focus on fighting for the survival of the plant as a whole, rather than their individual positions. Fight for survival could outweigh these low Motivating Potential Score results. The competitive pay package may effectively lock-in employees where alternative employment provides a less attractive package.

Since the completion of this study human factors have increasingly become a key area of interest in Lean research. Jones et al (2013) argue that employee empowerment in Lean automobile plants is an illusion, promoted under the guise of consensus decision making, whereas in reality management manipulates the process to secure cost

reductions and efficiencies over employee welfare. At Nissan Sunderland Plant the intense focus on fighting for survival, and competing with other internal plants, does appear to promote improvement over intrinsic motivation. This isn't at a detriment to pay and benefits which appear to be very competitive. However, the slightly low Responsible Autonomy scores do suggest that employees are not actively involved in decision making. Rather than being an illusion this fight for survival / whatever-it-takes mentality appeared to be a uniting goal that kept the plant striving forward.

Carter et al (2011b) argue that Lean has a detrimental effect on employees. Whereas staff are often expected to participate in Lean activities, including Kaizen initiatives, suggestions from workers are often ignored. Interviewees in this study were often unable to participate in Lean activities as they are increasingly tied to the line. There is however a similar opinion that suggestions are dismissed, or ignored, due to ridiculous reasons and internal politics. This is arguably more of an issue with management, rather than Lean itself, with managers at Nissan Sunderland Plant recognising that they need to do more to provide feedback for suggestions made.

Radnor (2011) notes that Lean is about both tools and behaviours, it's about managing to do more with less, however there is a danger of finance / taking money out becoming the focus. Lean is not inherently stressful however management practices can create stress (Conti et al. 2006). Whereas Nissan Sunderland Plant's fast line speeds and tough targets have created a very demanding environment within which to work there was little mention of unwelcome stress. Instead there was great pride in achieving the unachievable, continuing to grow the success of the plant, and an appreciation for the job security and compensation this has provided.

8 CONCLUSIONS

Existing studies of Lean operations are often focused on the technical (rather than human) elements of Lean. This may be due to the difficulty researchers are likely to face in securing access to gather data on employee attitudes towards Lean (Shadur et al. 1995). Despite being instrumental to the success of the Nissan Sunderland Plant, an exemplar UK Lean automotive manufacturer, Nissan Production Way research is currently limited. A unique and rare opportunity was secured to gain access to office, production, and cross-function staff at the Nissan Sunderland Plant. This included the opportunity to interview three members of staff who had a detailed knowledge of the Nissan Production Way. The data gathered has allowed this thesis to provide a valuable contribution to knowledge, viz, to establish whether our current knowledge of Lean sufficiently encapsulates the concept's many facets.

This is an exploratory single case study. The use of case studies is a good strategy for exploratory investigations (Voss et al. 2002). It is often desirable to utilise a single case (Siggelkow 2007). This thesis used convenience sampling which, in management research, is a very common approach used more prolifically than probability sampling (Bryman and Bell 2007). Convenience samples are not generalisable but acceptable when the gathered data is too good to miss (Bryman and Bell 2007). Claiming to have a representative sample in case research is *"a mismatch of method and goals: to say something's representative, you need to pick a different methodology"* (Siggelkow 2007: p21).

At the time of study our current view of lean waS confused and not aided by the use of multiple terminologies to define what is essentially the same phenomenon. Debate continues as to what constitutes a Lean practice and whether Lean is a system or an overarching philosophy. This has become increasingly complex as Lean has been

adapted for different tasks (e.g. distribution, healthcare) and adapted for different cultural contexts (Lee and Jo 2007). Existing attempts to define lean have previously focused on technical elements or have attempted to identify a core set of universally applicable lean tools. The human impact of Lean has become a key topic for discussion since the completion of this study. This research has shown that it is often incorrectly assumed that intrinsic motivation (respect-for-human) is core to any Lean implementation.

The literature review concluded that Lean cannot be defined as a neat and concise set of tools and practices. The Views of Lean Table aggregated a number of sources into a table comparing our knowledge of Lean. When combined with a view of the Nissan Production Way, Nissan Sunderland Plant's implementation of Lean, it was evident that our attempts to create tightly defined definitions of Lean have resulted in a narrow interpretation of Lean. In practice, however it became evident that Lean cannot be restricted to a specific set of tools but instead is best viewed as a philosophy with a wide associated set of tools which are often adapted to suit an organisation's culture, constraints, and strengths.

The Nissan Production Way initial interviews and expert interviews found a unique environment where employee and employer mutually agree that they need each other to survive. This to a great extent outweighs the low motivating potential score highlighted in the motivation survey. Competition between plants is fierce and the sharing of information is one way the Renault-Nissan plants compete. Most survey participants agree that their jobs are not 100% secure and the initial interviews uncovered negative opinions towards the plant and its production system. However, the interviews also uncovered a degree of pride and determination along with a strong team ethos. This is reflected in staff remaining employed by the plant for the long-term.

Empirical results suggested that the Nissan Sunderland Plant has untapped human potential, one of its 17 wastes. According to the expert interviewees there is also a relatively high degree of potential across the plant with high competition for promotion. In this regard, the Nissan Sunderland Plant may be a victim of its own success. Several initial interviewees felt that their jobs were getting harder and that they were increasingly pushed to the limit. This seems to have resulted in production staff being increasingly tied to the production line. Subsequently they have been less able to participate in improvement activities.

The Nissan Sunderland Plant is a successful but imperfect plant. Both the Trim and Chassis Line 2 manager and expert interviewees were keen to highlight this fact. There seems to be a big focus on the technical elements with very little focus on human elements. Rewards seldom exist, suggestion schemes are sporadic, staff consider training to be ineffective and the potential for intrinsic motivation is low. However, the plant continues to seek ways to increase plant efficiency and this extends to 0.5 tier and 1st tier suppliers. The Nissan Sunderland Plant is successful because of the sheer resilience and hard work of its dedicated workforce, the fight for survival culture, and effective supply chain management. It would appear that the plant has a bright future.

This chapter concludes this thesis by readdressing the research questions. Contributions to knowledge and practice are provided before research limitations and opportunities for future research are clearly outlined.

8.1 RESEARCH QUESTIONS

This research aimed to answer four research questions. These are revisited below to clearly demonstrate how this thesis has delivered against these questions:

1. **What is our theoretical / academic view of Lean?**

   Chapter Two (page 12) provided an in-depth literature review. This included using Pettersen (2009) and Shah and Ward (2007) as a basis for building the Views of Lean Table (Section 2.5: p43). This detailed our academic view of Lean, combining multiple sources, to enable a clear presentation of the tools and principles academia commonly associates with Lean. This table formed the basis of the Expert Interviews, and enabled the comparison of our academic view of Lean to Lean in Practice (Research Question 3).

2. **What is the Nissan Production Way?**

   Section 2.6. (p54) reviewed literature focused on the Nissan Production Way. It identified a limited number of studies, focusing on specific elements of the Nissan Production Way, rather than giving a holistic view. The Initial Interviews (Chapter 4: p98) provide an account of life at Nissan Sunderland Plant from an employee perspective (direct, and indirect staff). The Expert Interviews (Chapter 5: p119) provide an in-depth view of the Nissan Production Way, from a series of semi-structured interviews with the plant's experts, which used both the Initial Interviews (Chapter 4: p98) and Views of Lean Table (Section 2.5: p43) as a basis for the interview protocols. The Motivation Survey (Chapter 6: p143) capitalised on access to further explore whether the Nissan Production Way, and life at Nissan Sunderland Plant, was intrinsically motivating. This was all brought together in the full Views of Lean Table (Section 7.1: p192-196) which lists the tools and practices which form the Nissan Production Way.

3. **How does practice compare to our theoretical / academic view of Lean?**

   The empirical studies (Chapters 4 – 6) identified the tools, features, and human aspects which form the Nissan Production Way at Nissan Sunderland Plant. This was added to the Views of Lean Table (see p49-52 for original version) alongside an additional source, Moyano-Feuntes and Sarcristan-Diaz (2012), which like Pettersen (2009) and Shah and Ward (2007) brings a number of sources together in an attempt to define Lean. The full Views of Lean Table is provided in Section 7.1. (p192-196) and compares academic views of Lean, with Lean at the Nissan Sunderland Plant.

   It must be acknowledged that since the completion of this study Lean has continued to evolve both outside of the automotive industry (e.g. Lean healthcare), and to more widely recognise the human aspects within Lean operations. Section 2.7. (p58) acknowledges the development in Lean literature since this study was completed in 2009.

4. **Is intrinsic motivation necessary for the success of a Lean implementation?**

   The Motivation Survey (Chapter 6: p143) was a small-scale survey capitalising on access to Nissan Sunderland Plant. Its purpose was to ascertain whether the working environment at Nissan Sunderland Plant was intrinsically motivating. This study suggests that intrinsic motivation might be low with a bigger focus on extrinsic motivators (e.g. overall package) and a continuous intense fight for survival against other Renault-Nissan plants. Section 7.2. (p203) provides a detailed answer to this research question suggesting that in Nissan Sunderland's case the low intrinsic motivation does not seem to have a negative impact on the success of its Lean implementation.

8.2 CONTRIBUTIONS TO KNOWLEDGE

This study has made the following contributions to knowledge;

1. **Views of Lean Table**

   The Views of Lean Table demonstrates the need to understand the wide range of Lean views. It also emphasises the need to use multiple Lean definitions in building empirical protocols for Lean studies. There is no common agreement as to what constitutes Lean but there are a range of regularly cited tools (i.e. Kaizen, waste reduction). Whereas the expert interviewees view the Nissan Production Way as containing a wide variety features the individual Views of Lean Table sources have a more focused view of Lean.

2. **Provides a detailed analysis of the Nissan Production Way**

   There are a limited number of studies which focus on the Nissan Production Way from a holistic perspective. Two notable works (Wickens 1987; Garrahan and Stewart 1992) were published before the Nissan Production Way was introduced in 1994. This study provides an in-depth description of the production system and compares the Nissan Production Way to our current views of Lean.

3. **Intrinsic motivation can be offset**

   This study built a contextualised version of Hackman and Oldham's (1974) Job Classification Model (JCM) and Job Diagnostic Survey (Job Diagnostic Survey) based on the findings from de Treville and Antonakis (2006). This enabled this study to assess both the potential for Nissan Sunderland Plant jobs to be intrinsically motivating and the impact of influencing practices. Whereas the potential for jobs to be intrinsically motivating was low it was found that the

Nissan Sunderland Plant's environment of intense competition can offset the low scores as workers focus on survival. Moyano-Fuentes and Sacristan-Diaz (2012) suggest that social relationships form the basis for worker motivation in Lean settings. This could also be the case at the Nissan Sunderland Plant.

8.3 CONTRIBUTIONS TO PRACTICE

This study has made the following contributions to practice:

1. **Lean is not a one-size fits all system, but instead is a philosophy with a toolbox of well-regarded practices**

   The Nissan Production Way Experts highlighted that Lean at the Nissan Sunderland Plant is regarded as a philosophy with a toolkit of tools and practices they use where appropriate. Not all plants have the same implementation of the Nissan Production Way – whereas the setup / tools may differ the overall philosophy remains the same.

2. **Intrinsic motivation is not a pre-cursor to a successful Lean implementation**

   This study identified low levels of intrinsic motivation at the Nissan Sunderland Plant. Initial Interviews and Expert Interviews instead focused heavily on extrinsic motivators (e.g. overall package) and the continued fight for survival appeared to override the need for intrinsic motivation. Employees have a shared cause in doing whatever it takes to keep the plant going and expressed great pride in the plant's achievements. As a result, the plant continues to thrive and attract further investment suggesting that intrinsic motivation is not a pre-cursor to a successful Lean implementation.

3. **The Nissan Sunderland Plant has untapped human potential**

   This research suggests that the Nissan Production Way may not be reducing one of its 17 wastes; untapped human potential. Production staff are being increasingly tied to the line and, as a result, increasingly unable to participate in improvement activities. Suggestion schemes are sporadic and employees do not often feel that their ideas are valued. However, both employee and employer need each other to survive. The Nissan Sunderland Plant can use this research's findings to help increase the potential for intrinsic motivation to occur. This may also help in reducing the amount of untapped human potential as several of the influencing practices involve employee participation (e.g. Kaizens).

8.4 RESEARCH LIMITATIONS

This section details the limitations of this research. The following sub-sections discuss limitations in; (i) access, and (ii) the views of Lean table.

8.4.1 ACCESS

As mentioned in Chapter 3 access to the Nissan Sunderland Plant was obtained through contacts gained during an industrial placement at the facility, and through the Press Office. This research capitalised on the Nissan Sunderland Plant's scheduled downtime during the second half of 2008 which enabled this research to gain access to production personnel. This scheduled downtime was a response to a fall in demand for the Nissan Sunderland Plant's products. Following the analysis of initial and expert interview results, access and support was granted in principle for the motivation survey. The intention was to conduct random sampling and administer the survey plant wide. However, full support was withdrawn due to the Nissan Sunderland Plant's workforce reduction in January 2009 (1200 staff made redundant) and the subsequent rehiring of

staff (April 2009) to cope with increased demand as a result of the UK Government's Car Scrappage Scheme. Access was secured to administer the survey to a single department. Through consultation with the Nissan Sunderland Plant Press Office the Quality Assurance team was chosen due to their mix of production and office staff being the least dissimilar to that of the plant. The low sample size (40) did not permit the data to be statistically tested.

8.4.2 VIEWS OF LEAN TABLE

The Views of Lean Table's purpose is to highlight the need to consider multiple views when building Lean empirical protocols. The Views of Lean Table does not claim to represent the gamut of views existing in Lean literature. The sources in this thesis' Views of Lean Table iteration were primarily chosen for their holistic view of Lean. Sources were also chosen for their particular insight or different approach in discussing Lean. Research in the current Views of Lean Table iteration is focused on Lean in manufacturing. Further learning and insight may have achieved through widening the focus to include Lean operations in general (i.e. services, logistics).

Expanding the Views of Lean Table to cover a larger number of sources encompassing a wider range of views may have had an impact on this study's comparison of Lean and the Nissan Production Way. This may also have also added further detail and/or questions to the expert interviews protocol. Increasing the level of detail or questioning in the expert interviews may have required longer interview sessions, or multiple interview sessions. This could have impacted on this study's ability to gain access to staff with a detailed holistic knowledge of the Nissan Production Way.

8.5 FUTURE RESEARCH

Empirical Lean research is in its infancy (Shah and Ward 2007) and the majority of existing studies focus on technical elements. This may be due to the difficulty in gaining access to assess workers' opinions of Lean operations (Shadur et al. 1995). In hindsight where an opportunity for access exists, both researcher and subject would benefit from committing to a research contract, viz a document clearly defining the responsibilities and expectations of both parties. However, this was not possible with the Nissan Sunderland Plant as the press office was hesitant to formally commit to access. Future research at Nissan Sunderland Plant should seek to administer the Nissan Production Way motivation survey on a larger scale. Questions remain as to why employees stay working at Nissan Sunderland Plant for the long-term despite the low potential for intrinsic motivation. It is also not clear whether the fight for survival culture within the Nissan Sunderland Plant is engineered or genuine.

The Views of Lean Table should be continually updated and expanded. Future Lean research should consider how other Lean operations compare to the views of Lean, and the Nissan Production Way. This should not be confined to the manufacturing industry but expanded to cover the use of Lean in a wide variety of contexts. The use of this format allows researchers to clearly identify differences between our existing knowledge of Lean, and Lean in practice. Researchers must also pay particular attention to identifying both the technical and human elements of Lean implementations. Existing Lean literature is focused on technical elements; this also appeared to be the case in the expert interviewees' accounts of the Nissan Production Way. Information on human elements may not be forthcoming and researchers may need to seek novel approaches to elicit this kind of information.

"Collaboration between HF (human factor) researchers and OM (operations management) researchers can help to span the gap between OM and HRM" (Neumann and Dul 2010: p942). Considering the complex, context-based nature of Lean it would make sense to utilise the experiences and expertise of other researchers outside of Operations Management. Collaborative research could prove to be crucial in furthering our understanding of the Lean phenomenon. *"Lean should be regarded as more than a set of mechanistic hard tools and techniques and the human dimensions of motivation, empowerment and respect for people are very important"* (Hines et al. 2004: p998).

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APPENDIX A: VIEWS OF LEAN TABLE NOTES FOR TABLES 2.9 AND 7.1

Note ID	Refers to	Notes
1	Kaizen / Continuous improvement	Does not include Kaizens / group improvement activities
2	Supplier involvement	Planning documents sent to suppliers as and when developed
3	Improvement circles	Improvement circles / QCs are a separate movement
4	Poka-Yoke[4]	Fail safes
5	Education / cross training (OJT)	Including cross functional teams
6	Production levelling (Heijunka)	Continuous flow, daily scheduling adherence
7	Just-in-time	Just-in-Time links with customers and Just-in-Time delivery by suppliers NOT Just-in-Time principles
8	Improvement circles	Group problem solving
9	Communities of Practice	COP needed for implementation for Kaizen activities and as Kaizen events are claimed to be part of Lean subsequently COP is by default
10	Aoki (2009)	Aoki (2009) discusses Kaizen events and doesn't discuss Lean in general. However by stating that Kaizen events are part of TPS/Lean inferences can be made
11	Mehri (1996)	Mehri (2006) offers an insider view of the TPS and as such is an important insight. However, the article is based on experience rather than giving a comprehensive account of the system components
12	Layout adjustments	Plant uses less space due to *"gross negligence by the company, which subordinates the safety of its workers to lowering plant costs"* (Mehri, 2006: p25).
13	Culture of rules	Rules fall into three categories; (i) written, (ii) unwritten, and (iii) cultural, viz, learned by being Japanese or living in Japan. Rules are also formal or informal. *"All the rules help construct an expected code of behaviour"* (Mehri, 2006: p25).

APPENDIX A: VIEWS OF LEAN TABLE NOTES FOR TABLES 2.9 & 7.1 (CONTINUED)

Note ID	Refers to	Notes
14	Tatemae/honne (private vs. public)	Tatemae is *what you are supposed to feel or do.* Honne means *what you actually feel or do.* Mehri (2006) argues that there is a big difference between the two
15	Innovation from outside	Innovation bought from external companies. Creativity dampened by cultural and organisational structure
16	Education / cross training (OJT)	Employees are sometimes required to work on products they don't normally work on with little or no training
17	Profit over employee welfare$_{17}$	Line speed too fast, institutionalised rule of must come to work even if ill to hide sickness and absenteeism from accounts
18	Open office arranged by seniority	Those sitting close to management are the power group who will move up the ranks of the company (Aoki, 2008)
19	Improvement circles	Referred to as quality improvement teams
20	Teamwork	Implies teamwork through citing team briefings as a component
21	Value stream mapping / flowcharting	Implied through emphasis on defining the value stream
22	Production levelling (Heijunka)	Implied through emphasis on maintaining production flow
23	Autonomation (Jidoka)	Implied through fool-proof automation devices
24	Just-in-time	Global deliveries also received Just-in-Time
25	Production levelling (Heijunka)	Including production smoothing
26	Standardised work	Standardisation at all levels including training and documentation
27	Time/work studies	Including process mapping
28	Teamwork	Autonomous teams

APPENDIX A: VIEWS OF LEAN TABLE NOTES FOR TABLES 2.9 & 7.1 (CONTINUED)

Note ID	Refers to	Notes
29	100% inspection	Doesn't include goods inward inspection. Includes neighbourhood checks, check and repair operators and final line checks and testing. Focus on replacing operator based checks with automated checks
30	Improvement circles	Incorporated within other features
31	Root cause analysis (5 Whys)	Forms part of Quality Control Stories (quality control stories)
32	Employee involvement	Primarily at local job role based level. Limited due to employees being increasingly tied to the production line
33	Autonomation (Jidoka)	Automation with a human touch
34	Process Synchronisation	Synchronisation includes some suppliers (referred to as CAT3 suppliers)
35	Communities of Practice	Supervisors are considered to be the MD's of their zone. Nissan Production Way expert interviews acknowledged that team dynamics vary between the different teams each of which have their own rest areas and slightly different working practices (although sticking to the standard operations). Supervisors are responsible for hiring and ensuring employees are a good fit for their team. This may suggest that COPs are present but is inconclusive
36	Seniority	Observed whilst interviewing office staff and confirmed with the plant's press office
37	Performance appraisal for all	Includes possible annual merit payment based on performance. Also includes Continuous Development Plans and employee fact files which record all positive and negative issues
38	Profit over employee welfare	Not in a negative way! Nissan Production Way expert interviews suggest that an intense level of competition brings a general agreement from employees that Nissan Sunderland Plant has to do whatever it can to survive. This view was also expressed by some individuals I the Nissan Production Way initial interviews
39	Flexible working agreements	Flexible working agreements are in place to enable Nissan Sunderland Plant to ask workforce to stand-down or stand-up depending on business need (Nissan Sunderland Plant vehicles' demand levels)

APPENDIX A: VIEWS OF LEAN TABLE NOTES FOR TABLES 2.9 & 7.1 (CONTINUED)

Note ID	Refers to	Notes
40	Build-to-order	Currently over 90% with Qashqai. Nissan Sunderland Plant aims to achieve 100% build-to-order
41	17 Wastes	Includes the original 7 wastes plus 10 additional Nissan Production Way wastes
42	Joint supplier-plant training	0.5 tier (on-site) suppliers receive Nissan Sunderland Plant training on cross plant initiatives. Other suppliers are also offered some Nissan Sunderland Plant training courses
43	Team based recognition	Whereas the expert interviews suggested that team recognition has occurred in practice both the initial interviews and motivational survey claim that this is abnormal (i.e. rewards don't exist)
44	Decision Analysis	Improvement Diagnostic System (Improvement Diagnostic Tool) is cited as being a decision analysis tool
45	Ergonomics	Cited as a way of reducing waste (e.g. worker movements and reducing absenteeism through injury)
46	Production methodology used in indirect areas	Nissan Production Way philosophy extended to indirect areas including standardisation, clear documentation and reducing non-value adding elements
47	Six Sigma	V-Decide is cited as being a Six Sigma type tool
48	Toolbox thinking	The idea that there are a range of tools available which operators use according to suitability for the job in question
49	Limited batch production	Although considered to be not ideal a limited number of batch shops exist within the Nissan Sunderland Plant
50	Employee development	Employee development through training, department rotation, additional responsibilities for high potential employees, and standing-up temporarily into higher positions
51	Genba Kanri	Genba Kanri is a disciplined approach to managing the shop floor.

APPENDIX B: INITIAL INTERVIEW TRANSCRIPT EXAMPLE (ABBREVIATED)

Trim & Chassis Line 2 Manager

1. Why did you choose to work for Nissan UK?

- Been at Nissan since 16 (21 years)
    - Joined straight from school
- Honest answer – all friends had jobs and they had money and I didn't have money
    - At the time Nissan were advertising for a trainee maintenance technician scheme
        - Uncle tipped him off about it
- The main motivation was the wanting to have money at 16 but it is one of the best things that has ever happened to me

2. How do you think working for Nissan UK differs in comparison to other car manufacturers?

- Haven't seen many other car manufacturers – visited the odd one such as Vauxhall
- I don't know whether it is unique but some of the strengths that we have here are…
    - Team working
    - Discipline
    - Pride in what we do
    - Fact that we never want to fail in anything we do
    - I do think that we have the Japanese manufacturing ethos where everything has to be Lean and has to have a purpose, to a standard and as efficiently as possible
        - I have visited many Japanese plants and I believe that this plant is just as good if not better
        - Definitely have the cultural element of how to make cars Japanese style
        - Visited Nissan plants in Japan – Suzuki would not let me visit their plant when I was over there – I tried but I think it is because I am a competitor

3. What words would you use to describe the Nissan working environment to an outsider?

- W
- Quite an easy question to answer and I am sure you will have similar answers from other staff you have spoken to today…
    - Extremely demanding
    - Extremely challenging
    - We push everyone to the limit regardless of where they work – we try and get every last drop of energy from them
        - At the same time it can be very rewarding as well
        - On a personal level my job is demanding, long hours and pressured but when things go well you get a great feeling of pride
            - Example: Recently had an audit from a Japanese group of auditors to look at our shop floor control systems / workshop management
            - An awful lot of effort went into it – I was heavily involved as were my seniors – the whole team was
            - We got the best result any plant has had globally so far
            - We were compared to the Japanese plants and again were told that we were as good as and in many cases better than the Japanese plants
            - This is what I mean by getting a great level of satisfaction when things go well
            - Yes it is demanding for everyone and challenging – everyone is stretched to the limits but when things go well it is very rewarding
- When first came into the manufacturing section it was as a supervisor – went around making sure I knew exactly what the jobs were
    - In fact the lads make it look so easy but it is actually very hard
        - You have the mental demands – the monotony
        - You have the physical demands, the time, the pressure
        - The phrase a colleague uses is that it is the pressure cooker of the shop floor
    - I would like to think that the lads go home and think that they have achieved something

- The line speed doesn't get turned down because of the time of night or because people may be tired – it is relentless
- This place is built on being Lean and I don't think we ever hide the fact from anybody at the first minute they walk through the door we impress on them how difficult and demanding it is – hopefully everyone comes in with their eyes open

So you definitely need to be the right person for the job?

- I believe so
- The best illustration I can think of is that in despite of all of our efforts – we give them line experience, subject them to a line trial – a minimum of 2 hours on the line actually building the cars, interviewing and testing and impress on them the job
- There is still a fall out rate
- We understand how difficult it is and offer support but some people are just not made for the job
- There are some people I refer to as car builders with affection – it never ceases to amaze me how they work – they are a special breed

4. Do you own a Nissan? If so why, or why not?

- Very fortunate to be eligible for company lease cars
    - I drive a Qashqai and my wife has a Micra
        - They are both very good cars

Did you choose a Nissan due to the value for money the scheme offers?

- Yeh at the moment
- Managers are expected to drive Nissans rightly so
    - Only Nissans on the scheme – even though we are in an alliance with Renault there are no Renaults on the scheme
- Before I was promoted and eligible for the company car scheme I drove Nissans as well
    - Because I was proud that I worked here and the products we make are very good

If you had never worked at Nissan do you think you would have bought a Nissan or is it because you have the appreciation through working here?

- I am not sure
- My parents, father in law and mother in law drive Nissans
    - Previously they haven't
    - I have had influence over them
    - These days anyone can go to a car dealer and get similar levels of discount to what the friends and family scheme offers especially in the current economic climate
    - Father-in-law driven a lot of different makes of car but between him and my mother in law they are on about their third Nissan so far
- I would like to think that if I hadn't of worked here I would have driven a Nissan and be taken by it and become sold on it

5. Why do you think customers buy Nissan vehicles?

- Long standing reputation for quality like many of the other Japanese manufacturers have
- Cars we build are very reliable and generally well built – that is first and foremost
- Since Carlos Ghosn took the reins and since the alliance with Renault
    - Embarked on a fairly long term strategy to change the brand image
    - Trying to shift the brand image to make them feel that our cars are a bit more appealing, bit more sporty, interesting, adventurous
    - To some extent trying to compete with premium brands such as Lexus and BMW
    - As a result the whole of the company is trying to develop a new brand but we are getting there
        - 350Z, Infinity range, GTR
        - Deliberate products being put into our range to try and shift the brand
        - Over time Nissan is becoming more of a sexy brand – we have the 350 soon to be the 370, the Infinity range, GTR, Mirrano and we have got some pretty good designs out there that are available

Do you think that the design has been changing since the plant first opened?

- I think so
- To be honest with you when I first started here Nissan had an extremely well built but fairly bland product range
    - Bluebird, Almeria, old style Primera, old style Micra – none of them were particularly good looking cars if we are being honest but they are all very reliable and most of them will still be running today and they were very well built
    - So we have this foundation for inbuilt quality
    - Unfortunately I think that you need more than that in this day and age
        - Other car manufacturers, even some of the low cost ones, are creating good quality cars
        - So you need more than just good quality and that is one of Carlos Ghosn's leadership goals

6. What factors in your view make Nissan (global) successful?

- I believe that this company has a very clear strategy
    - Most people around the world will be able to talk to you about similar things
        - Brand positioning
        - Nissan Production Way
        - Quality of management
        - GT2012 midterm plan
- Before the alliance and Carlos Ghosn I don't think that the company had a united direction globally but now I think we have
    - I think because we have this everyone knows what is expected from them
- We also had what is now affectionately known as the near death experience where we almost went out of business
    - I think that this really focused everyone's mind and we now pull together in the same direction for the same cause which is the good of the company
    - Honestly believe that is a strength of this organisation on a global basis

7. What factors in your view make Nissan Sunderland successful?

- Already touched on some of them
- You already know what I am going to say first of all... it's the workforce
    - As corny as that may sound it is the truth of the matter
    - I don't think that there are many other areas in this country or other countries in Europe that could have produced a success story like Sunderland
        - It is all based on the efforts of the people here
        - You regularly hear when you talk to the lads on the line or management in the MD office we all agree that everyone works extremely hard and we are where we are because of their efforts
- Most productive plant in Europe
- Compared in the same breath as other Japanese plants on a quality perspective due to the efforts of the people who work here
    - I think this is the single most important factor

Do you think that the manufacturing process has a big impact?

- Yes I think it is key
- The staff are the foundation that everything is built on but at the same time if we did not have a successful manufacturing process that is right for the business we wouldn't be here
- Nissan Production Way
    - Clearly defined
    - Global standard
        - Earlier mentioned audit was to check whether we are applying the Nissan Production Way correctly
    - It is another pillar that the company is built on and the success of the company is based on

Do you think it is any different to any other Japanese manufacturing plants?

- I think from what I can understand Toyota have the TPS, Honda have their version
    - There are a lot of similarities with subtle differences

    - Generally I would think the same rules apply
        - Good workshop management in place
        - Total Quality Management
        - Kaizen as part of everyday life
    - All of these things are common

So you have a core group of basics and around that are the differentiating factors?

- Yes exactly
- If you look at the Nissan Production Way model it talks about
    - Genba Kanri at the bottom
    - Nissan Production Way tools and techniques such as Kaizen, Quality Control Story, Just-in-Time, PLM
        - All tools and techniques you apply to make sure you build the cars in the best way
    - Total Quality Management is the umbrella above all of them
        - Make sure you have all of the systems in control and they are delivering the right results
- I suspect that this basic model is the same but that there are subtle difference
    - i.e. one of our key measures is how timely we are – Delivery Schedule Time Achievement Ratio
        - Target is that 98% of all of our cars reach the compound in point within two hours of the set schedule
        - So we have Douki Seisan, ideal manufacturing principles
- Ultimately it is the same backbone with subtle differences

Do you think Nissan treat people well as a company and are there a lot of rewards to recognise peoples' efforts?

- I suspect you will have a different answer from myself than from the other interviewees
- I genuinely believe that the rewards and the recognition are there
    - It is something we are always trying to work to improve
    - It is important that people understand that their efforts are appreciated and recognised
        - Personally I like to receive recognition if I feel that I have done something well
    - Generally the terms and conditions are pretty good compared to other UK car manufacturers of local industries – we are very competitive in that respect
    - Benefits are second to none
        - Excellent pension scheme
        - Excellent private healthcare scheme
        - Gym
        - Car lease scheme for all staff
    - The package is very good
    - Working environment
        - Always mindful to give the lads the best possible environment to work in
        - Closely linked to safety and their well being
            - Zero accidents target by 2010
            - Benchmarking with world leaders in health and safety Dupont in Northern Ireland
            - Taken many of their systems and developed them for application at Nissan
- Overall I think we make a hell of an effort
    - People are one of our best assets – if we do not look after them we will not get the best from them
- I honestly believe that we do have a good HR package overall for the guys that work here
- Recently completed a global survey
    - Conducted by Hays Consultancy
    - Everyone answered the same questions
    - June/July 2008
    - Survey to be repeated next year
    - Results
        - Every department, every manager and director given task to come up with an improvement plan to address the issues that were raised or negative comments
        - Guys have said that we can improve in looking after their wellbeing and their welfare

        - Always try and improve and listen to what the guys want
- Overall not bad but we can always do better

8. Do you think that Nissan has good supplier relations? If so why, or why not??

- Yes generally speaking we have
- I think that it is a very similar situation to our own workforce
    - Very demanding of suppliers
    - But very honest and transparent
        - Nobody is under any miss-illusion of their role, responsibilities and Nissan's expectations and their expectations of Nissan
    - They know what we expect from them and what they need to deliver
    - Most local suppliers have similar systems
        - Employ similar Total Quality Management systems
    - We do a lot of cross functional working with them
    - Suppliers on-site i.e. Karsonic Kansai
    - Attend meetings, start of shift meetings, safety meetings
    - We make them feel part of this shop and this department
    - We work very closely with them
        - That's true when you move away from this region and even abroad
- We have a very close working relationship with our suppliers and that's the key to it

9. What do you think makes the Nissan Production Way different to other car production systems?

- Not familiar enough with other car company systems
- The one thing which I think is the strength of ours is whilst it is a strong manufacturing system at all levels within our organisation we are always trying to develop it, improve it, benchmark it
- Nissan Production Way office in the Japanese head office
- Executives who are responsible for the Nissan Production Way
    - They have bi-monthly global meetings where all of the Nissan Production Way functions from each region, each plant, get together and share best practice and advances in technology
- Nissan Production Way computer infrastructure in place where we can go and look at activities that have been carried out in any plant around the world
    - Pinch and share ideas
- Nissan Production Way strength is that although the world is such a big place it is a tight knit community in terms of the Nissan Production Way function

If any staff notice any problems or areas of improvement is there a system in place to make these concerns known? Is it an open environment?

- It should be
- I am a little disappointed as the Hays survey I referred to give us a bit of unexpected bad news
    - The lads don't think we listen to what they say, their ideas
- In terms of the mechanism it should be no more complicated than them approaching their supervisors
    - Regular meetings i.e. start/end of shift meetings
    - Constant contact with supervisors
    - Should be able to approach supervisors with any suggestions or comments
    - In my opinion a big part of the supervisor role is to listen, give recognition for their comments
        - May not act on every single one – this is not practical
        - It is essential that we give feedback to suggest why an idea may have not been acted upon
- The forum is there, the opportunity is there, we have just got to make it happen perhaps better than it does at the moment

10. What do you think are the biggest challenges in implementing the Nissan Production Way?

Perhaps take Russia or India as an example

- Challenges we face to be able to apply them on a daily basis
    - Biggest thing we have is that working in the motor industry at the moment you have to be so agile (buzz word going around the plant at the moment)

        - You have to be able to respond to what is going on in the wider world with speed and efficiency
        - All the time you are trying to do this within the boundaries of the Nissan Production Way
            - Sometimes the two things don't go hand in hand
            - Sometimes agility doesn't fit in with the Nissan Production Way and that is a tough challenge
            - If you do not stay true to the manufacturing system you end up falling foul
                - In the short term it may be the right decision
                - Always the temptation to take shortcuts but you end up falling foul
- Greenfield site trying to apply Nissan Production Way
    - Cultural thing
        - Need to believe in it
        - Need to know that it will work
        - Need to be passionate about it
        - If it is something new to you that is the single most important thing
        - Need to fully understand it – why it works, why it is important – this is probably the toughest thing the guys in Russia will have to cope with as they are gearing up for start of production
            - Been to Nissan Sunderland Plant to witness it
            - It's a whole different animal putting it together
            - I guess it will be the same temptation for them to take shortcuts
            - Temptation and not understanding it are probably the two biggest challenges

Do you think that cultural issues will have an impact?

- I think that it is healthy for the company on a global basis that each plant has some of its own identity
- Each country and culture has its unique elements
- Sunderland is not different
    - There are something's we have to work harder at than perhaps Japanese guys do
    - i.e. Japanese workers find 5S principles and keeping their place in an orderly fashion easier it comes more naturally to them than it does to our guys
    - However 5S is part of the DNA of the Nissan Production Way and our guys do understand the importance of it and have seen how successful it can make us so they get on with it
    - Maybe more of an effort here than in Japan but this is not such a bad thing
    - There are things that we are very good at that maybe the Japanese guys perhaps struggle with and I am sure that it will be the same with the India project, Morocco, Russia
    - I don't think it is such a big problem as long as people understand the Nissan Production Way, how important it is, how vital it is to making a good quality product efficiently at the cheapest cost and the best quality and you always remember that and understand that I don't think you will go far wrong

Do you think that the Nissan Production Way is the rulebook and as long as you follow the rules it is up to you what you do?

- I think Nissan Production Way is like a boundary or the framework you operate in
- You need to have the ability to make your own decisions and make your own versions maybe differences to something that happened in Japan
- Generally speaking it is the constants that lay down the standards
- I think that there is always scope for variation as long as you do not step outside the boundaries

So basically anywhere you go the essence of the Nissan Production Way would still be there but there will be some slight cultural differences i.e. they may be quicker using different types of tooling?

- I will give you an example
- Quality Control Stories are a common global tool
    - Just finished our local Quality Control Story competition in Sunderland
    - Our winning entry is from our shop and will be entered into a global competition
        - Proud to speak about it as it is from my shop
    - Compared against all plants across the world
- QCS is a fundamental part of the Nissan Production Way
    - Problem solving tool we should use to get to the root cause of the problem
- QCS when was first introduced was an 11 step process but it is now an 8 step process in this plant

    - Other plants around the world still apply the 11 steps
    - We decided that at Sunderland there are one or two steps that can be combined and that is acceptable
    - Still have the Plan-Do-Check-Act cycle within the 8 steps the same as you have with the 11 steps
        - Haven't stepped outside of the boundaries of what makes Quality Control Story work
        - But we have changed within and make the decisions ourselves
- One of the benefits of having a fairly flexible system that can be applied differently around the world

APPENDIX C: EXPERT INTERVIEW TRANSCRIPT EXAMPLE (ABBREVIATED)

Expert 1 Transcript

Part One: Resource reduction

1. What is the Nissan Production Way's view about resource reduction?
Prompt: A resource can be working hours, movements, raw materials, space, or production time

- Essentially the Nissan Production Way promotes manufacturing with minimum resource and we have a Nissan Production Way handbook and one of the opening gambits in there is to only give the customer what he is willing to pay for
- So in terms of resource reduction it is essentially what Nissan Production Way is all about – everything is reduction of non-value added, moving waste away from the main line processes
- In terms of working hours we are constantly trying to improve productivity as our history of productivity is that we are the most productive plant in Europe and have been for the last 13 or so years.
    - We can only maintain these levels by constantly improving the operator's efficiency and we can only do this by taking waste out
    - What we try and do is to present the parts to the operator within a strike zone so he has very minimal movement
    - We try and reduce the number of choices he has to make we present a part to him so that he doesn't have to move very far to it which makes it a lot quicker to fit
- In terms of overall cost everything contributes to Total Delivered Cost which is our main objective
    - Current economic climate we are competing with all of our sister plants and Renault (who are in an alliance with, and own a stake in Nissan) for future new models
    - The only way we can do this is to continue to reduce costs and resources
- One of the main roles of the supervisor is to minimise waste and take away non-value added processes
- *Andrew: Just coming back on what you said about only giving the customer what they are willing to pay for is there a certain level of customer involvement anywhere?*
    - Within Douki Seisan which is our ideal manufacturing system we aim to / have a philosophy of build-to-order
        - We try and give the customer exactly what they want and when they want it
        - This is one of the ways we can reduce waste by giving them the specification vehicle they require and nothing else as that is what they are willing to pay for
        - We have many end derivatives of vehicle to suit customers' requirements
        - We are particularly good at this time and achieving over 90% build to customer order
            - We are aiming, and it is at the forefront of our business to aim for 100%
            - In this current climate we are looking to increase our customer share by giving the customer what he wants and when he wants it
- *Andrew: Unfortunately you had to lay off some staff. Was that mostly by voluntary redundancy – is that how that happens?*
    - We ended up with a surplus and had to embark in what we call right sizing for the current business environment
        - We entered recession and ended up with an excess of approximately 800 to 1000 employees because not six months prior to the recession hitting us we hit peak production and actually launched three shifts and in launching three shifts we hired up to 1000 – 1200 people during that period and had to release them again
        - It was very difficult. Most of it was done through voluntary redundancy and early retirement or combination of both
        - Apart from temps with the fixed term contracts everything else was voluntary
- *Andrew: One of the things appearing in the news was why Nissan were reducing staff whereas other factories are keeping the staff and making do. Now I obviously have my own opinions being a Lean thinking person but is this continuous change in staff numbers part of the Nissan Production Way. Is matching staff numbers to production a big issue?*
    - Definitely – it is definitely the way that we operate within Nissan Production Way
        - We try to maintain upward and downward flexibility wherever possible

        - Initiatives such as the scrap incentive scheme caught us a little bit unaware having just released up to a thousand people then all of a sudden we had to recruit very quickly over 400 people for the line speed going back up.
        - For that reason we try and hold temps for downward flexibility but also in terms of upward flexibility try and keep those temps' details so we can get them back quickly and we also were very good at recruiting now at short notice in terms of being able to pull a recruitment team together from the various functions and shops
- *Andrew: Do the temps go through the same training process as any other employee when they come in?*
    - Yeh
- *Andrew: Say if you employ 400 or so more people it takes time to employ them and train them. Do you know how long it takes on average to train an employee for the production line?*
    - Yes we have a 21 day training programme that includes 5 days induction
        - This is a standardised training package / programme regardless of what production environment they go into in Nissan
        - It does consist of induction and offline basic skills training and also online training
        - There is no real limit to the online training period – we have guidelines of how long it should take for the operator to be fully trained on an assignment and it is approximately 10 – 15 production shifts but if it goes longer it doesn't matter we are fine with that as long as at the end of it they are capable and confident.
- *Andrew: There must be some way you need to figure out the cost of laying off in terms of how much it costs and employing new people. Do you have to make an assessment to say are we better off in keeping people as obviously if you are reducing staff and increasing staff you obviously have to do a certain amount of training even if they have been there before. How do you take that into account?*
    - We will do it on sales predictions so in the past we have maintained surplus labour for up to 4 to 6 weeks because it means it is costing extra to hold onto the labour but we haven't got the risk of not employing the right person and not being able to train them in time.
    - But this particular incident caught us unaware – we probably wouldn't have released the amount of people we released if we had known about the scrappage allowance incentive scheme.
    - I don't think we would have done that as to recruit and train 400 people in the timescale we did it was quite painful in terms of resource from the supervisor in having to train these people – very very difficult.

2. How does the Nissan Production Way reduce the use of resources?
Prompt: An example could be the reduction of setup times or the reduction of lead times

- In terms of what we have previously discussed in terms of headcount for example or working hours / actual hours we use a Key Performance Indicator called design standard time ratio (DSTR)
    - We benchmark this Key Performance Indicator with our sister plants and with Renault as well and ultimately it is a measure of how productive we are
    - So built up within the ratio of actual time versus design standard time which is the amount of time you are allowed to build a vehicle versus how long it does take to build the vehicle you then have an element of time that is non-value added and we focus on reducing this non-value added element of design standard time
    - It is simple – we just take out non-value added operations and if we continue to chip away at this and taking advantage of volume increases and automation
        - We have got a system at the moment called IFA which is Integrated Factory Automation and we have a dedicated team which their primary focus is to reduce headcount through reduction of DSTR
        - Their main task is to introduce low cost automation in terms of shuttles, parts selection systems, AGVs etc taking headcount out of the process so that is DSTR
- In terms of Lean manufacturing we have a Key Performance Indicator called Delivery Schedule Time Achievement Ratio which is Delivery Schedule Time Achievement Ratio
    - We know how long it takes to build a car and we measure ourselves against this plus or minus a two hour window

    - We measure this Key Performance Indicator daily and I guess instances where we fail this particular Key Performance Indicator we look at the reasons why and put in countermeasures to resolve that issue
    - In affect that does reduce resources in building a car right first time – saves a lot of wasted resources such as time and materials to repair the vehicles
- In terms of reducing inventory we operate a system called Douki Seisan
    - Within Douki Seisan you have got Delivery Schedule Time Achievement Ratio but you have also got lead time as well and we are constantly trying to reduce lead time
        - To do this, and going back to our Nissan Production Way ethos it is to identify concerns and then put in place solutions so whenever we are trying to reduce lead time you need to improve OEE, improve quality and reduce stock in terms of safety stock, online WIP, transportation stock etc
        - So we constantly preach that we should be bringing to the surface these problems and then fixing them and then we can reduce lead time
        - This has been a constant activity for the last 8 – 10 years now
- *Andrew: What is the impact on staff as obviously you are saying that it is flexible staffing levels and you are trying to closely match your staffing levels to production to reduce cost? What is the effect on staff there... is there an effect? In terms of job security and feeling secure in their jobs*
    - In terms of my position I do not witness it first hand as I do not have many direct reports but from my experience as a production senior and supervisor before that I think that having a certain level of temporary labour is good because they are very very keen to impress.
        - Their goal is to achieve full time employment which we promote and encourage
        - I think for the first time recently we found ourselves in a position where people in the company who had been in the company for up to 25 years were then in a situation where they were reaching just over 51 – 52 and thought this is actually an opportunity for early retirement as well as redundancy
        - So in terms of motivation for current permanent staff it was quite good as it presented an opportunity for an early retirement, a lump sum redundancy to allow them to retire or move abroad or do something different
        - I think it worked for both permanent and temporary employees
        - Obviously if you are a temp and get laid off it is not very good and we have had some very emotive discussions with temps that have got mortgages and it is not a good situation but unavoidable

Part Two: Production Management

1. How is the Nissan Production Way organised?
Prompts: Is the system arranged by cells or groups? Are processes synchronised? Is production levelled or smoothed. Are products pushed to the next process or pulled from the previous process?

- Yeh we have very specific functions in support departments such as production control, engineering, maintenance and then production
    - Certainly within the production department they tend to be self-sufficient in terms of process such as press shop, body shop, paint shop, trim and chassis all have their own structure and specialised process
    - All pull together in the same direction rather than the push system
    - Each knowing what their customer requires in terms of delivery, quality requirements etc
- In terms of structure for Nissan Production Way we have steering committees, steering groups and working level groups to discuss performance indices relating to Nissan Production Way
    - I chair a meeting every month with the production manager for each production shop
    - I also chair a meeting with the production seniors specifically regarding Nissan Production Way activity and probably more specifically our manufacturing capability in terms of how affective are we at building the car and that is discussed at regularly, monthly meetings – our performances are communicated as well
- *Andrew: Douki-seisan is a process of synchronising everything isn't it?*
    - Yes
- *Andrew: Do you still smooth / level production?*
    - That still has to happen. I think the biggest problem we have now is the disparity between petrol and diesel

    - When you are building on a multi-model line such as our line 2 facility at one time they were building 3 vehicles down one line and you didn't have to just smooth variants of one model you had to smooth models as well
        - At one point we had Micra C+C, Note and Micra down the same line
        - Build content between Micra and Note although similar size car there is quite a disparity there and we have to be very careful with model mix
- *Andrew: It terms of what you produce over days is that levelled out as well? Say if you have so many orders in a week you will level it across the days?*
    - Yes we will level it across 24 hours

2. To what extent is Just-in-Time utilised in the Nissan Production Way?
Prompt: Is it used factory wide? How important is it to the Nissan Production Way?

- I think it is to a large extent really. Just-in-time in the sense of building to customer order but the term Just-in-Time for the production department really relates to an improvement technique for the elimination of waste from the process
    - Certainly we will produce in the right quantities at the right time but in terms of Just-in-Time we definitely refer that / associate that with an improvement tool or an improvement activity where we will map the process in terms of process flow, inventory, time etc then look to take out the wastes
- *Andrew: How far is it integrated into your supply chain then?*
    - I think certainly within first tier supply chain we have a support function for suppliers called Alliance Supplier Improvement Programme – alliance supplier improvement programme – they go into suppliers and help them meet their productivity costs and targets and help them improve the process and help them develop the product and also deliver a cheaper product
    - We constantly try and reduce Total Delivered Costs which includes our parts and suppliers have to commit to cost reduction but we don't just demand it from them we go in and help them achieve it as well
        - In terms of process mapping and Just-in-Time they are part of the tools that are used in that process
- *Andrew: Do you have any idea whether suppliers beyond first tier take the same kind of steps or attitude as you take as say roll it down?*
    - I don't actually – it is probably not as deep routed as we would like but that is just a guess
    - I have seen it to a certain extent
- *Andrew: I just wondered whether you would try and roll it down the supply chain as far as you could as obviously you have achieved cost reductions and things like that...*
    - I believe we have recently gone into second tier but I couldn't confirm it
- *Andrew: So it's something you have at least thought about*
    - Yeh definitely
    - For the first time this year we have actually taken Nissan Production Way diagnosis system which is a measurement system of how capable you are at manufacturing a product and it looks as the whole row of the production supervisor in terms of their capability to deliver production volume, safety, quality etc
        - We have recently just taken that into first tier suppliers this year and it has proved quite successful
        - We have identified scope for significant improvement and they have embraced it actually as a measurement tool they can use to quantify their performance
- *Andrew: Are your first tier suppliers normally suppliers you have had for years or do they change?*
    - They do change
    - We have had suppliers that have been with us for a long time such as Unipress
        - They have their own UPS system very similar to TPS and Nissan Production Way – they are all very very similar
    - We also have CK who have been supplying us for a long time but we do get new suppliers all the time particularly with new model – new processes, new design features sometimes require new suppliers

3. Does the Nissan Production Way use tools to analyse work flows with the aim of increasing productivity?
Prompts: Such as time/work studies, multi-tatistical process control, layout adjustments, cellular manufacturing

- Lots of systems I have just spoken about Just-in-Time that does map the process

- We also use a system that evolved from Just-in-Time called Improvement Diagnostic System – improvement diagnosis system
    - It is a little bit more detailed than Just-in-Time in terms of quantifying the actual process but what it essentially does it tell us through decision analysis of what we find in the process flow to what tools we need to use to improve the process to reduce non-value added activity etc
- We also use process mapping in the form of douki seisan improvement
    - Mapping the process to identify process flow in terms of inventory levels, lead time etc and we have various what we call IE experts that are trained to carry out that activity – those people were trained in Japan
        - Which is different to IE engineer – different function

Part Three: Supply Chain Management

1. To what extent are Nissan Production Way production management techniques used by Nissan Sunderland Plant's suppliers?
Prompt: Is the Nissan Production Way used by first tier suppliers, second tier suppliers, third tier etc

- Through Alliance Supplier Improvement Programme again we do take standard operations, introduce them to 5S, job observation, some of the simple tools we use in Nissan Production Way
- *Andrew: So are on-site suppliers more integrated into your way of thinking than off site suppliers*
    - Definitely yeh
    - For example in terms of site standards such as when we launched 5S two years ago we knew that we couldn't launch 5S without the full involvement of every employee on site and that included on-site suppliers
        - That was one of the first time we introduced a companywide strategy simultaneously which it did include all on-site suppliers and they embraced it and to be fair to them maintained it as well so it was a good activity
    - Joint training initiatives yes – the onsite suppliers have the added advantage of being able to utilise some of our training programmes
        - We as an Nissan Production Way office have been involved in development of on-site suppliers
- *Andrew: If suppliers have had an idea that has been used and worked well in their own version of the Nissan Production Way do they get involved with you guys and sometimes bring anything over to you? To what extent are the suppliers involved in terms with that kind of thing*
    - I cannot recollect anything that we have utilised from suppliers but at the same time we do not force them to use NMUK initiatives either
    - Sometime we have very similar systems – 9 times out of 10 the only difference is the performer they use to calculate or carry out the activity
    - I cannot think of anything we have taken from the suppliers – no
- *Andrew: Are they always involved in new product development*
    - Yes all suppliers are involved in new product development
        - We have a design stage called S-LOT – suppliers are involved from an early stage.
        - It's crucial really – I don't think we could build a vehicle without involving them very early on in the process

2. Are suppliers involved at Nissan Sunderland Plant and if so how are they involved?
Prompt: Are there joint training initiatives, joint product development programmes

Note: See previous section/s

3. Does the Nissan Production Way include value stream mapping or flowcharting?
Prompt: Value stream mapping is the mapping of product and information flows and the analysis of this data to identify and eliminate wastes.

- Yeh in terms of Alliance Supplier Improvement Programme they'll map the full process – IE experts really live within the Alliance Supplier Improvement Programme function and they do value stream mapping and flow-charting

Part Four: Standardisation, Defects and Improvement

1. What does the Nissan Production Way have in place to identify, stop and fix defects?

Prompts: For example intelligent automation / autonomation, line stop, Poka-Yoke / failure prevention

- We have within Nissan Production Way a function called quick response and Quick Response Quality Confirmation (quick response quality confirmation) which is essentially our quality management activity on the shop floor and we have lots of policies and procedures for managing outflow of quality defects more importantly for monitoring occurrence and effectiveness of countermeasures
    - This may well include closed loop fault detection, automating the process to ensure defects don't occur, it may include poke yoke type low cost automation to detect and prevent faults from reoccurring
    - We have rules and standards and systems for stopping the line pulling the help cord for assistance, lots of rules and systems that prevent outflow
- *Andrew: Are your robots able to sense when there are defects?*
    - In terms of the automated processes part detection is generally the main method we use for detecting whether the parts in the correct orientation or position before it is picked up and fed into automated presses for example
    - Handling robots have proximity sensors to make sure they pick them up correctly etc
    - In the machining environment such as some of the head machining or some of the head casting they do have closed loop type measurement systems in there so that every single part if it is critical feature will be measured in line and if it does not meet tolerance levels the machine will stop which is effectively closed loop. It is feeding back results all of the time to the machine
    - But it is mainly in the machining environment some of the head machining in unit shop and we also have similar systems in our suspension (axles) shop

2. What does the Nissan Production Way have in place to standardise elements of the production system?
Prompts: Standard operations, housekeeping (5S), visual control and management / management by sight

- Certainly within Nissan Production Way our main documentation is standardised so from the way we train operators using the 21 day model to the documents we use to train operators such as standard operation these are standard in every shop and process.
    - It is also global standard.
    - We call it NTWI which is Nissan Training Within Industry
    - There is a standard set of documents that are used for documenting how to build the car, how to instruct the operator to build the car
    - Not only is there a standard format there is a standard method for writing these documents as well
        - For example in terms of splitting the operation up into its main steps, identifying key points by underlining them, putting the reasons for these key points in brackets all of that is a global standard
        - We send our supervisors on an internal training course to be able to write these correctly to global standards – they are then issued with a standard operations license which lasts for three years and then they have to be reaccredited
- In terms of housekeeping 5S we have again standards in terms of criteria – we have a standard evaluation system for sustaining 5S, we have a standard education for our manned staff on 5S
- Visual management control we have company procedures for concern management – there is one for visual control and management
- We have a standard Total Quality Management system across departments – not just in production – it is called the Nissan Management Way but it is essentially Total Quality Management
- *Andrew: Would you say that a lot of the management here is by sight? So people actually going and being involved in what they are managing?*
    - Yeh I mean our management tends to be very visual, very transparent all the way from NMUK top level objectives on the DMD's Total Quality Management board all the way down to supervisors' Total Quality Management board – those objectives are clear
        - Everybody knows what everybody's objectives are and everybody should understand what the link is and their contributions to the company level objectives
        - Ultimately through Total Quality Management you cascade from NMUK top level all the way down and at the bottom level should be the supervisors' objectives then be able to link check back to how that is contributing to top level objectives
        - This is an activity we do every month in every process

3. What improvement strategies or techniques are used in the Nissan Production Way?
Prompts: For example continuous improvement, root cause analysis

- Lots – the main ones are Just-in-Time as we have already mentioned Total Preventative Maintenance, Quality Control Story – Quality Control Story is our problem solving tool, Genba Kanri which is essentially work shop management. Within that we use Kaizen using two day improvement activity, two hour Kaizen so lots of improvement techniques at the supervisors' disposal
- We essentially we call these tools and they keep them in the toolbox and bring them out when they need to
- To promote and maintain these tools we tend to say keep your tools sharp
    - For example Quality Control Story we have an annual Quality Control Story competition which promotes involvement, keeps their skills honed and is an opportunity for reward and recognition as well
    - So we have cross-functional competition involves people of all departments and all shops and in recent years until we ran up to the economic crisis the winners went to Japan to present their activity in a global competition
        - It was a really good activity
        - *Andrew: lucky for the winners!*
        - Some of them thought it was lucky some of them didn't

Part Five: Human Relations

1. How are employees involved with the Nissan Production Way?
Prompts: Are they involved in improvement circles / group problem solving?

- We try to involve manufacturing staff in improvement activities such as 2 hour Kaizen, 2 day improvement which tends to be focused on a very small area mainly their man assignment
    - If we are carrying out an activity to improve line balance, productivity or efficiency we will generally involve the operators within that activity
    - Also 5S improvement, 5S audits would involve manufacturing staff
    - We have a company philosophy called ZIP which is our zero injury programme which involves weekly behavioural audits which again we involve the manufacturing staff in
        - We take them around the process and ask them if they can observe any unsafe behaviour
- *Andrew: So would you say that there is a high level of employee involvement then?*
    - Definitely yes
    - Also Quality Control Story – because we tend to use them in Quality Control Story not only for involvement but for their experience of the actual process
    - Sometimes it is so obvious that you don't see it and it takes an operator to say have you looked at that and they can contribute
    - So it's not just involvement for the sake of involvement – they do add value to a lot of the activities they are involved in

2. How are employees managed within the Nissan Production Way?
Prompts: Appraisals, discipline, company hierarchy

- We recently developed / launched the Nissan Way which is essentially a subsection of the Nissan Production Way as is Nissan Management Way as is Nissan Recycling Way
    - NW is a global initiative to make people aware of their actions and mind-sets
    - We have 5 mind-sets and 5 actions which we explain to all of our staff and explain exactly what they mean to them
    - We then based their performance appraisal on these mind-sets and actions
        - For example motivation, commitment and targets performance, being fugal, transparent, cross-functional – most of those appear in the performance appraisal as headings
- Each employee receives a performance appraisal every year
    - Based on their performance they will receive a merit award which can result in a pay award
- In terms of discipline we do have a disciplinary procedure supported by our HR department in line with our terms and conditions supported by the union and company council
- In terms of company hierarchy not sure what you mean by that

    - *Note: Andrew explains*
    - We do have a set hierarchy and it's the same in every department from DMD – directors – managers – seniors – supervisors – team leaders – ultimately man staff
        - It is a recognised hierarchy system
- *Andrew: So where do you fit in this chain is there a manager above you?*
    - Yes I have a manager then it is the production director and then it is the DMD who is essentially the managing director of this company who reports to Trevor Mann who is the MD of this company and our Spanish organisations as well
- *Andrew: He is the VP of European Manufacturing?*
    - Yes he is the VP
- *Andrew: If you have your manager and then the production director if you needed to go and speak to anybody about anything could you easily go up and speak to the production director?*
    - Yes – I can go straight up to Kevin Fitzpatrick our MD and approach him
- *Andrew: So you don't have to go through the chain?*
    - No there is no process
    - For manned staff to go directly to Kevin Fitzpatrick would be awkward and we generally say if you want to speak to Kevin or ask a question it will be done through the supervisor
        - But if anybody in the company wanted to express an opinion then Kevin will have an audience with them
- *Andrew: So it is very open*
    - Yes
    - I would say it doesn't happen very often (referring to Kevin)
    - But they are provided with the opportunity to air their views, opinions at half yearly communication sessions in the canteen where the MD and in some cases Trevor will address the full company in bite size chunks because of the venue
        - They do have an opportunity to speak directly to Trevor or Kevin about anything they want basically – in an open forum
        - Outside of that they can also do it on a one to one

3. What development and training opportunities are there for employees within the Nissan Production Way?
Prompts: Training, promotion/progression, taking extended leave for travelling etc.

- Lots exist
- We have what we call a Continuous Development Plan for every employee which is a continuous development plan
    - One of these exists for every level within the company
    - It is generally specific skills required of that specific role or function (48:38)
- Part of the appraisal is development opportunities section
    - Either the person superior would can say I would like to develop you in this area and so can put you on these training courses
    - Or the appraise can ask for development in a particular area and can put comments on his appraisal to that affect
        - The appraiser will 9 times out of 10 agree to this resource permitting etc.
- *Andrew: What about promotion and things like that – is it all done from within?*
    - Generally promotion comes through internal promotion generally due to succession management planning
        - We have a system whereby we can offer the opportunity to demonstrate their potential in a stand-up position
        - For example as a senior supervisor I could be asked to stand up as a manager if there was a position vacant – it gives them the opportunity to view a person in that role and gives the person standing the opportunity to see whether they can cope or manage and like the position
        - Certainly that opportunity exists – you can stand up at all levels – it is essentially a test run
    - In terms of succession management certain levels of the company will recognise potential and then promote that potential by giving them additional responsibilities, standing them into a higher profile position, even moving departments.
        - They could move you production to QA, from QA to engineering for their development – we call them highly potential people and it's a way of promoting that development
- *Andrew: Hypothetically if you wanted to take a sabbatical and go to Australia / see the world are there options for people to take extended time off?*

    - I don't think so
    - I certainly haven't heard of it other than legislation for child care and stuff like that I do not know of any sabbatical type arrangements – definitely not

4. How does the Nissan Production Way get the full value from employees?

Andrew: Obviously the whole focus is on removing non-value added from the production line so do you try and transfer that over to your staff?

- Yeh I think from manned staff everybody in my opinion recognises their role and what is expected of them
    - We clearly communicate this through the introduction of the Nissan Production Way where we explained what our expectations of them where and also what they should be thinking of in terms of their contribution
    - We ask them to focus on their actual contribution whether it be building a car or planning the schedules
    - Yeh I think it works
- In terms of whether the manned staff building the car know everything about Nissan Production Way – probably not but I think they certainly know what is expected from them and we tell them what their role within Nissan Production Way is

5. What rewards and recognition schemes exist for employees?

- Yeh in terms of monetary recognition we do give merit awards through appraisal so there is certainly reward and recognition through appraisal
- We also have reward and recognition for Quality Control Story competitions
- We also have it for 5S application – recently held an NMUK 5S competition
- Recognition through monthly communication DVD, monthly publications, photographs of team, certificates rewarded and rewarded by having a working lunch provided, sometimes cinema tickets for the team involved.
    - In the past we have given new fridges and microwaves for the rest areas
    - That type of activity

Part Six: Other Features / Components

1. Are there any features / components that the Nissan Production Way utilises but are recognised as an 'add-on' rather than part of the core production system?

- I think the only one that I could think of is Improvement Diagnostic System
    - The improvement diagnosis system is something that was developed within NMUK and blended into Nissan Production Way
    - It doesn't exist in any other Nissan Plant
    - It's a variation of Just-in-Time – a little bit more detailed
- *Andrew: Do you think Total Quality Management is part of the core of the Nissan Production Way or is it an add on?*
    - I think it complements
    - Total Quality Management here is called the Nissan Management Way and we have the Nissan Recycling Way, the Nissan Way which is mind-sets and actions – I guess they all complement each other
        - Whether they actually all live under the Total Quality Management banner is difficult to say as I know Total Quality Management within different Nissan organisations as slightly different
- *Andrew: Do things just get blended in? You have added in the Improvement Diagnostic System – is that now just blended into the system?*
    - It is introduced in such a way that it's sold as an improvement to Nissan Production Way current systems and tools that we already have
    - It is blended in such a way that we demonstrate its effectiveness and then the representatives from each shop – managers and shop seniors are then informed and educated about these new processes
        - Total Quality Management was a good example many many years ago it was introduced as the new way we were going to measure and manage our objectives, cascade and deploy our objectives
        - It was introduced and almost just blended into NMUK's Nissan Production Way culture

2. Have all of the elements of the Nissan Production Way we have discussed thus far been part of the Nissan Production System at Nissan Sunderland Plant since the system was first introduced?
Prompt: How has the system developed at the plant, what are the notable omissions and additions. Are the additions / omissions core components or add-ons?

Andrew: Improvement Diagnostic System was introduced after the system was first introduced... is that a regular occurrence?

- Things are either added or tools evolved
    - We've had for example Genba Kanri diagnosis is a measurement of manufacturing capability – we have had Genba Kanri diagnosis for probably 15 years but that has evolved over the 15 years and we have re-launched and repackaged it only 6/8 months ago
    - It never stands still – always evolving, always changing

3. Is the Nissan Production Way at Nissan Sunderland Plant a mirror image to the Nissan Production Way used at other Nissan plants?
Prompt: Is anything unique to Nissan Sunderland?

Andrew: Presumably based on your answer to question one you would say that that is a no?

- I would say it's a yes but modified slightly to suit our culture
- We have definitely seen differences in the way it has been managed and applied mainly due to culture and work ethic
    - Those types of differences mean that we may change the performer, frequency, focus of an activity
    - But essentially it is the same

Part Seven: Additional information

1. Are there any other aspects or is there anything about the Nissan Production Way we have not covered?

Andrew: Is there any aspects we have majorly missed here in asking the questions I have asked you?

- I don't think so
- Pre-reading of the questions and in my answers I think we have covered just about everything

2. Do you have any opinions you are comfortable sharing with us with regards to the Nissan Production Way in general and its long-term viability as the way to manage production?

Andrew: Also are there any problems you have noticed... is everything rosy?

- I think in terms of is it necessary and will it be viable for the future absolutely so
    - Recently this office function has been involved in future mid-term plans which we are calling challenge mid-term plans
    - We are essentially challenging for new models, new business and we are finding ourselves in a climate now where we are competing with our sister plants and Renault our alliance partner
        - The only way to reduce Total Delivered Cost and to demonstrate manufacturing capability and viability to produce these new cars is through consistent application of Nissan Production Way
        - We have proven that it does deliver – it definitely works
        - All the tools that production use to manage the process, improve the process exist within Nissan Production Way we just get better at using them – we have to – our future depends on it, our livelihood depends on it
- *Andrew: Just as one last key point would you say there are any areas you have highlighted that need working on? Areas where you are not so strong? Or would you say that you are strong across the board?*
    - I think at this moment in time we are probably the strongest we have ever been
    - In recent times we have had to reintroduce certain systems, we have had to reinforce certain systems and tools because they weren't being used correctly – Total Quality Management being an example
        - Over the years knowledge has been eroded for how the Total Quality Management process worked – we've addressed that very recently over the last few years

- We've operated a 3S system for 15 years and we have recently introduced 5S and then had to reintroduce it again and reinforce it because it is a system that relies on behaviour and attitude – we found ourselves having to reinforce that
- I think currently we are in the best shape we have ever been but we have to be as we are fighting for our survival
- It's been acknowledged by the various top people within the organisation that NMUK is as good as if not better than most Japanese plants and we have to remain that way
- There is no question – when we are competing against the likes of Nissan China who have very low wage bills and are very competent and capable it's a frightening prospect that they're catching us up
- We have to continue to compete otherwise we will not be here and don't forget ten years ago we have been at the brink of survival – I mean we have learnt some valuable lessons from that
- I certainly believe in it

APPENDIX D: MOTIVATION SURVEY

BRADFORD UNIVERSITY School of Management

5 Minute Questionnaire

Your opinions on the characteristics of your job

What is this all about?

It's all about you and how you feel about your job. We are conducting some research on the Nissan Production Way and need your help. A member of our research team is an ex-employee of Nissan Sunderland and this work will help him to gain his PhD. This should take you less than 5 minutes to complete and will form the most important part of our research. The answers you provide should be personal to you.

Confidentiality

This is a Bradford University School of Management study supported by Nissan Sunderland Plant. Completed questionnaires will only be handled by our research team off-site and independently from the plant. As this questionnaire is anonymous we have no way of tracking your answers back to you. Please **do not** write your name on this questionnaire or on the envelope provided. We may provide the plant's management with a report of our findings in addition to using data collected in our research.

Here we go!

Complete the general details section and then read the statements carefully before indicating your personal feelings about each one. If you go wrong just scribble out your answer and select the right one.

General Details

*Circle or **underline** the correct answer*

Gender:	Male	Female			
Age Range:	16 - 25	26 - 35	36 - 45	46 - 55	56+
Job Rank:	Team Member	Team Leader	Supervisor	Senior Supervisor	Manager
Time at Plant:	0 – 1 years	2 – 5 years	6 – 10 years	11 – 20 years	21+ years

Statements

***Place an X** in a box for each statement to indicate how strongly you agree / disagree*

	strongly agree	agree	slightly agree	neutral	slightly disagree	disagree	strongly disagree
My job requires me to use a number of complex or high-level skills	☐	☐	☐	☐	☐	☐	☐
My job is arranged so that I do not have the chance to do an entire piece of work from beginning to end	☐	☐	☐	☐	☐	☐	☐
My job gives me considerable freedom in how I do the work	☐	☐	☐	☐	☐	☐	☐
My job provides me the chance to completely finish the pieces of work I begin	☐	☐	☐	☐	☐	☐	☐
My job is arranged so that I can judge for myself how well I am doing	☐	☐	☐	☐	☐	☐	☐
I regularly participate in improvement teams	☐	☐	☐	☐	☐	☐	☐
We are under constant pressure to keep improving the plant to secure our jobs	☐	☐	☐	☐	☐	☐	☐
I rotate between a number of different jobs	☐	☐	☐	☐	☐	☐	☐
Supervisors often let me know how well they think I am performing the job	☐	☐	☐	☐	☐	☐	☐
I can attend relevant additional training courses with ease	☐	☐	☐	☐	☐	☐	☐
I am able to clearly see how my job contributes towards achieving company objectives	☐	☐	☐	☐	☐	☐	☐

Statements (continued)

***Place an X** in a box for each statement to indicate how strongly you agree / disagree*

	strongly agree	agree	slightly agree	neutral	slightly disagree	disagree	strongly disagree
The team I work in receives recognition if we do a good job	☐	☐	☐	☐	☐	☐	☐
I do not have the authority to make decisions that affect my work area	☐	☐	☐	☐	☐	☐	☐
My job is one where a lot of other people can be affected by how well the work gets done	☐	☐	☐	☐	☐	☐	☐
My job is repetitive	☐	☐	☐	☐	☐	☐	☐
There is intense competition for new models between all the company's plants	☐	☐	☐	☐	☐	☐	☐
I have only received training to do one job in the plant	☐	☐	☐	☐	☐	☐	☐
My job denies me any chance to use my personal initiative or judgement in carrying out the work	☐	☐	☐	☐	☐	☐	☐
I cannot tell how well I am performing just by doing my job	☐	☐	☐	☐	☐	☐	☐
I do not often get the opportunity to participate in group problem solving activities	☐	☐	☐	☐	☐	☐	☐
The plant's training courses are a waste of time	☐	☐	☐	☐	☐	☐	☐
The job itself is not very significant or important in the broader scheme of things	☐	☐	☐	☐	☐	☐	☐
Job rotation doesn't occur in practice	☐	☐	☐	☐	☐	☐	☐
My supervisors almost never give me any feedback about how well I am doing in my work	☐	☐	☐	☐	☐	☐	☐
My job does not contribute towards company objectives	☐	☐	☐	☐	☐	☐	☐
My job is 100% secure	☐	☐	☐	☐	☐	☐	☐
My team's efforts normally go un-noticed	☐	☐	☐	☐	☐	☐	☐
The company council has no real power	☐	☐	☐	☐	☐	☐	☐
There is a lot of variety in my job	☐	☐	☐	☐	☐	☐	☐
The results of my work are likely to significantly impact the well-being of other people	☐	☐	☐	☐	☐	☐	☐
My team never share work related tips or give each other advice	☐	☐	☐	☐	☐	☐	☐
I am trained to do several jobs	☐	☐	☐	☐	☐	☐	☐
I frequently receive feedback from other members of my team	☐	☐	☐	☐	☐	☐	☐
Company council has a big impact on me at work	☐	☐	☐	☐	☐	☐	☐
We do not have to compete with other Renault-Nissan plants	☐	☐	☐	☐	☐	☐	☐
My job is always the same and never different	☐	☐	☐	☐	☐	☐	☐
My job performance has no impact on anyone else	☐	☐	☐	☐	☐	☐	☐
I am responsible for continually improving my work area	☐	☐	☐	☐	☐	☐	☐

All done!

Just pop this questionnaire in the envelope provided and then place in internal mail. If you wish to make any comments or want any further information you can email Andrew (a.s.mcsweeney@bradford.ac.uk). Lost your envelope? If you know anyone else doing the questionnaire pop it in the envelope with theirs or place in a sealed envelope marked "Andrew McSweeney – Press Office" and put in internal mail. Thanks for taking the time to help us with our research!

APPENDIX E: CORE JOB DIMENSION RAW DATA

SV1: The job requires me to use a number of complex or high level skills

Sorted by Age:

	16 - 25	26 - 35	36 - 45	46 - 55
Strongly Agree			1	1
Slightly Agree	2	3	1	1
Agree	10	5	1	
Neutral	4	2	1	
Disagree	3	2	1	
Slightly Disagree		2		
Strongly Disagree				

Overview:

Strongly Agree	2
Slightly Agree	7
Agree	16
Neutral	7
Disagree	6
Slightly Disagree	2
Strongly Disagree	0

Sorted by Years at Plant:

	0 - 1	2 - 5	6 - 10	11 - 20	21+
Strongly Agree				1	1
Slightly Agree		2	3	1	1
Agree	1	6	7	2	
Neutral	1	3	1	2	
Disagree	2	1	3		
Slightly Disagree		1		1	
Strongly Disagree					

Sorted by Area of Work:

	Direct	Semi Direct	Indirect
Strongly Agree	1	1	
Slightly Agree	2	3	2
Agree	8	5	3
Neutral	5	2	
Disagree	6		
Slightly Disagree	2		
Strongly Disagree			

SV2: My job is repetitive

Sorted by Age:

	16 - 25	26 - 35	36 - 45	46 - 55
Strongly Agree	15	8	1	
Slightly Agree				
Agree	1	1		
Neutral	1	1		
Disagree	2	1	2	2
Slightly Disagree		1	1	
Strongly Disagree		2	1	

Overview:

Strongly Agree	24
Slightly Agree	0
Agree	2
Neutral	2
Disagree	7
Slightly Disagree	2
Strongly Disagree	3

Sorted by Years at Plant:

	0 - 1	2 - 5	6 - 10	11 - 20	21+
Strongly Agree	4	9	8	3	
Slightly Agree					
Agree			2		
Neutral			2		
Disagree		3		2	2
Slightly Disagree			1	1	
Strongly Disagree		1	1	1	

Sorted by Area of Work:

	Direct	Semi Direct	Indirect
Strongly Agree	22	2	
Slightly Agree			
Agree	1	1	
Neutral		2	
Disagree	1	4	2
Slightly Disagree		2	
Strongly Disagree			3

SV1&2

Sorted by Age:

	16 - 25	26 - 35	36 - 45	46 - 55
Strongly Agree	0	1	1	0.5
Slightly Agree	1	2	1	0.5
Agree	6	3	1.5	1
Neutral	2.5	1.5	0.5	0
Disagree	2	1.5	0.5	0
Slightly Disagree	0	1	0	0
Strongly Disagree	7.5	4	0.5	0

Overview:

Strongly Agree	2.5
Slightly Agree	4.5
Agree	11.5
Neutral	4.5
Disagree	4
Slightly Disagree	1
Strongly Disagree	12

Sorted by Years at Plant:

	0 - 1	2 - 5	6 - 10	11 - 20	21+
Strongly Agree	0	0.5	0.5	1	0.5
Slightly Agree	0	1	2	1	0.5
Agree	0.5	4.5	3.5	2	1
Neutral	0.5	1.5	1.5	1	0
Disagree	1	0.5	2.5	0	0
Slightly Disagree	0	0.5	0	0.5	0
Strongly Disagree	2	4.5	4	1.5	0

Sorted by Area of Work:

	Direct	Semi Direct	Indirect
Strongly Agree	0.5	0.5	1.5
Slightly Agree	1	2.5	1
Agree	4.5	4.5	2.5
Neutral	2.5	2	0
Disagree	3.5	0.5	0
Slightly Disagree	1	0	0
Strongly Disagree	11	1	0

SV3: There is a lot of variety in my job

Sorted by Age:

	16 - 25	26 - 35	36 - 45	46 - 55
Strongly Agree				1
Slightly Agree	2	2	1	
Agree	2	2	3	1
Neutral	1	1		
Disagree	7	3		
Slightly Disagree	2			
Strongly Disagree	5	6	1	

Overview:

Strongly Agree	1
Slightly Agree	5
Agree	8
Neutral	2
Disagree	10
Slightly Disagree	2
Strongly Disagree	12

Sorted by Years at Plant:

	0 - 1	2 - 5	6 - 10	11 - 20	21+
Strongly Agree					1
Slightly Agree		4		1	
Agree		1	3	3	1
Neutral			2		
Disagree	3	4	3		
Slightly Disagree			2		
Strongly Disagree	1	4	4	3	

Sorted by Area of Work:

	Direct	Semi Direct	Indirect
Strongly Agree		1	
Slightly Agree	1	3	1
Agree	2	2	4
Neutral	1	1	
Disagree	7	3	
Slightly Disagree	2		
Strongly Disagree	11	1	

SV4: My job is the same and never different

Sorted by Age:

	16 - 25	26 - 35	36 - 45	46 - 55
Strongly Agree	1		1	
Slightly Agree		1		
Agree	5	2		
Neutral	1	1	1	
Disagree	8	5	2	1
Slightly Disagree	2	2		
Strongly Disagree	2	3	1	1

Overview:

Strongly Agree	2
Slightly Agree	1
Agree	7
Neutral	3
Disagree	16
Slightly Disagree	4
Strongly Disagree	7

Sorted by Years at Plant:

	0 - 1	2 - 5	6 - 10	11 - 20	21+
Strongly Agree		1	1		
Slightly Agree		1			
Agree	4	2	1		
Neutral		1	1	1	
Disagree		5	6	4	1
Slightly Disagree		1	2	1	
Strongly Disagree		2	3	1	1

Sorted by Area of Work:

	Direct	Semi Direct	Indirect
Strongly Agree	2		
Slightly Agree	1		
Agree	7		
Neutral	2	1	
Disagree	8	5	3
Slightly Disagree	2	2	
Strongly Disagree	2	3	2

SV3&4

Sorted by Age:

	16 - 25	26 - 35	36 - 45	46 - 55
Strongly Agree	1	1.5	0.5	1
Slightly Agree	2	2	0.5	0
Agree	5	3.5	2.5	1
Neutral	1	1	0.5	0
Disagree	6	2.5	0	0
Slightly Disagree	1	0.5	0	0
Strongly Disagree	3	3	1	0

Overview:

Strongly Agree	4
Slightly Agree	4.5
Agree	12
Neutral	2.5
Disagree	8.5
Slightly Disagree	1.5
Strongly Disagree	7

Sorted by Years at Plant:

	0 - 1	2 - 5	6 - 10	11 - 20	21+
Strongly Agree	0	1	1.5	0.5	1
Slightly Agree	0	2.5	1	1	0
Agree	0	3	4.5	3.5	1
Neutral	0	0.5	1.5	0.5	0
Disagree	3.5	3	2	0	0
Slightly Disagree	0	0.5	1	0	0
Strongly Disagree	0.5	2.5	2.5	1.5	0

Sorted by Area of Work:

	Direct	Semi Direct	Indirect
Strongly Agree	1	2	1
Slightly Agree	1.5	2.5	0.5
Agree	5	3.5	3.5
Neutral	1.5	1	0
Disagree	7	1.5	0
Slightly Disagree	1.5	0	0
Strongly Disagree	6.5	0.5	0

TS1: My job is one where a lot of other people can be affected by how well the work gets done

Sorted by Age:

	16 - 25	26 - 35	36 - 45	46 - 55
Strongly Agree	1			
Slightly Agree	2	3		1
Agree	5	1		
Neutral	5	4	2	
Disagree	5	5	2	
Slightly Disagree		1	1	1
Strongly Disagree	1			

Overview:

Strongly Agree	1
Slightly Agree	6
Agree	6
Neutral	11
Disagree	12
Slightly Disagree	3
Strongly Disagree	1

Sorted by Years at Plant:

	0 - 1	2 - 5	6 - 10	11 - 20	21+
Strongly Agree			1		
Slightly Agree		1	2	2	1
Agree	1	3	2		
Neutral	2	3	3	3	
Disagree	1	4	6	1	
Slightly Disagree		1		1	1
Strongly Disagree		1			

Sorted by Area of Work:

	Direct	Semi Direct	Indirect
Strongly Agree	1		
Slightly Agree	3	3	
Agree	5	1	
Neutral	7	3	1
Disagree	7	3	2
Slightly Disagree		1	2
Strongly Disagree	1		

TS2: The job itself is not very significant or important in the broader scheme of things

Sorted by Age:

	16 - 25	26 - 35	36 - 45	46 - 55
Strongly Agree				
Slightly Agree		2		
Agree	6	4	1	
Neutral	5	3	1	
Disagree	5	3	1	1
Slightly Disagree	1		1	
Strongly Disagree	2	2	1	1

Overview:

Strongly Agree	0
Slightly Agree	2
Agree	11
Neutral	9
Disagree	10
Slightly Disagree	2
Strongly Disagree	6

Sorted by Years at Plant:

	0 - 1	2 - 5	6 - 10	11 - 20	21+
Strongly Agree					
Slightly Agree		1	1		
Agree	2	3	5	1	
Neutral	2	3	2	2	
Disagree		3	4	2	1
Slightly Disagree		1		1	
Strongly Disagree		2	2	1	1

Sorted by Area of Work:

	Direct	Semi Direct	Indirect
Strongly Agree			
Slightly Agree	1	1	
Agree	9	2	
Neutral	7	2	
Disagree	6	2	2
Slightly Disagree		1	1
Strongly Disagree	1	3	2

TS1&2

Sorted by Age:

	16 - 25	26 - 35	36 - 45	46 - 55
Strongly Agree	1.5	1	0.5	0.5
Slightly Agree	1.5	1.5	0.5	0.5
Agree	5	2	0.5	0.5
Neutral	5	3.5	1.5	0
Disagree	5.5	4.5	1.5	0
Slightly Disagree	0	1.5	0.5	0.5
Strongly Disagree	0.5	0	0	0

Overview:

Strongly Agree	3.5
Slightly Agree	4
Agree	8
Neutral	10
Disagree	11.5
Slightly Disagree	2.5
Strongly Disagree	0.5

Sorted by Years at Plant:

	0 - 1	2 - 5	6 - 10	11 - 20	21+
Strongly Agree	0	1	1.5	0.5	0.5
Slightly Agree	0	1	1	1.5	0.5
Agree	0.5	3	3	1	0.5
Neutral	2	3	2.5	2.5	0
Disagree	1.5	3.5	5.5	1	0
Slightly Disagree	0	1	0.5	0.5	0.5
Strongly Disagree	0	0.5	0	0	0

Sorted by Area of Work:

	Direct	Semi Direct	Indirect
Strongly Agree	1	1.5	1
Slightly Agree	1.5	2	0.5
Agree	5.5	1.5	1
Neutral	7	2.5	0.5
Disagree	8	2.5	1
Slightly Disagree	0.5	1	1
Strongly Disagree	0.5	0	0

TS3: The results of my work are likely to significantly impact the well-being of other people

Sorted by Age:

	16 - 25	26 - 35	36 - 45	46 - 55
Strongly Agree	1	2	2	1
Slightly Agree	2	2	1	
Agree	10	5		1
Neutral	2	4	1	
Disagree	3	1		
Slightly Disagree	1		1	
Strongly Disagree				

Overview:

Strongly Agree	6
Slightly Agree	5
Agree	16
Neutral	7
Disagree	4
Slightly Disagree	2
Strongly Disagree	0

Sorted by Years at Plant:

	0 - 1	2 - 5	6 - 10	11 - 20	21+
Strongly Agree		2	1	2	1
Slightly Agree		3	1	1	
Agree	2	5	6	2	1
Neutral	1		6		
Disagree	1	2		1	
Slightly Disagree		1		1	
Strongly Disagree					

Sorted by Area of Work:

	Direct	Semi Direct	Indirect
Strongly Agree	1	4	1
Slightly Agree	3	1	1
Agree	10	4	2
Neutral	5	1	1
Disagree	4		
Slightly Disagree	1	1	
Strongly Disagree			

TS4: My job performance has no impact on anyone else

Sorted by Age:

	16 - 25	26 - 35	36 - 45	46 - 55
Strongly Agree				
Slightly Agree				
Agree	1			
Neutral	4	2		
Disagree	9	7	3	1
Slightly Disagree	3	4	1	1
Strongly Disagree	2	1	1	

Overview:

Strongly Agree	0
Slightly Agree	0
Agree	1
Neutral	6
Disagree	20
Slightly Disagree	9
Strongly Disagree	4

Sorted by Years at Plant:

	0 - 1	2 - 5	6 - 10	11 - 20	21+
Strongly Agree					
Slightly Agree					
Agree	1				
Neutral	2	2	2		
Disagree	1	5	9	4	1
Slightly Disagree		6		2	1
Strongly Disagree			3	1	

Sorted by Area of Work:

	Direct	Semi Direct	Indirect
Strongly Agree			
Slightly Agree			
Agree	1		
Neutral	5	1	
Disagree	13	4	3
Slightly Disagree	3	5	1
Strongly Disagree	2	1	1

TS3&4

Sorted by Age:

	16 - 25	26 - 35	36 - 45	46 - 55
Strongly Agree	1.5	1.5	1.5	0.5
Slightly Agree	2.5	3	1	0.5
Agree	9.5	6	1.5	1
Neutral	3	3	0.5	0
Disagree	2	0.5	0	0
Slightly Disagree	0.5	0	0.5	0
Strongly Disagree	0	0	0	0

Overview:

Strongly Agree	5
Slightly Agree	7
Agree	18
Neutral	6.5
Disagree	2.5
Slightly Disagree	1
Strongly Disagree	0

Sorted by Years at Plant:

	0 - 1	2 - 5	6 - 10	11 - 20	21+
Strongly Agree	0	1	2	1.5	0.5
Slightly Agree	0	4.5	0.5	1.5	0.5
Agree	1.5	5	7.5	3	1
Neutral	1.5	1	4	0	0
Disagree	1	1	0	0.5	0
Slightly Disagree	0	0.5	0	0.5	0
Strongly Disagree	0	0	0	0	0

Sorted by Area of Work:

	Direct	Semi Direct	Indirect
Strongly Agree	1.5	2.5	1
Slightly Agree	3	3	1
Agree	11.5	4	2.5
Neutral	5	1	0.5
Disagree	2.5	0	0
Slightly Disagree	0.5	0.5	0
Strongly Disagree	0	0	0

TI1: My job provides me the chance to completely finish the pieces of work I begin

Sorted by Age:

	16 - 25	26 - 35	36 - 45	46 - 55
Strongly Agree		1		1
Slightly Agree		1		
Agree	3	3	3	1
Neutral	1		1	
Disagree	4	2		
Slightly Disagree		2		
Strongly Disagree	11	5	1	

Overview:

Strongly Agree	2
Slightly Agree	1
Agree	10
Neutral	2
Disagree	6
Slightly Disagree	2
Strongly Disagree	17

Sorted by Years at Plant:

	0 - 1	2 - 5	6 - 10	11 - 20	21+
Strongly Agree			1		1
Slightly Agree			1		
Agree		3	3	3	1
Neutral			1	1	
Disagree	1	3	1	1	
Slightly Disagree		2			
Strongly Disagree	3	5	7	2	

Sorted by Area of Work:

	Direct	Semi Direct	Indirect
Strongly Agree		1	1
Slightly Agree		1	
Agree		6	4
Neutral	2		
Disagree	6		
Slightly Disagree	1	1	
Strongly Disagree	15	2	

TI2: My job is arranged so that I do not have the chance to do an entire piece of work from beginning to end

Sorted by Age:

	16 - 25	26 - 35	36 - 45	46 - 55
Strongly Agree	8	4		
Slightly Agree	3	2		
Agree	5	2	2	1
Neutral		1		
Disagree	2	4	1	
Slightly Disagree	1		2	
Strongly Disagree				1

Overview:

Strongly Agree	12
Slightly Agree	5
Agree	10
Neutral	1
Disagree	7
Slightly Disagree	4
Strongly Disagree	1

Sorted by Years at Plant:

	0 - 1	2 - 5	6 - 10	11 - 20	21+
Strongly Agree	2	4	4	2	
Slightly Agree		4	1		
Agree	2	1	4	2	1
Neutral		1			
Disagree		2	4	1	
Slightly Disagree		1	1	2	
Strongly Disagree					1

Sorted by Area of Work:

	Direct	Semi Direct	Indirect
Strongly Agree	12		
Slightly Agree	4		1
Agree	6	1	3
Neutral	1		
Disagree		6	1
Slightly Disagree	1	3	
Strongly Disagree		1	

TI1&2

Sorted by Age:

	16 - 25	26 - 35	36 - 45	46 - 55
Strongly Agree	0	0.5	0	1
Slightly Agree	0.5	0.5	1	0
Agree	2.5	3.5	2	0.5
Neutral	0.5	0.5	0.5	0
Disagree	4.5	2	1	0.5
Slightly Disagree	1.5	2	0	0
Strongly Disagree	9.5	4.5	0.5	0

Overview:

Strongly Agree	1.5
Slightly Agree	2.5
Agree	8.5
Neutral	1.5
Disagree	8
Slightly Disagree	3.5
Strongly Disagree	14.5

Sorted by Years at Plant:

	0 - 1	2 - 5	6 - 10	11 - 20	21+
Strongly Agree	0	0	0.5	0	1
Slightly Agree	0	0.5	1	1	0
Agree	0	2.5	3.5	2	0.5
Neutral	0	0.5	0.5	0.5	0
Disagree	1.5	2	2.5	1.5	0.5
Slightly Disagree	0	3	0.5	0	0
Strongly Disagree	2.5	4.5	5.5	2	0

Sorted by Area of Work:

	Direct	Semi Direct	Indirect
Strongly Agree	0	1	0.5
Slightly Agree	0.5	2	0
Agree	0	6	2.5
Neutral	1.5	0	0
Disagree	6	0.5	1.5
Slightly Disagree	2.5	0.5	0.5
Strongly Disagree	13.5	1	0

CA1: My job gives me considerable freedom in how I do the work

Sorted by Age:

	16 - 25	26 - 35	36 - 45	46 - 55
Strongly Agree				
Slightly Agree				1
Agree		1	1	1
Neutral	2	1	1	
Disagree	3	5	2	
Slightly Disagree	1	1		
Strongly Disagree	13	6	1	

Overview:

Strongly Agree	0
Slightly Agree	1
Agree	3
Neutral	4
Disagree	10
Slightly Disagree	2
Strongly Disagree	20

Sorted by Years at Plant:

	0 - 1	2 - 5	6 - 10	11 - 20	21+
Strongly Agree					
Slightly Agree					1
Agree			1	1	1
Neutral		2	1	1	
Disagree		3	4	3	
Slightly Disagree		1	1		
Strongly Disagree	4	7	7	2	

Sorted by Area of Work:

	Direct	Semi Direct	Indirect
Strongly Agree			
Slightly Agree			1
Agree		1	2
Neutral	1	2	1
Disagree	2	7	1
Slightly Disagree	2		
Strongly Disagree	19	1	

CA2: My job denies me any chance to use my personal initiative or judgement in carrying out the work

Sorted by Age:

	16 - 25	26 - 35	36 - 45	46 - 55
Strongly Agree	2			
Slightly Agree	4	1		
Agree	7	6		
Neutral	2	2		
Disagree	3	2	3	1
Slightly Disagree		1	2	
Strongly Disagree	1	1		1

Overview:

Strongly Agree	2
Slightly Agree	5
Agree	13
Neutral	5
Disagree	9
Slightly Disagree	3
Strongly Disagree	3

Sorted by Years at Plant:

	0 - 1	2 - 5	6 - 10	11 - 20	21+
Strongly Agree		2			
Slightly Agree	2	1	1	1	
Agree	2	6	3	2	
Neutral		2	3		
Disagree		2	4	2	1
Slightly Disagree			1	2	
Strongly Disagree			2		1

Sorted by Area of Work:

	Direct	Semi Direct	Indirect
Strongly Agree	1	1	
Slightly Agree	4	1	
Agree	12	1	
Neutral	3	2	
Disagree	4	1	4
Slightly Disagree		3	
Strongly Disagree		2	1

CA1&2

Sorted by Age:

	16 - 25	26 - 35	36 - 45	46 - 55
Strongly Agree	0.5	0.5	0	0.5
Slightly Agree	0	0.5	1	0.5
Agree	1.5	1.5	2	1
Neutral	2	1.5	0.5	0
Disagree	5	5.5	1	0
Slightly Disagree	2.5	1	0	0
Strongly Disagree	7.5	3	0.5	0

Overview:

Strongly Agree	1.5
Slightly Agree	2
Agree	6
Neutral	4.5
Disagree	11.5
Slightly Disagree	3.5
Strongly Disagree	11

Sorted by Years at Plant:

	0 - 1	2 - 5	6 - 10	11 - 20	21+
Strongly Agree	0	0	1	0	0.5
Slightly Agree	0	0	0.5	1	0.5
Agree	0	1	2.5	1.5	1
Neutral	0	2	2	0.5	0
Disagree	1	4.5	3.5	2.5	0
Slightly Disagree	1	1	1	0.5	0
Strongly Disagree	2	4.5	3.5	1	0

Sorted by Area of Work:

	Direct	Semi Direct	Indirect
Strongly Agree	0	1	0.5
Slightly Agree	0	1.5	0.5
Agree	2	1	3
Neutral	2	2	0.5
Disagree	7	4	0.5
Slightly Disagree	3	0.5	0
Strongly Disagree	10	1	0

RA1: I am responsible for continually improving my work area

Sorted by Age:

	16 - 25	26 - 35	36 - 45	46 - 55
Strongly Agree			1	1
Slightly Agree	1	2	1	
Agree	1		2	1
Neutral	3	4		
Disagree	10	5		
Slightly Disagree	2	2		
Strongly Disagree	2	1	1	

Overview:

Strongly Agree	2
Slightly Agree	4
Agree	4
Neutral	7
Disagree	15
Slightly Disagree	4
Strongly Disagree	4

Sorted by Years at Plant:

	0 - 1	2 - 5	6 - 10	11 - 20	21+
Strongly Agree				1	1
Slightly Agree		1	1	2	
Agree		1		2	1
Neutral	1	3	3		
Disagree	1	7	5	2	
Slightly Disagree	1		3		
Strongly Disagree	1	1	2		

Sorted by Area of Work:

	Direct	Semi Direct	Indirect
Strongly Agree	1	1	
Slightly Agree	2	2	
Agree	1	1	2
Neutral	3	3	1
Disagree	11	3	1
Slightly Disagree	2	1	1
Strongly Disagree	4		

R2: I do not have the authority to make decisions that affect my work area

Sorted by Age:

	16 - 25	26 - 35	36 - 45	46 - 55
Strongly Agree	6	4		
Slightly Agree	2			
Agree	10	6	2	
Neutral			1	1
Disagree		1	1	
Slightly Disagree				
Strongly Disagree	1	3	1	1

Overview:

Strongly Agree	10
Slightly Agree	2
Agree	18
Neutral	2
Disagree	2
Slightly Disagree	0
Strongly Disagree	6

Sorted by Years at Plant:

	0 - 1	2 - 5	6 - 10	11 - 20	21+
Strongly Agree		4	4	2	
Slightly Agree		1	1		
Agree	4	5	6	3	
Neutral				1	1
Disagree			1	1	
Slightly Disagree					
Strongly Disagree		3	2		1

Sorted by Area of Work:

	Direct	Semi Direct	Indirect
Strongly Agree	8	2	
Slightly Agree	1	1	
Agree	9	7	2
Neutral			2
Disagree	1		1
Slightly Disagree			
Strongly Disagree	5	1	

RA1&2

Sorted by Age:

	16 - 25	26 - 35	36 - 45	46 - 55
Strongly Agree	0.5	1.5	1	1
Slightly Agree	0.5	1	0.5	0
Agree	0.5	0.5	1.5	0.5
Neutral	1.5	2	0.5	0.5
Disagree	10	5.5	1	0
Slightly Disagree	2	1	0	0
Strongly Disagree	4	2.5	0.5	0

Overview:

Strongly Agree	4
Slightly Agree	2
Agree	3
Neutral	4.5
Disagree	16.5
Slightly Disagree	3
Strongly Disagree	7

Sorted by Years at Plant:

	0 - 1	2 - 5	6 - 10	11 - 20	21+
Strongly Agree	0	1.5	1	0.5	1
Slightly Agree	0	0.5	0.5	1	0
Agree	0	0.5	0.5	1.5	0.5
Neutral	0.5	1.5	1.5	0.5	0.5
Disagree	2.5	6	5.5	2.5	0
Slightly Disagree	0.5	0.5	2	0	0
Strongly Disagree	0.5	2.5	3	1	0

Sorted by Area of Work:

	Direct	Semi Direct	Indirect
Strongly Agree	3	1	0
Slightly Agree	1	1	0
Agree	1	0.5	1.5
Neutral	1.5	1.5	1.5
Disagree	10	5	1.5
Slightly Disagree	1.5	1	0.5
Strongly Disagree	6	1	0

FB1: My job is arranged so that I can judge for myself how well I am doing

Sorted by Age:

	16 - 25	26 - 35	36 - 45	46 - 55
Strongly Agree				
Slightly Agree	1	1	2	1
Agree	3	5		
Neutral	6	3		1
Disagree	8	4	3	
Slightly Disagree	1			
Strongly Disagree		1		

Overview:

Strongly Agree	0
Slightly Agree	5
Agree	8
Neutral	10
Disagree	15
Slightly Disagree	1
Strongly Disagree	1

Sorted by Years at Plant:

	0 - 1	2 - 5	6 - 10	11 - 20	21+
Strongly Agree					
Slightly Agree			2	2	1
Agree	1	3	2	2	
Neutral	2	4	2	1	1
Disagree	1	5	7	2	
Slightly Disagree			1		
Strongly Disagree		1			

Sorted by Area of Work:

	Direct	Semi Direct	Indirect
Strongly Agree			
Slightly Agree	1	3	1
Agree	6	1	1
Neutral	6	2	2
Disagree	9	5	1
Slightly Disagree	1		
Strongly Disagree	1		

FB2: I cannot tell how well I am performing just by doing the job

Sorted by Age:

	16 - 25	26 - 35	36 - 45	46 - 55
Strongly Agree				
Slightly Agree	2	2	1	
Agree	9	7	2	
Neutral	5	4	2	
Disagree	3	1		1
Slightly Disagree				
Strongly Disagree				1

Overview:

Strongly Agree	0
Slightly Agree	5
Agree	18
Neutral	11
Disagree	5
Slightly Disagree	0
Strongly Disagree	1

Sorted by Years at Plant:

	0 - 1	2 - 5	6 - 10	11 - 20	21+
Strongly Agree					
Slightly Agree	1	2		2	
Agree	2	7	7	2	
Neutral	1	3	4	3	
Disagree		1	3		1
Slightly Disagree					
Strongly Disagree					1

Sorted by Area of Work:

	Direct	Semi Direct	Indirect
Strongly Agree			
Slightly Agree	3	2	
Agree	13	5	
Neutral	7	2	2
Disagree	1	1	3
Slightly Disagree			
Strongly Disagree		1	

FB1&2

Sorted by Age:

	16 - 25	26 - 35	36 - 45	46 - 55
Strongly Agree	0	0	0	0.5
Slightly Agree	0.5	0.5	1	0.5
Agree	3	3	0	0.5
Neutral	5.5	3.5	1	0.5
Disagree	8.5	5.5	2.5	0
Slightly Disagree	1.5	1	0.5	0
Strongly Disagree	0	0.5	0	0

Overview:

Strongly Agree	0.5
Slightly Agree	2.5
Agree	6.5
Neutral	10.5
Disagree	16.5
Slightly Disagree	3
Strongly Disagree	0.5

Sorted by Years at Plant:

	0 - 1	2 - 5	6 - 10	11 - 20	21+
Strongly Agree	0	0	0	0	0.5
Slightly Agree	0	0	1	1	0.5
Agree	0.5	2	2.5	1	0.5
Neutral	1.5	3.5	3	2	0.5
Disagree	1.5	6	7	2	0
Slightly Disagree	0.5	1	0.5	1	0
Strongly Disagree	0	0.5	0	0	0

Sorted by Area of Work:

	Direct	Semi Direct	Indirect
Strongly Agree	0	0.5	0
Slightly Agree	0.5	1.5	0.5
Agree	3.5	1	2
Neutral	6.5	2	2
Disagree	11	5	0.5
Slightly Disagree	2	1	0
Strongly Disagree	0.5	0	0

APPENDIX F: INFLUENCING PRACTICES RAW DATA

K1: I regularly participate in improvement teams

Sorted by Age:

	16 - 25	26 - 35	36 - 45	46 - 55
Strongly Agree			1	1
Slightly Agree	1			
Agree	4	2	1	
Neutral	3	4		
Disagree	9	7	3	1
Slightly Disagree	1	1		
Strongly Disagree	1			

Overview:

Strongly Agree	2
Slightly Agree	1
Agree	7
Neutral	7
Disagree	20
Slightly Disagree	2
Strongly Disagree	1

Sorted by Years at Plant:

	0 - 1	2 - 5	6 - 10	11 - 20	21+
Strongly Agree				1	1
Slightly Agree		1			
Agree		1	5	1	
Neutral		4	3		
Disagree	4	4	6	5	1
Slightly Disagree		2			
Strongly Disagree		1			

Sorted by Area of Work:

	Direct	Semi Direct	Indirect
Strongly Agree	1	1	
Slightly Agree	1		
Agree	3	2	2
Neutral	4	2	1
Disagree	13	5	2
Slightly Disagree	1	1	
Strongly Disagree	1		

K2: I do not often get the opportunity to participate in group problem solving activities

Sorted by Age:

	16 - 25	26 - 35	36 - 45	46 - 55
Strongly Agree	1			
Slightly Agree	1	2	1	
Agree	12	3	2	
Neutral	2	5		
Disagree	2	4		1
Slightly Disagree	1		1	
Strongly Disagree			1	1

Overview:

Strongly Agree	1
Slightly Agree	4
Agree	17
Neutral	7
Disagree	7
Slightly Disagree	2
Strongly Disagree	2

Sorted by Years at Plant:

	0 - 1	2 - 5	6 - 10	11 - 20	21+
Strongly Agree			1		
Slightly Agree		1	3		
Agree	4	5	4	4	
Neutral		3	3	1	
Disagree		3	3		1
Slightly Disagree		1		1	
Strongly Disagree				1	1

Sorted by Area of Work:

	Direct	Semi Direct	Indirect
Strongly Agree	1		
Slightly Agree	3	1	
Agree	11	6	
Neutral	5	1	1
Disagree	3	2	2
Slightly Disagree			2
Strongly Disagree	1	1	

K1&2

Sorted by Age:

	16 - 25	26 - 35	36 - 45	46 - 55
Strongly Agree	0	0	1	1
Slightly Agree	1	0	0.5	0
Agree	3	3	0.5	0.5
Neutral	2.5	4.5	0	0
Disagree	10.5	5	2.5	0.5
Slightly Disagree	1	1.5	0.5	0
Strongly Disagree	1	0	0	0

Overview:

Strongly Agree	2
Slightly Agree	1.5
Agree	7
Neutral	7
Disagree	18.5
Slightly Disagree	3
Strongly Disagree	1

Sorted by Years at Plant:

	0 - 1	2 - 5	6 - 10	11 - 20	21+
Strongly Agree	0	0	0	1	1
Slightly Agree	0	1	0	0.5	0
Agree	0	2	4	0.5	0.5
Neutral	0	3.5	3	0.5	0
Disagree	4	4.5	5	4.5	0.5
Slightly Disagree	0	1.5	1.5	0	0
Strongly Disagree	0	0.5	0.5	0	0

Sorted by Area of Work:

	Direct	Semi Direct	Indirect
Strongly Agree	1	1	0
Slightly Agree	0.5	0	1
Agree	3	2	2
Neutral	4.5	1.5	1
Disagree	12	5.5	1
Slightly Disagree	2	1	0
Strongly Disagree	1	0	0

CT1: I am trained to do several jobs

Sorted by Age:

	16 - 25	26 - 35	36 - 45	46 - 55
Strongly Agree	4	5	2	1
Slightly Agree	1	1	2	
Agree	14	8	1	1
Neutral				
Disagree				
Slightly Disagree				
Strongly Disagree				

Overview:

Strongly Agree	12
Slightly Agree	4
Agree	24
Neutral	0
Disagree	0
Slightly Disagree	0
Strongly Disagree	0

Sorted by Years at Plant:

	0 - 1	2 - 5	6 - 10	11 - 20	21+
Strongly Agree		3	5	3	1
Slightly Agree		1		3	
Agree	4	9	9	1	1
Neutral					
Disagree					
Slightly Disagree					
Strongly Disagree					

Sorted by Area of Work:

	Direct	Semi Direct	Indirect
Strongly Agree	6	6	
Slightly Agree	1	2	1
Agree	17	3	4
Neutral			
Disagree			
Slightly Disagree			
Strongly Disagree			

CT2: I have only received training to do one job in the plant

Sorted by Age:

	16 - 25	26 - 35	36 - 45	46 - 55
Strongly Agree				
Slightly Agree	1			
Agree				
Neutral	1			
Disagree	7	8	2	1
Slightly Disagree	4			
Strongly Disagree	6	6	3	1

Overview:

Strongly Agree	0
Slightly Agree	1
Agree	0
Neutral	1
Disagree	18
Slightly Disagree	4
Strongly Disagree	16

Sorted by Years at Plant:

	0 - 1	2 - 5	6 - 10	11 - 20	21+
Strongly Agree					
Slightly Agree			1		
Agree					
Neutral		1			
Disagree	3	5	6	3	1
Slightly Disagree	1	2	1		
Strongly Disagree		5	6	4	1

Sorted by Area of Work:

	Direct	Semi Direct	Indirect
Strongly Agree			
Slightly Agree	1		
Agree			
Neutral	1		
Disagree	10	5	3
Slightly Disagree	2	2	
Strongly Disagree	10	4	2

CT1&2

Sorted by Age:

	16 - 25	26 - 35	36 - 45	46 - 55
Strongly Agree	5	5.5	2.5	1
Slightly Agree	2.5	0.5	1	0
Agree	10.5	8	1.5	1
Neutral	0.5	0	0	0
Disagree	0	0	0	0
Slightly Disagree	0.5	0	0	0
Strongly Disagree	0	0	0	0

Overview:

Strongly Agree	14
Slightly Agree	4
Agree	21
Neutral	0.5
Disagree	0
Slightly Disagree	0.5
Strongly Disagree	0

Sorted by Years at Plant:

	0 - 1	2 - 5	6 - 10	11 - 20	21+
Strongly Agree	0	4	5.5	3.5	1
Slightly Agree	0.5	1.5	0.5	1.5	0
Agree	3.5	7	7.5	2	1
Neutral	0	0.5	0	0	0
Disagree	0	0	0	0	0
Slightly Disagree	0	0	0.5	0	0
Strongly Disagree	0	0	0	0	0

Sorted by Area of Work:

	Direct	Semi Direct	Indirect
Strongly Agree	8	5	1
Slightly Agree	1.5	2	0.5
Agree	13.5	4	3.5
Neutral	0.5	0	0
Disagree	0	0	0
Slightly Disagree	0.5	0	0
Strongly Disagree	0	0	0

CT3: I can attend relevant additional training courses with ease

Sorted by Age:

	16 - 25	26 - 35	36 - 45	46 - 55
Strongly Agree				
Slightly Agree	1	1	1	1
Agree	1		1	1
Neutral	3	1	2	
Disagree	7	4	1	
Slightly Disagree	2	4		
Strongly Disagree	5	4		

Overview:

Strongly Agree	0
Slightly Agree	4
Agree	3
Neutral	6
Disagree	12
Slightly Disagree	6
Strongly Disagree	9

Sorted by Years at Plant:

	0 - 1	2 - 5	6 - 10	11 - 20	21+
Strongly Agree					
Slightly Agree		1	1	1	1
Agree		1		1	1
Neutral	3		1	2	
Disagree	1	4	7		
Slightly Disagree		2	3	1	
Strongly Disagree		5	2	2	

Sorted by Area of Work:

	Direct	Semi Direct	Indirect
Strongly Agree			
Slightly Agree	1	2	1
Agree		1	2
Neutral	3	1	2
Disagree	9	3	
Slightly Disagree	4	2	
Strongly Disagree	7	2	

CT4: The plant's training courses are a waste of time

Sorted by Age:

	16 - 25	26 - 35	36 - 45	46 - 55
Strongly Agree				
Slightly Agree	2	2		
Agree	4	4	1	
Neutral	7	3	3	
Disagree	3	3		1
Slightly Disagree	3	2		
Strongly Disagree			1	1

Overview:

Strongly Agree	0
Slightly Agree	4
Agree	9
Neutral	13
Disagree	7
Slightly Disagree	5
Strongly Disagree	2

Sorted by Years at Plant:

	0 - 1	2 - 5	6 - 10	11 - 20	21+
Strongly Agree					
Slightly Agree		2	2		
Agree	1	3	2	3	
Neutral	2	3	5	3	
Disagree		3	3		1
Slightly Disagree	1	2	2		
Strongly Disagree				1	1

Sorted by Area of Work:

	Direct	Semi Direct	Indirect
Strongly Agree			
Slightly Agree	1	3	
Agree	6	3	
Neutral	11	1	1
Disagree	3	3	1
Slightly Disagree	2		3
Strongly Disagree	1	1	

CT3&4

Sorted by Age:

	16 - 25	26 - 35	36 - 45	46 - 55
Strongly Agree	0	0	0.5	0.5
Slightly Agree	2	1.5	0.5	0.5
Agree	2	1.5	0.5	1
Neutral	5	2	2.5	0
Disagree	5.5	4	1	0
Slightly Disagree	2	3	0	0
Strongly Disagree	2.5	2	0	0

Overview:

Strongly Agree	1
Slightly Agree	4.5
Agree	5
Neutral	9.5
Disagree	10.5
Slightly Disagree	5
Strongly Disagree	4.5

Sorted by Years at Plant:

	0 - 1	2 - 5	6 - 10	11 - 20	21+
Strongly Agree	0	0	0	0.5	0.5
Slightly Agree	0.5	1.5	1.5	0.5	0.5
Agree	0	2	1.5	0.5	1
Neutral	2.5	1.5	3	2.5	0
Disagree	1	3.5	4.5	1.5	0
Slightly Disagree	0	2	2.5	0.5	0
Strongly Disagree	0	2.5	1	1	0

Sorted by Area of Work:

	Direct	Semi Direct	Indirect
Strongly Agree	0.5	0.5	0
Slightly Agree	1.5	1	2
Agree	1.5	2	1.5
Neutral	7	1	1.5
Disagree	7.5	3	0
Slightly Disagree	2.5	2.5	0
Strongly Disagree	3.5	1	0

JR1: I rotate between a number of different jobs

Sorted by Age:

	16 - 25	26 - 35	36 - 45	46 - 55
Strongly Agree	1		1	1
Slightly Agree	5	1	1	
Agree	8	8	2	
Neutral		1	1	
Disagree	5	2		1
Slightly Disagree		2		
Strongly Disagree				

Overview:

Strongly Agree	3
Slightly Agree	7
Agree	18
Neutral	2
Disagree	8
Slightly Disagree	2
Strongly Disagree	0

Sorted by Years at Plant:

	0 - 1	2 - 5	6 - 10	11 - 20	21+
Strongly Agree			1	1	1
Slightly Agree		1	5	1	
Agree	2	7	5	4	
Neutral			1	1	
Disagree	2	3	2		1
Slightly Disagree		2			
Strongly Disagree					

Sorted by Area of Work:

	Direct	Semi Direct	Indirect
Strongly Agree		3	
Slightly Agree	4	3	
Agree	14	4	
Neutral	1		1
Disagree	5		3
Slightly Disagree		1	1
Strongly Disagree			

JR2: Job rotation doesn't occur in practice

Sorted by Age:

	16 - 25	26 - 35	36 - 45	46 - 55
Strongly Agree				
Slightly Agree				
Agree		1	1	
Neutral	2	2		
Disagree	12	8	4	1
Slightly Disagree	4	2		
Strongly Disagree	1	1		1

Overview:

Strongly Agree	0
Slightly Agree	0
Agree	2
Neutral	4
Disagree	25
Slightly Disagree	6
Strongly Disagree	3

Sorted by Years at Plant:

	0 - 1	2 - 5	6 - 10	11 - 20	21+
Strongly Agree					
Slightly Agree					
Agree			1	1	
Neutral		2	2		
Disagree	4	7	7	6	1
Slightly Disagree		3	3		
Strongly Disagree		1	1		1

Sorted by Area of Work:

	Direct	Semi Direct	Indirect
Strongly Agree			
Slightly Agree			
Agree		2	
Neutral	2	2	
Disagree	19	3	3
Slightly Disagree	3	1	2
Strongly Disagree		3	

JR1&2

Sorted by Age:

	16 - 25	26 - 35	36 - 45	46 - 55
Strongly Agree	1	0.5	0.5	1
Slightly Agree	4.5	1.5	0.5	0
Agree	10	8	3	0.5
Neutral	1	1.5	0.5	0
Disagree	2.5	1.5	0.5	0.5
Slightly Disagree	0	1	0	0
Strongly Disagree	0	0	0	0

Overview:

Strongly Agree	3
Slightly Agree	6.5
Agree	21.5
Neutral	3
Disagree	5
Slightly Disagree	1
Strongly Disagree	0

Sorted by Years at Plant:

	0 - 1	2 - 5	6 - 10	11 - 20	21+
Strongly Agree	0	0.5	1	0.5	1
Slightly Agree	0	2	4	0.5	0
Agree	3	7	6	5	0.5
Neutral	0	1	1.5	0.5	0
Disagree	1	1.5	1.5	0.5	0.5
Slightly Disagree	0	1	0	0	0
Strongly Disagree	0	0	0	0	0

Sorted by Area of Work:

	Direct	Semi Direct	Indirect
Strongly Agree	0	3	0
Slightly Agree	3.5	2	1
Agree	16.5	3.5	1.5
Neutral	1.5	1	0.5
Disagree	2.5	1	1.5
Slightly Disagree	0	0.5	0.5
Strongly Disagree	0	0	0

FBO1: Supervisors often let me know how well they think I am performing the job

Sorted by Age:

	16 - 25	26 - 35	36 - 45	46 - 55
Strongly Agree				
Slightly Agree	3		1	1
Agree	4	4	1	
Neutral	5	3	1	
Disagree	5	4	2	1
Slightly Disagree	2	3		
Strongly Disagree				

Overview:

Strongly Agree	0
Slightly Agree	5
Agree	9
Neutral	9
Disagree	12
Slightly Disagree	5
Strongly Disagree	0

Sorted by Years at Plant:

	0 - 1	2 - 5	6 - 10	11 - 20	21+
Strongly Agree					
Slightly Agree	1		2	1	1
Agree	2	1	4	2	
Neutral		5	2	2	
Disagree	1	3	6	1	1
Slightly Disagree		4		1	
Strongly Disagree					

Sorted by Area of Work:

	Direct	Semi Direct	Indirect
Strongly Agree			
Slightly Agree	3	2	
Agree	5	3	1
Neutral	6	2	1
Disagree	7	3	2
Slightly Disagree	3	1	1
Strongly Disagree			

FBO2: My supervisors almost never give me any feedback about how well I am doing in my work

Sorted by Age:

	16 - 25	26 - 35	36 - 45	46 - 55
Strongly Agree				
Slightly Agree	2	3		
Agree	4	2	3	
Neutral	7	3	1	
Disagree	4	5		2
Slightly Disagree	2	1	1	
Strongly Disagree				

Overview:

Strongly Agree	0
Slightly Agree	5
Agree	9
Neutral	11
Disagree	11
Slightly Disagree	4
Strongly Disagree	0

Sorted by Years at Plant:

	0 - 1	2 - 5	6 - 10	11 - 20	21+
Strongly Agree					
Slightly Agree		3	2		
Agree	1	1	4	3	
Neutral	2	3	4	2	
Disagree	1	3	4	1	2
Slightly Disagree		3		1	
Strongly Disagree					

Sorted by Area of Work:

	Direct	Semi Direct	Indirect
Strongly Agree			
Slightly Agree	3	2	
Agree	5	4	
Neutral	8	2	1
Disagree	6	3	2
Slightly Disagree	2		2
Strongly Disagree			

FBO1&2

Sorted by Age:

	16 - 25	26 - 35	36 - 45	46 - 55
Strongly Agree	0	0	0	0
Slightly Agree	2.5	0.5	1	0.5
Agree	4	4.5	0.5	1
Neutral	6	3	1	0
Disagree	4.5	3	2.5	0.5
Slightly Disagree	2	3	0	0
Strongly Disagree	0	0	0	0

Overview:

Strongly Agree	0
Slightly Agree	4.5
Agree	10
Neutral	10
Disagree	10.5
Slightly Disagree	5
Strongly Disagree	0

Sorted by Years at Plant:

	0 - 1	2 - 5	6 - 10	11 - 20	21+
Strongly Agree	0	0	0	0	0
Slightly Agree	0.5	1.5	1	1	0.5
Agree	1.5	2	4	1.5	1
Neutral	1	4	3	2	0
Disagree	1	2	5	2	0.5
Slightly Disagree	0	3.5	1	0.5	0
Strongly Disagree	0	0	0	0	0

Sorted by Area of Work:

	Direct	Semi Direct	Indirect
Strongly Agree	0	0	0
Slightly Agree	2.5	1	1
Agree	5.5	3	1.5
Neutral	7	2	1
Disagree	6	3.5	1
Slightly Disagree	3	1.5	0.5
Strongly Disagree	0	0	0

FBO3: I frequently receive feedback from other members of my team

Sorted by Age:

	16 - 25	26 - 35	36 - 45	46 - 55
Strongly Agree				
Slightly Agree		1		
Agree	3	6		1
Neutral	6	4	1	1
Disagree	10	2	2	
Slightly Disagree		1	2	
Strongly Disagree				

Overview:

Strongly Agree	0
Slightly Agree	1
Agree	10
Neutral	12
Disagree	14
Slightly Disagree	3
Strongly Disagree	0

Sorted by Years at Plant:

	0 - 1	2 - 5	6 - 10	11 - 20	21+
Strongly Agree					
Slightly Agree		1			
Agree		6	2	1	1
Neutral	1	3	5	2	1
Disagree	3	3	7	1	
Slightly Disagree				3	
Strongly Disagree					

Sorted by Area of Work:

	Direct	Semi Direct	Indirect
Strongly Agree			
Slightly Agree	1		
Agree	5	1	4
Neutral	6	5	1
Disagree	10	4	
Slightly Disagree	2	1	
Strongly Disagree			

FBO4: My team never share work related tips or give each other advice

Sorted by Age:

	16 - 25	26 - 35	36 - 45	46 - 55
Strongly Agree				
Slightly Agree	2			
Agree	1	2		
Neutral	4	2		
Disagree	6	9	2	1
Slightly Disagree	5		2	1
Strongly Disagree	1	1	1	

Overview:

Strongly Agree	0
Slightly Agree	2
Agree	3
Neutral	6
Disagree	18
Slightly Disagree	8
Strongly Disagree	3

Sorted by Years at Plant:

	0 - 1	2 - 5	6 - 10	11 - 20	21+
Strongly Agree					
Slightly Agree			2		
Agree	1	1	1		
Neutral	1	1	3	1	
Disagree	2	6	5	4	1
Slightly Disagree		4	2	1	1
Strongly Disagree		1	1	1	

Sorted by Area of Work:

	Direct	Semi Direct	Indirect
Strongly Agree			
Slightly Agree	2		
Agree	1	2	
Neutral	5	1	
Disagree	11	4	3
Slightly Disagree	4	3	1
Strongly Disagree	1	1	1

FBO3&4

Sorted by Age:

	16 - 25	26 - 35	36 - 45	46 - 55
Strongly Agree	0.5	0.5	0.5	0
Slightly Agree	2.5	0.5	1	0.5
Agree	4.5	7.5	1	1
Neutral	5	3	0.5	0.5
Disagree	5.5	2	1	0
Slightly Disagree	1	0.5	1	0
Strongly Disagree	0	0	0	0

Overview:

Strongly Agree	1.5
Slightly Agree	4.5
Agree	14
Neutral	9
Disagree	8.5
Slightly Disagree	2.5
Strongly Disagree	0

Sorted by Years at Plant:

	0 - 1	2 - 5	6 - 10	11 - 20	21+
Strongly Agree	0	0.5	0.5	0.5	0
Slightly Agree	0	2.5	1	0.5	0.5
Agree	1	6	3.5	2.5	1
Neutral	1	2	4	1.5	0.5
Disagree	2	2	4	0.5	0
Slightly Disagree	0	0	1	1.5	0
Strongly Disagree	0	0	0	0	0

Sorted by Area of Work:

	Direct	Semi Direct	Indirect
Strongly Agree	0.5	0.5	0.5
Slightly Agree	2.5	1.5	0.5
Agree	8	2.5	3.5
Neutral	5.5	3	0.5
Disagree	5.5	3	0
Slightly Disagree	2	0.5	0
Strongly Disagree	0	0	0

HK1: I am able to clearly see how my job contributes towards achieving company objectives

Sorted by Age:

	16 - 25	26 - 35	36 - 45	46 - 55
Strongly Agree				1
Slightly Agree	1		1	
Agree	2	4		
Neutral	5		2	1
Disagree	8	10	2	
Slightly Disagree	3			
Strongly Disagree				

Overview:

Strongly Agree	1
Slightly Agree	2
Agree	6
Neutral	8
Disagree	20
Slightly Disagree	3
Strongly Disagree	0

Sorted by Years at Plant:

	0 - 1	2 - 5	6 - 10	11 - 20	21+
Strongly Agree					1
Slightly Agree			1	1	
Agree		2	4		
Neutral	1	2	2	2	1
Disagree	2	7	7	4	
Slightly Disagree	1	2			
Strongly Disagree					

Sorted by Area of Work:

	Direct	Semi Direct	Indirect
Strongly Agree		1	
Slightly Agree	2		
Agree	1	3	2
Neutral	3	2	3
Disagree	16	4	
Slightly Disagree	2	1	
Strongly Disagree			

HK2: My job does not contribute towards company objectives

Sorted by Age:

	16 - 25	26 - 35	36 - 45	46 - 55
Strongly Agree				
Slightly Agree				
Agree	3	2		
Neutral	10	5	1	1
Disagree	6	5	2	
Slightly Disagree		2		
Strongly Disagree			2	1

Overview:

Strongly Agree	0
Slightly Agree	0
Agree	5
Neutral	17
Disagree	13
Slightly Disagree	2
Strongly Disagree	3

Sorted by Years at Plant:

	0 - 1	2 - 5	6 - 10	11 - 20	21+
Strongly Agree					
Slightly Agree					
Agree	1	2	2		
Neutral	3	7	4	2	1
Disagree		3	7	3	
Slightly Disagree		1	1		
Strongly Disagree				2	1

Sorted by Area of Work:

	Direct	Semi Direct	Indirect
Strongly Agree			
Slightly Agree			
Agree	4		1
Neutral	13	3	1
Disagree	6	4	3
Slightly Disagree	1	2	
Strongly Disagree		2	

HK1&2

Sorted by Age:

	16 - 25	26 - 35	36 - 45	46 - 55
Strongly Agree	0	0	1	1
Slightly Agree	0.5	1	0.5	0
Agree	4	4.5	1	0
Neutral	7.5	2.5	1.5	1
Disagree	5.5	6	1	0
Slightly Disagree	1.5	0	0	0
Strongly Disagree	0	0	0	0

Overview:

Strongly Agree	2
Slightly Agree	2
Agree	9.5
Neutral	12.5
Disagree	12.5
Slightly Disagree	1.5
Strongly Disagree	0

Sorted by Years at Plant:

	0 - 1	2 - 5	6 - 10	11 - 20	21+
Strongly Agree	0	0	0	1	1
Slightly Agree	0	0.5	1	0.5	0
Agree	0	2.5	5.5	1.5	0
Neutral	2	4.5	3	2	1
Disagree	1.5	4.5	4.5	2	0
Slightly Disagree	0.5	1	0	0	0
Strongly Disagree	0	0	0	0	0

Sorted by Area of Work:

	Direct	Semi Direct	Indirect
Strongly Agree	0	1.5	0
Slightly Agree	1.5	1	0
Agree	3.5	3.5	2.5
Neutral	8	2.5	2
Disagree	10	2	0.5
Slightly Disagree	1	0.5	0
Strongly Disagree	0	0	0

TR1: The team I work in receives recognition if we do a good job

Sorted by Age:

	16 - 25	26 - 35	36 - 45	46 - 55
Strongly Agree				
Slightly Agree				
Agree	1	2	1	
Neutral	3	1		1
Disagree	13	5	3	1
Slightly Disagree		3		
Strongly Disagree	2	3	1	

Overview:

Strongly Agree	0
Slightly Agree	0
Agree	4
Neutral	5
Disagree	22
Slightly Disagree	3
Strongly Disagree	6

Sorted by Years at Plant:

	0 - 1	2 - 5	6 - 10	11 - 20	21+
Strongly Agree					
Slightly Agree					
Agree			2	2	
Neutral		2	1	1	1
Disagree	4	7	8	2	1
Slightly Disagree		1	1	1	
Strongly Disagree		3	2	1	

Sorted by Area of Work:

	Direct	Semi Direct	Indirect
Strongly Agree			
Slightly Agree			
Agree	4		
Neutral	2	2	
Disagree	12	6	4
Slightly Disagree	1	1	1
Strongly Disagree	4	2	

TR2: My team's efforts normally go un-noticed

Sorted by Age:

	16 - 25	26 - 35	36 - 45	46 - 55
Strongly Agree	4	7	2	
Slightly Agree	2	2	1	
Agree	13	5	1	1
Neutral			1	1
Disagree				
Slightly Disagree				
Strongly Disagree				

Overview:

Strongly Agree	13
Slightly Agree	5
Agree	20
Neutral	2
Disagree	0
Slightly Disagree	0
Strongly Disagree	0

Sorted by Years at Plant:

	0 - 1	2 - 5	6 - 10	11 - 20	21+
Strongly Agree		6	5	2	
Slightly Agree		1	3	1	
Agree	4	6	6	3	1
Neutral				1	1
Disagree					
Slightly Disagree					
Strongly Disagree					

Sorted by Area of Work:

	Direct	Semi Direct	Indirect
Strongly Agree	5	7	1
Slightly Agree	4	1	
Agree	14	2	4
Neutral	1	1	
Disagree			
Slightly Disagree			
Strongly Disagree			

TR1&2

Sorted by Age:

	16 - 25	26 - 35	36 - 45	46 - 55
Strongly Agree	0	0	0	0
Slightly Agree	0	0	0	0
Agree	0.5	1	0.5	0
Neutral	1.5	0.5	0.5	1
Disagree	13	5	2	1
Slightly Disagree	1	2.5	0.5	0
Strongly Disagree	3	5	1.5	0

Overview:

Strongly Agree	0
Slightly Agree	0
Agree	2
Neutral	3.5
Disagree	21
Slightly Disagree	4
Strongly Disagree	9.5

Sorted by Years at Plant:

	0 - 1	2 - 5	6 - 10	11 - 20	21+
Strongly Agree	0	0	0	0	0
Slightly Agree	0	0	0	0	0
Agree	0	0	1	1	0
Neutral	0	1	0.5	1	1
Disagree	4	6.5	7	2.5	1
Slightly Disagree	0	1	2	1	0
Strongly Disagree	0	4.5	3.5	1.5	0

Sorted by Area of Work:

	Direct	Semi Direct	Indirect
Strongly Agree	0	0	0
Slightly Agree	0	0	0
Agree	2	0	0
Neutral	1.5	1.5	0
Disagree	13	4	4
Slightly Disagree	2.5	1	0.5
Strongly Disagree	4.5	4.5	0.5

CC1: Company council has a big impact on me at work

Sorted by Age:

	16 - 25	26 - 35	36 - 45	46 - 55
Strongly Agree				
Slightly Agree				1
Agree		1	1	
Neutral	3	3		
Disagree	9	5	3	1
Slightly Disagree	3	1		
Strongly Disagree	4	4	1	

Overview:

Strongly Agree	0
Slightly Agree	1
Agree	2
Neutral	6
Disagree	18
Slightly Disagree	4
Strongly Disagree	9

Sorted by Years at Plant:

	0 - 1	2 - 5	6 - 10	11 - 20	21+
Strongly Agree					
Slightly Agree					1
Agree			1	1	
Neutral		3	3		
Disagree	4	4	6	3	1
Slightly Disagree		1	3		
Strongly Disagree		5	1	3	

Sorted by Area of Work:

	Direct	Semi Direct	Indirect
Strongly Agree			
Slightly Agree		1	
Agree	1	1	
Neutral	2	2	2
Disagree	13	2	3
Slightly Disagree	3	1	
Strongly Disagree	5	4	

CC2: The company council has no real power

Sorted by Age:

	16 - 25	26 - 35	36 - 45	46 - 55
Strongly Agree	3	1		
Slightly Agree	2	2	3	
Agree	6	4	1	
Neutral	4	1		
Disagree	3	3		2
Slightly Disagree	1	2		
Strongly Disagree	1	1	1	

Overview:

Strongly Agree	4
Slightly Agree	7
Agree	11
Neutral	4
Disagree	8
Slightly Disagree	3
Strongly Disagree	3

Sorted by Years at Plant:

	0 - 1	2 - 5	6 - 10	11 - 20	21+
Strongly Agree		2	2		
Slightly Agree		2	2	3	
Agree	1	4	5	1	
Neutral	2	2			
Disagree	1	2	2	1	2
Slightly Disagree			2	1	
Strongly Disagree		1	1	1	

Sorted by Area of Work:

	Direct	Semi Direct	Indirect
Strongly Agree	2	2	
Slightly Agree	3	3	1
Agree	6	4	1
Neutral	3		1
Disagree	5	1	2
Slightly Disagree	2	1	
Strongly Disagree	3		

CC1&2

Sorted by Age:

	16 - 25	26 - 35	36 - 45	46 - 55
Strongly Agree	0.5	0.5	0.5	0
Slightly Agree	0.5	1	0	0.5
Agree	1.5	2	0.5	1
Neutral	3.5	2	0	0
Disagree	7.5	4.5	2	0.5
Slightly Disagree	2.5	1.5	1.5	0
Strongly Disagree	3.5	2.5	0.5	0

Overview:

Strongly Agree	1.5
Slightly Agree	2
Agree	5
Neutral	5
Disagree	14.5
Slightly Disagree	5.5
Strongly Disagree	6.5

Sorted by Years at Plant:

	0 - 1	2 - 5	6 - 10	11 - 20	21+
Strongly Agree	0	0.5	0.5	0.5	0
Slightly Agree	0	0	1	0.5	0.5
Agree	0.5	1	1.5	1	1
Neutral	1	2.5	1.5	0	0
Disagree	2.5	4	5.5	2	0.5
Slightly Disagree	0	1.5	2.5	1.5	0
Strongly Disagree	0	3.5	1.5	1.5	0

Sorted by Area of Work:

	Direct	Semi Direct	Indirect
Strongly Agree	1.5	0	0
Slightly Agree	1	1	0
Agree	3	1	1
Neutral	2.5	1	1.5
Disagree	9.5	3	2
Slightly Disagree	3	2	0.5
Strongly Disagree	3.5	3	0

FS1: We do not have to compete with other Renault- Nissan plants

Sorted by Age:

	16 - 25	26 - 35	36 - 45	46 - 55
Strongly Agree				
Slightly Agree				
Agree				
Neutral				
Disagree	1	1	2	
Slightly Disagree	1			
Strongly Disagree	17	13	3	2

Overview:

Strongly Agree	0
Slightly Agree	0
Agree	0
Neutral	0
Disagree	4
Slightly Disagree	1
Strongly Disagree	35

Sorted by Years at Plant:

	0 - 1	2 - 5	6 - 10	11 - 20	21+
Strongly Agree					
Slightly Agree					
Agree					
Neutral					
Disagree		1	2	1	
Slightly Disagree			1		
Strongly Disagree	4	12	11	6	2

Sorted by Area of Work:

	Direct	Semi Direct	Indirect
Strongly Agree			
Slightly Agree			
Agree			
Neutral			
Disagree	3	1	
Slightly Disagree	1		
Strongly Disagree	20	10	5

FS2: There is intense competition for new models between all the company's plants

Sorted by Age:

	16 - 25	26 - 35	36 - 45	46 - 55
Strongly Agree	3	1		
Slightly Agree	2	2	3	
Agree	6	4	1	
Neutral	4	1		
Disagree	3	3		2
Slightly Disagree	1	2		
Strongly Disagree	1	1	1	

Overview:

Strongly Agree	4
Slightly Agree	7
Agree	11
Neutral	4
Disagree	8
Slightly Disagree	3
Strongly Disagree	3

Sorted by Years at Plant:

	0 - 1	2 - 5	6 - 10	11 - 20	21+
Strongly Agree		2	2		
Slightly Agree		2	2	3	
Agree	1	4	5	1	
Neutral	2	2			
Disagree	1	2	2	1	2
Slightly Disagree			2	1	
Strongly Disagree		1	1	1	

Sorted by Area of Work:

	Direct	Semi Direct	Indirect
Strongly Agree	2	2	
Slightly Agree	3	3	1
Agree	6	4	1
Neutral	3		1
Disagree	5	1	2
Slightly Disagree	2	1	
Strongly Disagree	3		

FS1&2

Sorted by Age:

	16 - 25	26 - 35	36 - 45	46 - 55
Strongly Agree	0	0	0	0
Slightly Agree	0	0	0	0
Agree	0	0	0	0
Neutral	0	0	0	0
Disagree	1.5	1.5	1	0
Slightly Disagree	1.5	0	0	0
Strongly Disagree	16	12.5	4	2

Overview:

Strongly Agree	0
Slightly Agree	0
Agree	0
Neutral	0
Disagree	4
Slightly Disagree	1.5
Strongly Disagree	34.5

Sorted by Years at Plant:

	0 - 1	2 - 5	6 - 10	11 - 20	21+
Strongly Agree	0	0	0	0	0
Slightly Agree	0	0	0	0	0
Agree	0	0	0	0	0
Neutral	0	0	0	0	0
Disagree	0	2	1.5	0.5	0
Slightly Disagree	0	0.5	1	0	0
Strongly Disagree	4	10.5	11.5	6.5	2

Sorted by Area of Work:

	Direct	Semi Direct	Indirect
Strongly Agree	0	0	0
Slightly Agree	0	0	0
Agree	0	0	0
Neutral	0	0	0
Disagree	3	1	0
Slightly Disagree	1	0.5	0
Strongly Disagree	20	9.5	5

FS3: My job is 100% secure

Sorted by Age:

	16 - 25	26 - 35	36 - 45	46 - 55
Strongly Agree				
Slightly Agree	1			
Agree	1		1	
Neutral	3	2		
Disagree	7	2	4	
Slightly Disagree	2	4		2
Strongly Disagree	5	6		

Overview:

Strongly Agree	0
Slightly Agree	1
Agree	2
Neutral	5
Disagree	13
Slightly Disagree	8
Strongly Disagree	11

Sorted by Years at Plant:

	0 - 1	2 - 5	6 - 10	11 - 20	21+
Strongly Agree					
Slightly Agree		1			
Agree			1	1	
Neutral	1	3	1		
Disagree	3	1	5	4	
Slightly Disagree		1	4	1	2
Strongly Disagree		7	3	1	

Sorted by Area of Work:

	Direct	Semi Direct	Indirect
Strongly Agree			
Slightly Agree	1		
Agree	1	1	
Neutral	3	2	
Disagree	9	3	1
Slightly Disagree	4	3	1
Strongly Disagree	6	2	3

FS4: We are under constant pressure to keep improving the plant to secure our jobs

Sorted by Age:

	16 - 25	26 - 35	36 - 45	46 - 55
Strongly Agree	8	8	4	2
Slightly Agree	2			
Agree	9	6	1	
Neutral				
Disagree				
Slightly Disagree				
Strongly Disagree				

Overview:

Strongly Agree	22
Slightly Agree	2
Agree	16
Neutral	0
Disagree	0
Slightly Disagree	0
Strongly Disagree	0

Sorted by Years at Plant:

	0 - 1	2 - 5	6 - 10	11 - 20	21+
Strongly Agree	4	4	6	6	2
Slightly Agree		2			
Agree		7	8	1	
Neutral					
Disagree					
Slightly Disagree					
Strongly Disagree					

Sorted by Area of Work:

	Direct	Semi Direct	Indirect
Strongly Agree	14	5	3
Slightly Agree	1	1	
Agree	9	5	2
Neutral			
Disagree			
Slightly Disagree			
Strongly Disagree			

FS3&4

Sorted by Age:

	16 - 25	26 - 35	36 - 45	46 - 55
Strongly Agree	0	0	0	0
Slightly Agree	0.5	0	0	0
Agree	0.5	0	0.5	0
Neutral	1.5	1	0	0
Disagree	8	4	2.5	0
Slightly Disagree	2	2	0	1
Strongly Disagree	6.5	7	2	1

Overview:

Strongly Agree	0
Slightly Agree	0.5
Agree	1
Neutral	2.5
Disagree	14.5
Slightly Disagree	5
Strongly Disagree	16.5

Sorted by Years at Plant:

	0 - 1	2 - 5	6 - 10	11 - 20	21+
Strongly Agree	0	0	0	0	0
Slightly Agree	0	0.5	0	0	0
Agree	0	0	0.5	0.5	0
Neutral	0.5	1.5	0.5	0	0
Disagree	1.5	4	6.5	2.5	0
Slightly Disagree	0	1.5	2	0.5	1
Strongly Disagree	2	5.5	4.5	3.5	1

Sorted by Area of Work:

	Direct	Semi Direct	Indirect
Strongly Agree	0	0	0
Slightly Agree	0.5	0	0
Agree	0.5	0.5	0
Neutral	1.5	1	0
Disagree	9	4	1.5
Slightly Disagree	2.5	2	0.5
Strongly Disagree	10	3.5	3