Manufacturing Initiatives in a Decentralised Company

By Laura Kennedy

B.A.Sc, Mechanical Engineering, University of Waterloo, Canada, 1996

Submitted to the Sloan School of Management and the Department of Mechanical Engineering in Partial Fulfilment of the Requirements for the Degrees of

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Abstract

When Powercomp*, a decentralised company, wanted to implement a large-scale improvement for its manufacturing processes, traditional top-down change management theories and practices were originally applied. It was soon found however, that this style of initiative was not the most appropriate for the structure and culture of Powercomp. This study considers culture, structure, manufacturing strategy and change management to recommend a more appropriate implementation plan for large scale manufacturing process improvements in a decentralised company.

Academic theory suggests that manufacturing strategy should be aligned with corporate-level business strategy, and top-notch manufacturing companies have a corporate-level strategy based on manufacturing excellence. In a decentralised company, the collaboration needed to achieve this stage of manufacturing excellence is complicated due to a wide range of markets, sub-cultures and industries. This thesis studies how a collection of manufacturing companies in a decentralised company can accumulate their local manufacturing strategy and execution to create the quality of high-level manufacturing performance as found in a centralised company.

This study lists the general steps of executing a manufacturing initiative, and compares various execution scenarios. A mix of high-level and low-level direction and a range of interaction between factories within the company are considered. Assuming that a co-operative and directed initiative is the most efficient, this study considers those scenarios first. Later, individualistic change initiatives are considered to determine whether the collective style of manufacturing strategy and execution excellence described above are possible in decentralised companies.

To support the individual efforts of factories in creating and executing a manufacturing strategy, a web-based Production Portal is recommended for Powercomp. The Portal includes a range of manufacturing development tools that match the wide variance of capabilities, needs and interests of Powercomp's four hundred factories globally. In addition to providing easier access to manufacturing resources, tools and models for process development, the Portal should also include case studies and best practices from Powercomp companies to facilitate knowledge sharing amongst production leaders in Powercomp.

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* Powercomp is a fictional name used to maintain the confidentiality of the company in this study.

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CHAPTER 1: Introduction and Problem Background

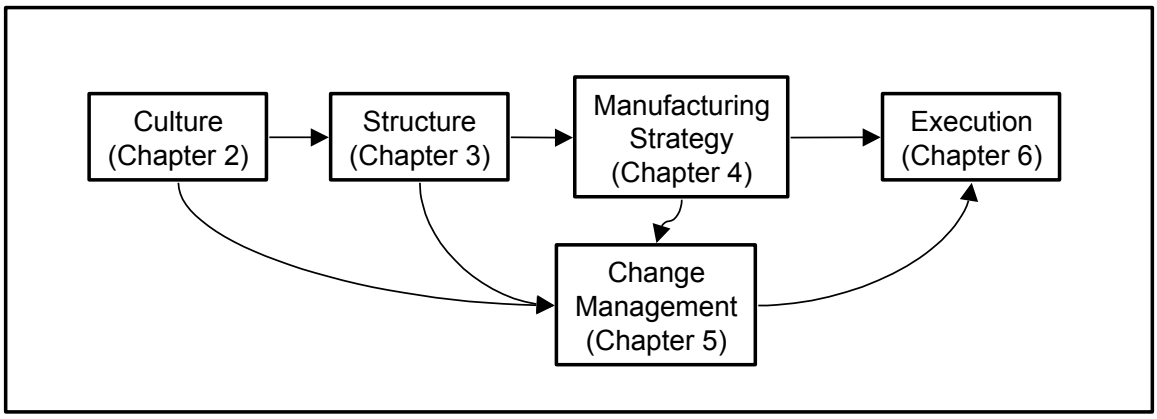
1.1 Introduction

This chapter gives an overview of this study and describes the history and structure of a company that is given the fictional name "Powercomp" to protect its confidentiality. Thesis research and practical work was performed at this company for a seven-month period. A model is used to illustrate the overall flow of the thesis, and then Powercomp's history and current business structure are described. Powercomp's Manufacturing Technologies Group is described, and its Agile Manufacturing project is introduced.

1.2 Thesis Overview

Figure 1.1 serves as a model to illustrate how the components of this study are related to one another. Beginning with company culture, assumptions and historical artefacts will be used to show how and why Powercomp chose its structure and how culture affects change management. Next, the company structure will be examined, where decentralised structure in particular will be considered. Culture and structure are included as inputs to manufacturing strategy. The output of manufacturing strategy is the execution of the manufacturing initiatives. Both culture and structure affect change management, another key input to execution. Execution is composed of acknowledging a trigger to change, rethinking the strategy, planning the initiative and implementing the initiative. Manufacturing initiatives in this study are of large scope and scale to improve manufacturing processes in Powercomp factories.

Figure 1.1 Thesis Overview



This model was chosen to identify how to enable more effective execution of manufacturing initiatives in a decentralised company. Culture, structure, strategy and change management were selected as the most important inputs for Powercomp's execution of manufacturing initiatives, and so are discussed in detail in later chapters. Throughout the study, the general case is considered first, followed by specific observations or considerations for Powercomp.

1.3 History of Powercomp

An important element in considering Powercomp's structure and culture is its history. Powercomp was formed in 1987-88 by the merger of two long-standing European companies. Both were traditional industrial companies supplying the high-growth electrical power transmission and distribution industry throughout the 20th century. Their key customers were government owned and/or regulated, which created strong pressures for local presence. Additional pressure for local presence across many markets was due to the complex nature of electrical power transmission and distribution and the variance of electrical standards across these markets. These aspects led to the establishment of numerous Powercomp factories worldwide, mostly through mergers with or acquisitions of existing local players.

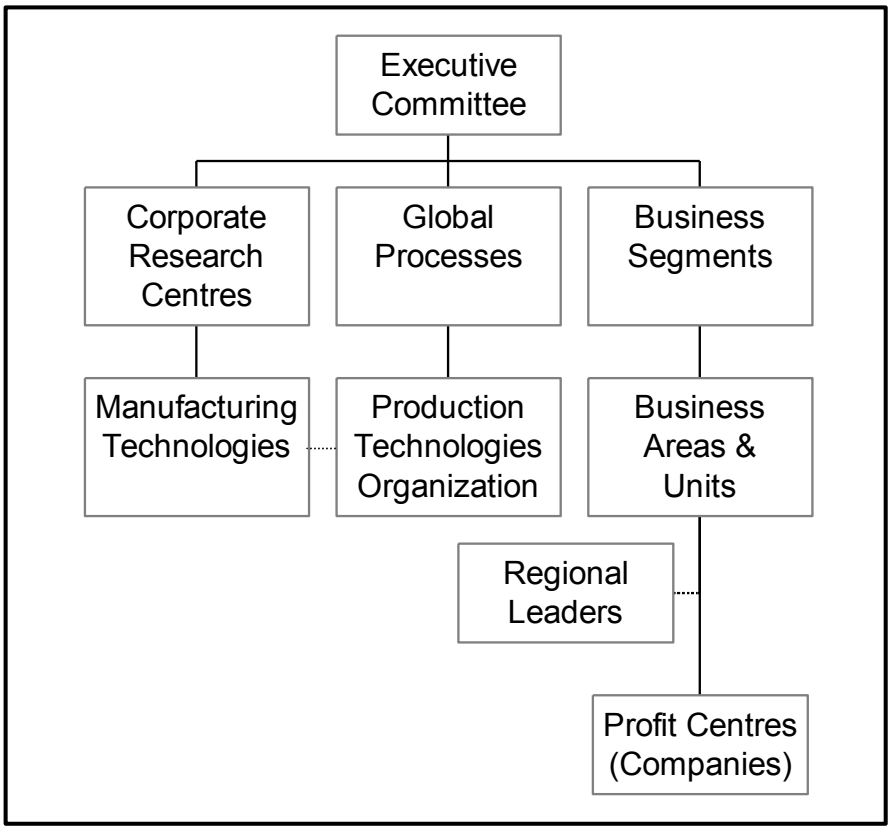
1.4 Powercomp Today

Though its headquarters are in Europe, Powercomp has165,000 employees and roughly 400 factories in more than 100 countries. It had sales of $30 billion in 1999. Powercomp is a large, decentralised, diverse, multinational company involved in designing, manufacturing and servicing a range of products and projects mostly for the electrical power transmission and distribution, building technologies, automation, oil and gas, and financial services. In contrast to the large number of employees globally, it has a relatively small team (roughly 200) of upper management housed at corporate headquarters in Zurich, Switzerland. As a result, Powercomp companies operate independently and autonomously with only high-level direction from the executive level.

Figure 1.2 shows the structure of Powercomp that is relevant to production activities and support groups. An executive committee of seven members leads Powercomp: one for each of its six business segments, and one for Corporate Research. The company is then divided at the highest level into "Segments", which are power transmission, power distribution, automation, oil, gas and petrochemical, and financial services. Reporting to the segment vice presidents are the "Business Areas" (BAs). Large BAs are broken into smaller "Business Units" (BUs). The smallest entities within Powercomp are the "Profit Centres", more commonly referred to as "Companies". Powercomp is a evolving entity, buying, selling and merging with others as required to meet its high-level goals.

Powercomp was recognised internationally for its unique matrix structure that was sorted by business and geographic regions. Originally the business group and regional group had equal power. However as competition became more global and as electrical power industries were deregulated in 1998, the Powercomp Executive Committee decided to decrease regional leaders' role. Today the regional leaders' role is to encourage improvement initiatives within their regions, while business leaders are responsible for strategic business decisions across their BA or BU. This thesis does not examine the effect of the matrix structure, but is included only as an important part of Powercomp's history and culture.

Figure 1.2 Powercomp Production-Related Structure



Powercomp management is selected by choosing people who are flexible and who can operate in a multicultural environment. English is the main business language, and management must be capable of working in English meetings, or reading and writing English business documents. Managers at lower levels (such as factory level) have accountability for their area's business performance, and are responsible for local decision making.

1.5 Corporate Research Centres and Production Technology Organisation

Powercomp's Manufacturing Technologies Group, the leader of the manufacturing initiatives described in this document, is funded by the Corporate Research Centre (CRC). Its goal is to improve the manufacturing performance across Powercomp by developing new technologies and improving existing processes in factories. To implement its ideas, consultants are contracted on a project by project basis from the Production Technologies Organisation (PTO). Consulting projects involving new ideas of the Manufacturing Technologies Group receive funding from the CRC. The factories receive a reduced rate for the projects in return for providing a testing ground for new manufacturing process ideas or technologies.

PTO and CRC deliver management consulting services to Powercomp companies. Each PTO group has up to 40 consultants per location, with roughly 200 consultants globally. Each regional PTO unit has a unique mix of core competencies, structure, culture and work processes.

The main channel for selling consulting projects is through personal contacts with local company management. An internal Powercomp document describing the PTO states, "There is relatively little work for Segments or BAs, and tasks linked to the formulation of [Powercomp] strategy are probably viewed as being too complex for the PTO group." The mission of PTO is, "to help [Powercomp] businesses to be more successful and competitive through the provision of innovative management consulting services". Likewise, the vision of PTO is "to be the first choice business consultants to local Powercomp companies, the core of the business being local consulting, but also to be capable of handling international assignments for Powercomp more widely, and to be influential in the development of Powercomp's global initiatives".

The PTO has recently been moved from the CRC to a central group called "Global Processes" (GP), while the CRC is still a separate entity within Powercomp (refer to Figure 1.2). Global Processes was created to take advantage of economies of scale by centralising certain activities such as information technologies, e-commerce, human resources, et cetera.

1.6 Motivation for this Study

As reported in the Powercomp Group Annual Report 1999, Operational Review, Powercomp is undergoing changes including:

- "transforming its business portfolio, expanding in higher value businesses based on intellectual capital, focusing on software, intelligent products and complete service solutions";
- "accelerating its shift to a knowledge and service company";
- "maintaining a strong local presence in every market around the world to balance the impact of regional economic fluctuations";
- "reducing our dependence on heavy assets and building our combined intellectual wealth".

These changes either effect or can be effected by manufacturing operations. There are also opportunities for manufacturing initiatives to support corporate goals, which include revenue growth by an average of 6-7% annually, and an operating margin target of 12% by 2003. Based on the scale of Powercomp operations and the magnitude of the company as a whole, it is estimated that a 10% reduction in inventory costs would result in $150M savings for the company annually.

More specific industry changes have also arisen that require action from Powercomp factories. One of the biggest stimulus for change (and quickly growing to global scale) is the Internet. Companies taking advantage of web-based information systems, sales and marketing are able to lower costs and gain market share around the world. New web-enabled supply chain systems, if under control and integrated across the value chain, can improve supplier relationship and customer service as well as lowering logistics administration costs. For factories to take advantage of the web-based initiatives, "back-end" production systems and processes need to be efficient and effective.

Also, the electrical power industry around the world is being deregulated. This has allowed suppliers to more easily compete in new markets, which in turn has intensified competition and lowered margins. The result is that production costs must continue to be reduced to win market share. Competitors are becoming more global, and as a result competition is increasing in existing markets.

Manufacturing Technologies, as the sponsor of this study, would like to learn how to provide the motivation and tools for Powercomp companies to achieve these goals outlined above. Until now, most Manufacturing Technologies services were provided to one factory at a time through consulting projects. As a fairly new team within Powercomp, it is starting to prove the worth and value of its ideas, but is under increasing pressure to develop a strategy for implementing manufacturing initiatives on a larger

scale. As the Manufacturing Technologies Group grows in the future, it should seek economies of scale in its efforts. The immediate challenge for the group is to attain broader scope and scale of manufacturing initiatives with less time and fewer resources. These pressures have led to the challenge of creating a wide-scale manufacturing improvement initiative that can be rolled out and implemented in a quicker fashion.

1.7 Agile Manufacturing Project

Agile Manufacturing is one of the key initiatives in the Manufacturing Technologies group. It was developed as a means to meet high-level targets for common manufacturing improvements "across the board" within Powercomp.

Agile manufacturing was originally implemented in five pilot projects factories from 1999, each with individual needs, goals and challenges to overcome. The pilot projects were successful and achieved lead-time reductions and cost savings for each of these factories. Both PTO/CRC consultants and factory employees were involved in the changes, and in some cases the projects were ongoing before PTO/CRC became involved. In all cases, the Agile team was credited with offering new ideas that resulted in better than expected improvements in manufacturing processes.

Due to the success of the Agile Manufacturing pilots at the factory level, Manufacturing Technologies wished to create an implementation plan to accelerate the adoption of Agile Manufacturing across Powercomp factories globally. The restrictions placed on the implementation plan were that it should use minimal resources and a limited rollout period.

This study discusses large-scale manufacturing improvement initiatives in a decentralised company, and the Agile Manufacturing project at Powercomp provides practical examples of the planning and execution of this type of initiative. My role, as an LFM intern, was to develop an implementation plan for Agile Manufacturing that would result in "across the board" improvement of manufacturing in Powercomp. To collect information and feedback on our ideas, I visited factories across Europe, interviewed PTO and CRC managers, and discussed ideas with BA leaders.

1.8 Summary

To achieve Powercomp performance and profitability goals, the Manufacturing Technology group wishes to develop an implementation plan for manufacturing improvement initiatives throughout Powercomp factories globally. Current industry and market conditions are providing new opportunities for cost savings and revenue growth based on improved manufacturing performance. This study will examine how large scale manufacturing initiatives can be implemented under Powercomp's decentralised structure.

Chapter 2: Organisational Culture

2.1 Introduction

Culture is defined and broken down according to popular academic theories in this chapter. Academic models for examining company culture are then applied to Powercomp to begin to understand the companies' day-to-day norms and assumptions for dealing with large-scale changes. The cultural findings and observations given in this chapter are re-examined or referred to in later chapters.

2.2 Academic Review of Organisational Culture

Schein (1985) defines culture as:

> "The pattern of basic assumptions – invented, discovered, or developed by a given group as it learns to cope with its problems of external adaptation and internal integration – that has worked well enough to be considered valid and, therefore, to be taught to new members as the correct way to perceive, think, and feel in relation to those problems".

Culture should be understood and or at least considered when planning day to day activities in the company, but even more so when undertaking major changes.

Schein uses three "Levels" to understand the depth of culture, and as a basis for understanding the type and range of information needed to understand a company's culture. Table 2.1 summarises Schein's three Levels of Culture:

Table 2.1: Schein's Levels of Culture

Level 1: Artefacts	- observations by hearing, seeing, feeling - day to day operating norms - doesn't tell you the "why" of culture
Level 2: Espoused Values	- consensus of how things "ought" to be - guide for dealing with uncertainty - official way things should be done
Level 3: Basic Underlying Assumptions	- tells you why they do what they do - defines what is normal, non-debatable - considers history and founder's effects - what is taken for granted how things are done

These levels help explain how culture can be explored and uncovered within a company. One of the key observations is that although Espoused Values (Level 2) and Basic Underlying Assumptions (Level 3) may explain why certain Artefacts (Level 1) are found, the opposite does not apply. Artefacts alone can not be used to conclude what the company's Espoused Values or Basic Underlying Assumptions may be. Caution should be taken when observing a culture, since these three levels show that culture is more than meets the eye.

Culture should be uncovered and understood through a mix of internal and external observers, interviews and historical analysis. The external observer should initially focus on what is new or different (Schein calls these "surprises"), and then systematically check that these surprises are not one time occurrences. To understand the culture further, external observers should begin to interview insiders, being aware of that person's (the interviewee's) agenda or motivation for taking part in the analysis. Together, the

insider and the outsider should work together to explain *surprises*, hypothesise what the Values and Assumptions could be, and then verify them by collecting evidence within the organisation. As the interview and hypotheses process gains direction and specificity, culture is uncovered, challenged and eventually better understood.

In a later book, Schein (1999) expands the content of culture to show the depth, breadth and complexity of culture. Culture content is broken into three categories: external survival issues, internal integration issues, and deeper underlying assumptions. External survival issues examine what the environment demands and affords, and leads first to mission, strategy and goals, then to the means for dealing with the environment (structure, systems, processes) and finally in measurement (error-detection and correction). Internal integration issues frame the common language and concepts, group boundaries and identity, nature of authority and relationship, and the allocation of awards and status in an organisation. The last category, deeper underlying assumptions, deals with human relationships relative to nature, including the nature of reality and truth, the nature of human nature, the nature of human relationships and the nature of time and space.

A thorough analysis of culture can help to understand an organisational issue, or more importantly to this study, can help to understand why an organisational issue is difficult to resolve or change. Culture impacts the performance of a firm, and culture can be changed or improved in working toward improving performance. It should not however be considered the "problem" itself without identifying a specific performance issue. Furthermore, it has been recognised that cultural changes are one of the most difficult types of change to undertake, and the effort to bring about such changes should not be underestimated.

2.3 Uncovering Powercomp's Culture

Compared to my baseline knowledge of companies, Powercomp was different because it is a European company, and I was working in the Finnish branch of the company. For these reasons, understanding Powercomp's company culture was particularly difficult since I needed to distinguish between Finnish cultural norms, and Powercomp cultural norms. Therefore uncovering Powercomp's corporate culture was difficult and slow. There were many *surprises* to be uncovered and examined as a*rtefacts*, but I had to determine which were true indicators of Powercomp's culture.

In this case, it was easier to start by researching Powercomp's history, founder and structure. As explained in Chapter 1, Powercomp was formed by one of the first large-scale mergers in Europe, and gained additional recognition for the unusual matrix structure that was implemented. Since Powercomp was founded, local companies and regional leaders had considerable power and autonomy. The founder and previous CEO wanted an agile company, and encouraged fast decision-making.

This combination of historical attributes provided insight into the working policies of Powercomp Manufacturing Technologies Group. In line with higher level autonomy and fast decision making, I was given complete control and freedom over my project in Agile Manufacturing. Ample support was provided so that a wide range of ideas could be tested and pursued.

There are many other cultural *surprises* that were uncovered and researched during this study. One of the major contributors to Basic Underlying Assumptions and Espoused Values is the size and structure of the company, which is discussed in Chapter 3.

2.4 Summary

Academic research on culture helps to explain how company history, norms and *surprises* can all be used to uncover the culture of a particular company. Cultural analysis should be included in change initiatives to use employees' assumptions and work habits to your advantage. Acknowledging the culture will reduce resistance to change and help leaders to stay within the set of assumptions valid for that company.

CHAPTER 3: Structure of Decentralised Companies

3.1 Introduction

What makes this study of manufacturing initiatives interesting yet challenging is the peculiarities of the decentralised company structure. In this chapter, decentralised structure is defined and examined from a theoretical point of view. Once the attributes of the decentralised company are explained, cultural assumptions that lead to the decentralised structure are described in the general sense and for Powercomp.

This chapter includes the effect that decentralisation plays on culture, and in later chapters, the effects of decentralisation on change management and manufacturing strategy are examined. Finally, an analysis of Powercomp's structure is provided as concrete evidence of its decentralised structure and work environment.

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3.2 Characteristics of Decentralised Companies

Decentralised structures are often selected to allow large companies greater flexibility, better response to customers, and to promote an entrepreneurial spirit. Egelhoff (1988) defines vertical decentralisation as "the distribution of formal decision making power along the chain of command or line of authority". Similarly then, a decentralised company is one where power and decision making is distributed functionally and geographically throughout the group. Greater size (scale and scope) leads to more decentralisation. In both American and European decentralised companies, it is common for certain functions such as finance, research and management development to remain under overall corporate headquarters' supervision. Manufacturing is less frequently subject to such head office direction.

Egelhoff (1988) writes, "environmental complexity seems to exert a strong positive influence on the extent of decentralisation". In such an environment, obstacles that make a centralised company structure difficult are:

1. Hi-level management is subject to information and responsibility overload – industry, environment, product, competitor and strategic complexity lead to information overload;
2. Top management will struggle to accumulate sufficient details to understand local scenarios;
3. Long time delay throughout the collection of information amongst all the sites, and the analysis, recommendation and implementation phases;
4. Lack of motivation at the local level due to lack of power or control over their local environment.

In these circumstances, a decentralised structure is often more appropriate.

Dreifus (1992) examines the question of how far to decentralise. The main issues he addresses are the difficulties in maintaining a uniform strategic vision for the company, and ensuring co-operation and learning between companies at the lower level. Based on his studies of decentralised companies, he advises limiting corporate headquarters control on BUs, and eliminating management layers. Increased co-operation between companies at lower levels can be promoted by increasing communications, encouraging team building and by offering corporate training programs that include a mix of BU participants.

Bartlett and Ghoshal (1989) discuss the effect that industry characteristics play on the selection of structure and organisation in a large company operating in many countries. *Multinational* companies, "corporations that manage a portfolio of multiple national entities", are capable of being sensitive and responsive to a wide variety of national environments around the world. Where global efficiency is dominant, *global* companies "treat the world market as an integrated whole… where the global operating environment and world-wide consumer demand are the dominant units of analysis, not the nation-state or

the local market". The other alternative for a large company to adopt is to become an *international* company. This strategy is based "primarily on transferring and adapting the parent company's knowledge or expertise to foreign markets", but local representatives have some freedom to adapt the product or service to their environment.

3.3 Cultural Assumptions Leading to Decentralised Structure

Certain cultural assumptions are often found in a decentralised structure. Many of these assumptions are aligned with Egelhoff's analysis given above. Leadership of a decentralised company must assume that local or business leaders are willing and capable of making strong business decisions. It is also accepted (either by supposition or previous experience) that information gathering would be slow, cumbersome and complex in a centralised structure. Finally, according to Egelhoff, the leader likely assumes that local employees will be more motivated if they are given more control over their workplace.

Powercomp's business environment and founder's background fit these cultural assumptions well. The Swedish business culture is characterised by consensus building, which can be a slower decision making process than an autocratic style. Based on the Swedish nationality of the founder, it is natural that he would conclude that a centralised structure would be unmanageable due to both slow information gathering and decision making processes.

Powercomp's leadership must also have assumed that they were dealing with a highly complex and diversified environment. Given the range of electrical power distribution, government regulations and technology at the time of the 1987 merger of the two companies, it would be extremely difficult for a centralised leadership team to understand each operating environment. The decentralised structure pushed analysis to the local level, and allowed business units to meet local needs and demands. The large number of products, technologies, and customer groups and the level of government regulations means that it would be difficult to achieve the co-ordination required for centralised companies.

Another essential assumption of leaders to adopt the decentralised structure is the quality of local leaders. For this structure to be effective, local managers must have the business acumen and leadership skills to make effective business decisions and to competently execute these decisions in their environment.

Overall, the company's leaders assume that the decentralised structure is a stronger business format than the centralised structure. If there are any doubts about these assumptions, the decentralised structure will suffer. High-level leaders who do not accept these assumptions will try to micro-manage and the effectiveness of the company's structure will suffer. Total autonomy at local levels could not be achieved if these assumptions were not accepted, inhibiting the decision making and motivation of local leaders.

3.4 Effect of Decentralised Structure on Culture

The previous section describes how cultural assumptions or norms lead to the adoption and successful implementation of a decentralised structure. Once that structure is selected and put into place, the structure has an effect on company culture. Schein would also claim that the structure itself reinforces cultural assumptions, and thus build and embed the culture in an organisation. Listed below are some observations on how a decentralised structure in particular may effect company culture. We can not conclude whether these are positive or negative effects, but for now we acknowledge that they exist.

1. The spread of power and decision making across the company increases the likelihood and variety of sub-cultures. Each local leader in a decentralised company has the power to create a structure, define employee roles, generate work ethics, and incorporate geographical cultural norms – all of which may

generate sub-cultures. Schein (1999) writes "sub-cultures may be highly functional and efficient, because the different parts of the organisation have to succeed in different kinds of environments".

2. Communication becomes more limited, formal and processed in a decentralised company since local leaders have fewer interactions with their peers than in a centralised organisation. Leaders are less familiar and further from other leaders, so more formal interactions (such as phone calls, meetings requiring travel, faxes, e-mails or letters) are used. Schein (1999) describes a potentially negative impact of unfamiliar communication, where "trust levels erode, and political processes begin to replace teamwork in pursuit of common goals".

3. Power and decision making is pushed to a local level. Managers at remote locations will be assumed to have the necessary skills, background and influence to make decisions for their group. Each local leader decides on its own decision-making criteria, business priorities and local conditions that should be required in forming recommendations.

4. Managers may be faced with difficult decisions due to trade-offs between local and overall high-level optimisation. Based on more cumbersome communication and localised decision making (criteria, priorities and conditions) described above, there may be more conflict over local versus global trade-off issues. High level vision, communication, culture and goals will determine how this conflict is resolved.

3.5 Powercomp as a Decentralised Company

From its inception as a company, Powercomp needed to establish a structure for the two merging entities. The CEO at that time decided to use a decentralised structure within a global matrix to "build a structure that simultaneously encourages local entrepreneurial initiatives and promotes global synergies" (Barhem and Heimer, 1998). One of the CEO's close aides described their goals when the structure was planned: "From the very beginning, we strove to build a company that was fast, flexible, customer-focused and present as a local partner for customers around the world. We wanted to combine the economies of scale and scope enjoyed by a large company with the entrepreneurial drive and customer orientation of a small business" (1996).

Practical evidence of the decentralised structure in Powercomp is the thin layer of top management, the network of country and product managers, and the autonomy that is allowed at the local level. The complex range of products, and the number of competitors and industry groups represented within Powercomp would make a centralised structure difficult for fear of information overload at the top levels of management. Historically, a great deal of complexity was due to the regulation of the electrical power and transmission industries by each country, which was a major part of their business at the time of the merger. Local representation was required, and product or group strategies could not be decided on a high level due to market and product variance from one country to another.

Another contributor to the decentralised structure of Powercomp is the number of acquisitions and mergers that took place. The rate at which Powercomp was acquiring or merging would have made it very difficult to centralise decision making for the growing company, considering the mix of new cultures, business environments and industries. Newly acquired companies were added to an existing segment of Powercomp, but were often able to maintain their own structure and culture, and continue to manage their own business affairs.

The number of top level managers is limited in Powercomp, and their role does not include day to day operations of companies. Powercomp's Executive Committee is responsible for deciding global strategy and monitoring global performance. Composed of the Segment Vice Presidents, this group's role is to

create broad business targets for Business Areas or countries. Business Area managers then report to the Segment Vice Presidents and their role is to optimise the global performance of their Business Area. This includes worldwide strategy, market allocation, and budget setting and maintenance. BA managers also approve business acquisitions, joint ventures and large investments. Finally, the companies are deliberately small in size to ensure that they are nimble in reacting to industry or customer demands – local management teams are usually less than five people.

Profit centres were encouraged to create their own identity and culture to encourage a sense of employee belonging and ownership, and ultimately to drive an entrepreneurial, small business atmosphere. In 1993, the founder stated in Business Week, "We are fervent believers in decentralisation. When we structure local operations, we always push to create separate legal entities. Separate companies allow you to create real balance sheets, with real responsibility for cash flow and dividends." Sub-cultures are permitted and encouraged in Powercomp.

According to Bartlett and Ghoshal's definitions of globally managed firms, Powercomp is historically a multinational company. The multinational structure and strategy allowed Powercomp to adapt to local needs and regulations in the power industry. Recently to benefit from cost efficiency opportunities (many of them enabled by the internet) Powercomp has developed a set of "Global Processes". By and large however, product and process development is carried out at the local level, maintaining Powercomp's status as a multinational company. A multinational structure is the most decentralised of the three possible management structures for globally operating companies.

3.6 Summary

Decentralised structures and their effect on culture, change management and manufacturing strategy were examined. With respect to culture, one can expect a high variance and number of subcultures, cumbersome and formal communication styles, decision making at all levels, and a mix of local and overall business optimisation.

CHAPTER 4: Manufacturing Strategy

4.1 Introduction

This chapter reviews manufacturing strategy theory, how it should be developed and why it is important. Manufacturing strategy relating to process improvements is the focus of this chapter. Although product design and development are important considerations for manufacturing effectiveness, they are not discussed here in order to concentrate on manufacturing process improvements. Special considerations for manufacturing strategy in a decentralised company are also considered. High-level observations concerning manufacturing strategy implications for Powercomp are given.

4.2 Manufacturing Strategy Academic Review

A review of academic research indicates that manufacturing strategy is important to methodically build the appropriate capabilities to help manufacturing contribute most effectively to corporate goals. Manufacturing initiatives should be aligned to contribute to company strategy if the manufacturing strategy has been properly researched, analysed and developed. Once strategic alignment is achieved, manufacturing may be seen as a tool for the company to gain competitive advantage, and the manufacturing strategy defines how to achieve that advantage.

According to Hayes, Wheelwright and Clark (1984), the purpose of a manufacturing strategy is to "focus an organisation's resources, capabilities, and energies on building a sustainable advantage over its competitors along one or more dimension of performance". A well developed and executed manufacturing strategy can help the business to lower costs, shorten lead times, improve customer service and facilitate sales. An effective manufacturing organisation will be capable of delivering products more efficiently, more reliably and with higher precision.

Other research, however, warns that manufacturing should not take on a purely technical focus. Skinner (1969) advises "strategic considerations should outweigh technical and conventional industrial engineering factors invoked in the name of *productivity*". The reasoning is that regardless of how productive, efficient or low cost manufacturing is, if it does not provide a means for the company to achieve its strategic goals, manufacturing will become a liability rather than an asset.

A clear manufacturing strategy then, indicates how the manufacturing organisation will contribute to the overall corporate strategy. According to Hayes and Pisano (1994), "the key role for a company's manufacturing strategy is to guide the selection of improvement programs". The improvement programs should not in themselves be the end goal or purpose of the strategy, but rather the way that a company will build capabilities in manufacturing. The more capable the manufacturing group is, the more it is able to react to and impact upon the overall corporate strategy.

Research shows that aligning manufacturing strategy with corporate strategy is critical. Hayes and Wheelwright (1985) describe four stages of development that affect how intertwined manufacturing and corporate strategy actually are, and how this affects manufacturing's role in the company. Table 4.1 summarises these stages.

Table 4.1: Stages of Manufacturing Strategy Development

Stage 1	"Minimise manufacturing's negative potential: internally neutral" - manufacturing is seen as incapable of affecting corporate success - manufacturing appears as clumsy, incapable, and complicated
Stage 2	"Achieve parity with competitors: externally neutral" - manufacturing follows industry norms, at parity with competition - product development focus, initiatives aimed at cutting costs
Stage 3	"Provide credible support to the business strategy: internally supportive" - manufacturing expected to strengthen and support competitive position - manufacturing management understands business and plans long term
Stage 4	"Pursue a manufacturing based competitive advantage: externally supportive" - manufacturing expected to play key role in company competitiveness - frontrunners in technology and innovation, cross-functional planning

4.3 Frameworks for Creating Manufacturing Strategy

To create a manufacturing strategy, the production leader identifies which capabilities the company wishes to pursue, and examines how manufacturing can contribute to the business goals. For manufacturing process development, these include cost, quality, dependability, and flexibility. Opposing views exist on whether these areas can be simultaneously pursued or not. Some believe that a trade-off must be made or otherwise the company will be "mediocre" or "stuck in the middle" (Porter,1980). Others argue that the complexity of available tools, and level of understanding of managers today allow for a range of tools to be used at once to achieve synergies, and thus capture competitive advantages in more than one area at a time.

Hayes and Wheelwright (1984) write:

> "It is difficult (if not impossible) and potentially dangerous, for a company to try to compete by offering superior performance along *all* of these dimensions simultaneously, since it will probably end up second best on each dimension to some other company that devotes more of its resources to developing that competitive advantage"

Other authors, such as Hill (1989), acknowledge that trade-offs exist, but that a company should not be stuck in the area of competition or manufacturing strength that it pursues. Hill refers to how changing strengths in manufacturing process are needed throughout the product lifecycle, and as a result, companies will follow different competitive advantages depending on the stage of the product.

Some researchers, however, believe that the level of sophistication of certain manufacturing process methods (such as Lean Manufacturing, Total Quality Management, and Just In Time) allow manufacturing groups to simultaneously pursue more than one area of competitiveness without the risk of becoming "mediocre" in those categories. Ferdows and DeMeyer (1991) recommend a certain order for achieving synergies, "which begins by establishing a strong foundation of high quality operations. This should be followed by developing capability in dependability, flexibility and, finally, cost". In contrast to this progressive development there is hypercompetition. Here, a firm's goal is to continuously disrupt competitor's ability to gain market share, and does so by dynamically shifting amongst all the areas of competitiveness.

Regardless of whether there are trade-offs or synergies between these competitive areas, the company must define how it wishes to compete. To do this, the company must analyse its customers, its

competition, and the industry. Furthermore, it must have an idea of the skills it could develop that would be difficult for a competitor to replicate, to achieve more sustainable advantages.

Given the wide variety of factors to consider in creating a strategy, several academics propose a series of steps for determining strategy. Skinner (1969) proposes one such model. His focus is that manufacturing strategy must be based on corporate strategy, and that top management should determine it through an "orderly process or sequence of steps". These are:

- Analyse competitors to determine opportunities or risks in the industry;
- Assess the current capabilities of the company (skills, resources, facilities, and approaches);
- Form company strategy to take advantage of market opportunities in defined market niche;
- Define how manufacturing tasks will complement or contribute to this company strategy;
- Study economic and technological trends or constraints in the industry;
- Integrate all previous factors to form the manufacturing strategy;
- Decide which programs, controls, metrics, etc will be used to achieve this strategy.

Fine and Hax (1985) offer a more detailed approach for analysing and defining the manufacturing strategy based on Wheelwright's work (1984). They define nine major manufacturing strategic decision categories as follows: facilities, capacity, vertical integration, processes and technologies, scope and new products, human resources, quality management, manufacturing infrastructure and vendor relations. In practice however, the ability of a given production manager to address these decision categories depends heavily on the firms businesses, structure, and culture, as well as his influence in and knowledge of the company.

4.4 The Importance of Manufacturing Strategy

The theory given above discusses how factory managers should be capable of identifying the areas where they wish to develop competencies, and then to define a development path for building those competencies. But based on today's turbulent, competitive environment, companies not only need to be able to write and execute a meaningful manufacturing strategy, but they must also understand the importance of adapting and redirecting the strategy. Shorter product life cycles, e-commerce, global competition, and focus on share performance are reasons that companies should not only create a manufacturing strategy, but also re-evaluate that strategy often. Examples of pressures to have a clear manufacturing strategy include:

- Shorter product life cycles reduce the time between ramp-up and ramp-down of products. The product life cycle has an effect on which strategy or area of competition that a company pursues at any given time;
- E-commerce increases the pressure to shorten lead times and to cater your product to various global demands;
- Manufacturing industries are becoming more competitive as global supply chains are increasing the number or players in local markets;
- Focus on share price performance means the company is judged on a quarterly and annual basis and speed to react to market risks or opportunities are crucial.

Companies need to monitor how customer value changes over time, to observe or predict global market changes, and to anticipate competitor and customer reactions to these changes. Following a prescribed methodology for manufacturing strategy (such as that described by Skinner) will ensure rigorous analysis of the appropriate factors, and open communications between the relevant functions in a company. The act of forming the strategy (the research, analysis and communication) is a valuable tool in itself.

Participation by the manufacturing employees in the company's strategy is very important. Tools and metrics must be defined properly so that all employees see how their input contributes to the end goal. Breadth of employees' capabilities is important to allow the company the flexibility to change its area of competitiveness as needed. Strong change management skills (discussed Chapter 6) are necessary to allow the company to adapt to and work towards new strategic directions on a continual basis.

Focusing on other business metrics, manufacturing strategy is also important since production can either positively or negatively affect the financial and marketing success of the firm. Higher quality may result in a product with unique marketing advantages. Efficient production can increase the profitability of the business. Minimal order delivery time can attract new customers. There are many other examples of how manufacturing's strategic direction can impact the business as a whole, thus proving the importance of a well-directed and co-ordinated manufacturing strategy.

The reverse of showing why manufacturing strategy is important is to study what happens if manufacturing is neglected. Hayes, Wheelright and Clark (1988) demonstrate how a downward spiral can start if manufacturing is neglected, and fewer production investments or initiatives are started. As investments and initiatives taper off, production seems like a hopeless cause, and upper management starts to manage "around" manufacturing rather than "through" it. Eventually, opportunities for core competencies or competitiveness in manufacturing are lost, and upper management may find it easier to divest manufacturing instead of reviving it. Once operations are outsourced, opportunities for competitive advantages in internal low cost manufacturing or high-technology processes may be lost.

4.5 Effect of Decentralised Structure on Manufacturing Strategy

Popular academics have argued that manufacturing strategy should follow the business strategy. The challenge in a decentralised structure is the level at which to create a manufacturing strategy. If formed at the highest level, it could be too vague for others to act upon, particularly in a large, diverse company. But if the high-level strategy is relatively simple, it could serve to provide guidance for companies and factories. If, for example, there is no high-level strategy and each decentralised group is permitted to develop its own manufacturing strategy, the overall direction of the company may not be aligned. But on the other hand, if business groups are serving particular customers or industries with dissimilar needs, the lack of alignment on how to manufacture may be less important.

For discussion, we will simplify the strategy setting levels that are possible in a decentralised structure. These levels will be "global", "group" and "factory". For manufacturing strategy to be set at a global level, there would need to be a high level leader or group representing manufacturing at the highest level of the organisation. Similarly, manufacturing strategy set at a group level would need a manufacturing leader or team at the group (business area) level. While the first two levels of manufacturing strategy are recommended for collaborated or centralised manufacturing practices within the operation of the company, they are not absolutely needed. The factory leader however, must have a manufacturing strategy to develop its own local operations. So depending on the other levels of production leaders in the company, factory leaders may or may not have higher level guidance to base their strategy on.

The set of decisions these leaders need to make depends on how responsibility is shared in the organisation. At the factory level, the production manager likely has responsibility for the amount of vertical integration, processes, technology, human resources, quality management, infrastructure and vendor relationships. This assumption means that higher level manufacturing decisions such as facilities, capacity, scope and new products are decided at the group level or higher. In reality, the division of responsibilities will vary company to company, and the appropriate leader needs to plan his strategy based on what decisions are within his power or influence.

The organisational level of leaders participating in the manufacturing strategy affects the manufacturing development stage that the company can attain, according to the model described by Hayes and Wheelright. At the lowest stage, 1: "Internally Neutral", we expect that manufacturing is not valued at a high level, and could assume that manufacturing strategy is only considered at the factory level. The next stage, 2: "Externally Neutral" could be achieved with factory manufacturing strategy alone, or also with factory and group level manufacturing strategy planning. The third stage, 3: "Internally Supportive" would likely require group level involvement in setting manufacturing strategy, since there should be a deep understanding from manufacturing leaders about long term business plans. Likewise, business management also needs a clear understanding of how manufacturing will contribute to its goals. Finally, the highest stage, 4: "Externally Supportive", would require manufacturing strategy to be planned at the global level of the company since at this level, manufacturing is expected to play a key role in company competitiveness. To attain this stage, factory, group and global level managers would need to value manufacturing and appreciate it as a vital function in the organisation's success.

So far, it seems that it would be impossible for a decentralised company to reach a "Stage 4" manufacturing level unless there is manufacturing representation at the executive level. But there is an important new qualifier to these stages of manufacturing development that must be considered. The level of collaboration in manufacturing must be considered for decentralised companies. A centralised company can reach a "Collaborated Stage 4" if manufacturing is properly aligned and represented at the executive level. In contrast, decentralised companies could reach a "Collective Stage 4" if each factory manager was acting at a Stage 4, even if there was no manufacturing representation at the executive level.

4.6 Observations for Powercomp Manufacturing Strategy Consideration

At one time, the electrical power and transmission market of Powercomp demanded localised solutions for local markets. To accommodate local requirements and preferences, products were designed with price, technology, materials and standards in mind. Historically then, Powercomp could operate without higher level manufacturing strategies since each local company created a manufacturing strategy based on the intricacies of its local environment, including customer demands, manufacturing capabilities, and country management.

De-regulation, globalisation and structural changes within Powercomp such as the shift of power from regional to business units offer new opportunities for Powercomp to reduce costs globally and increase market share. To take full advantage of the savings opportunities, Powercomp may need to re-evaluate how a higher level manufacturing strategy can contribute to the overall performance of operations. Opportunities may exist by reducing duplication of efforts, sharing ideas and developing similar technologies.

Other high-level Powercomp business initiatives, such as e-business standards or targets, effect processes within Powercomp factories. Targets and direction are given for these new initiatives, but execution and implementation is left to local managers. There is little practical guidance as to how production managers should pursue using the web, or how to reconfigure production to add either customer value or internal production efficiency. Autonomy and thus independent manufacturing strategy are still the norm in Powercomp even though new changes at a higher level are trying to increase standardisation for the sake of network and intranet compatibility.

Certain segments are pursuing higher-level (BA-level) business strategy changes that effect the local manufacturing group. In these cases, local groups autonomously deal with the implications of the changes and create their own solutions to meet the high-level goals or direction. In one BA, for example, factories are being re-configured to use the Focused Factory concept. Although the shifts in volume and products have a huge impact on each company's current production and future goals, each factory is still

expected to deal with these changes on the local level. New volume and product targets are assigned, but how to select and develop manufacturing capabilities to reach these goals rests in the hands of local production management.

In practice, there is a large variance of solutions for production leaders to reach these BA or Powercomp targets set at the higher levels. Some factories have clear strategies to plan in advance how to meet these goals, with well-detailed implementation plans to fulfil their goals and strategies. Other factories, however, do not have a strategy, and wide ranges of improvement teams are working in different areas in the factory. Finally there are also factories which lack the knowledge or resources to take part in any substantial improvement efforts.

4.7 Summary

We have seen that a strong manufacturing strategy is based on the high-level company strategy. If properly implemented, manufacturing can direct its efforts so that process improvement initiatives are aligned with company efforts as a whole. Without a clear strategy, production may not have sufficient impact on the company's key goals, and could eventually be spun off. Powercomp manufacturing strategy is created autonomously at the local levels, but the value and rigour applied to manufacturing strategy varies from factory to factory.

CHAPTER 5: Change Management

5.1 Introduction

This section reviews academic literature on organisational change management, which is an important consideration for the execution of manufacturing strategy and initiatives. Culture and structure are examined as key inputs to change management for the general sense and specifically for Powercomp. A thorough analysis of change is given for decentralised companies to consider what type of change is most effective in this type of company.

5.2 Academic Review of Change Management

Manufacturing initiatives attempt to bring about changes in the performance of a factory. In the past, the structure and plans for change were often not scrutinised or considered important. Nowadays, however, many companies, including Powercomp, are studying Change Management to better understand and improve how new ideas or directions are pursued within the company. Change management is included in this study to understand how change works, and to prescribe a plan for implementing changes in manufacturing.

Carlile (1999) uses source, scope, pace and process of changes to differentiate between different types of change. Each of these aspects can be seen as a continuum, where a change effort lies somewhere between the two extremes, listed in Table 5.1.

Table 5.1: Four Aspects of Organisational Change

Aspect	**Traditional Change**	**"New" Change**
Source	Top-down	Bottom-up
Scope	Radical	Incremental
Pace	Discontinuous	Continuous
Process	Planned	Emergent

A commonly accepted model for change involves the "unfreezing – change – refreezing" of Lewin (1986) found in discontinuous change. The unfreezing stage hinges on finding forces that are strong enough to overcome people's natural reaction of resisting change. Charismatic leaders or education are examples of forces that "unfreeze" the status quo, and they do this by overcoming people's anxiety about learning and by clearly identifying and communicating the need for change. In the change phase itself, users or participants must learn new concepts, systems and rewards. The change agent can use either defined role models for the users to follow or can allow the users to create, learn and employ new roles through trial and error. The final stage of refreezing is when new concepts are evaluated and internalised, and precautions are taken so users do not revert to the "old" way of doing things.

Beckhard and Harris (1987) form similar ideas in their research in identifying three conditions for change as follows: defining the future (where you want to get to), assessing the present (where you currently are) and finally, managing the transition (the activities and conditions to get you between the two). This sequence encourages an exploratory stage to start the change process, where managers are not limited by current issues or realities. Before jumping into this new vision however, managers pause to assess the current situation and evaluate how big the gap is, and where the priorities for development lay.

Leadership plays an important role in any change, and leaders have two major choices to make early in the change management process. The first is *whether or not to partake* in the change and the second

(assuming they answer 'yes' to the first) is *how to make* the changes. For leaders to be effective at making these decisions as well as being effective at managing change, Beckhard and Harris recommend they establish the following:

- Vision and direction for the organisation
- Clear sense of the organisation's identity
- Clear sense of the organisation's competitive environment (such as competitors and technology)
- Clear set of reachable scenarios to develop strategic plans and contingency choices
- Effective use of technology
- Properly aligned reward systems

Schein (1999) defines change leaders as "persons who create enough disconfirmation in the organisation to arouse motivation and change". To do this, he recommends that change leaders are people who are credible, have a clear vision, and are able to articulate that vision. The role of the change agent(s) then, is to fulfil the motivation and vision of the change leader, and to act as "catalysts and facilitators" in the change process. Change agents are not necessarily leaders in the organisation, and their function is more detail and execution oriented than the leader's function.

5.3 Effect of Culture on Change Management

Schein (1999) identifies that "the more one can use culture as an aid, the easier it is to achieve the change. If cultural elements are found to be hindrances, then new change processes have to be designed to deal with them." From this observation, it seems that an important part of the change process is to study the company culture, and estimate what types or styles of change would be most effective in that organisation. If there is more than one path to achieve the end result, company culture should be one way to evaluate the preferred path.

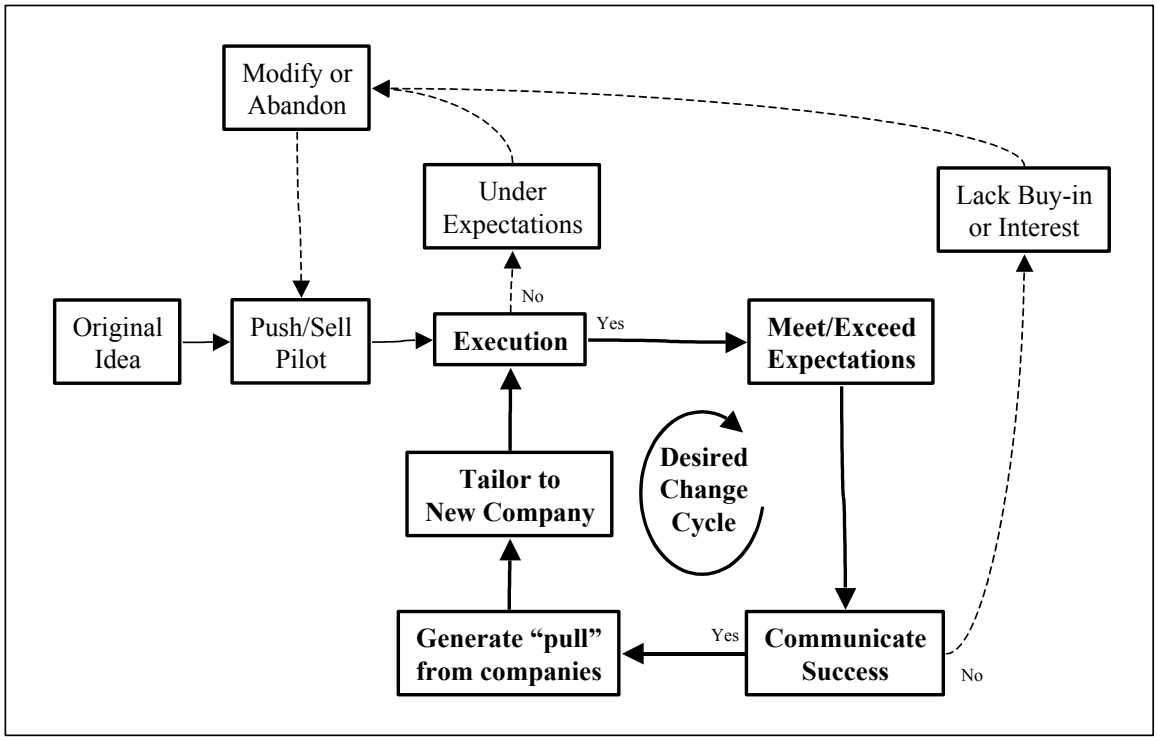
The culture of a company also guides how leaders are perceived, which in turn influences the success of certain types of change such as top-down initiatives. Some company's cultures are based on continuous challenge and constant change while others are steady and traditional. American companies are more apt to select distant "stretch" targets for their future, while European companies may be more conservative, selecting targets that seem more realistic.

5.3.1 Effect of Powercomp's Culture on Change Management

Powercomp's autonomous culture has a strong influence on change management. Since each company manager tries to optimise his or her own business unit and because each business is considered unique in the company, change management is rarely considered on a large scale. Each business is responsible for initiating and implementing its own changes according to its particular needs. Over time, this autonomy has led to an assumption on how changes are made in the company. This assumption is that highly effective initiatives should be communicated within Powercomp, and if they are successful and communicated effectively, other companies will slowly adopt the initiative. As each company adopts the initiative, the style of planning and executing the changes is tailored to the specific company's environment.

Figure 5.1 shows the assumed change process for Powercomp Manufacturing Technologies Group. This assumption is shared within CRC and PTO. In general, it is assumed that the best way to share ideas and motivate people to change is to achieve success in pilot projects, then to aggressively communicate the success. If the change initiative meets the needs of other companies, achieves impressive results, and is properly communicated to the appropriate audience, new companies will want to adopt the changes. Once a new company adopts the ideas, it is expected that it will tailor or modify the initiative to fit their local culture and needs.

Figure 5.1: Assumed Change Model in Powercomp



5.4 Effect of Decentralised Structure on Change Management

Defining the right players to initiate and implement change (change leaders and change agents respectively) may be more difficult in a decentralised organisation. A lack of common structure, roles, responsibilities, skills and influence within each subgroup means that intimate knowledge of key players in each group is needed to select change agents or leaders from a high level. For example, in a homogeneous company one could name the production manager as the change leader of the manufacturing initiative, and the line managers as the change agents. In a decentralised company however, the roles, responsibilities, power and knowledge of the production manager and line manager could vary so much from factory to factory that it would be impossible to recommend these people as change leaders and change agents without knowing their abilities.

Kotter (1995) recommends eight steps to transforming your organisation as follows:

1. Establishing a Sense of Urgency;
2. Forming a Powerful Guiding Coalition;
3. Creating a Vision;
4. Communicating the Vision;
5. Empowering Others to Act on the Vision;
6. Planning for and Creating Short-Term Wins;
7. Consolidating Improvements and Producing Still More Change;
8. Institutionalising New Approaches.

Using these steps, the "traditional" change model would be difficult for a decentralised company to follow unless production is managed from a top level. At the top of the list, decentralised groups will have different factors driving their sense and interpretation of urgency. Subcultures may perceive

urgency differently, and so, reaction to various issues will differ. Next, a guiding coalition may be difficult to organise at the highest level in the organisation if manufacturing does not have representatives at a high level, and a common vision will be challenging to build for the different groups. Once again, based on the cumbersome nature of communications in a decentralised company, mutual sharing and understanding of the vision may be limited.

The obstacles to traditional change continue. The autonomous nature of groups in a decentralised company makes it difficult for someone to motivate and also empower others to act in a co-ordinated way. So in turn, the means of setting schedules, celebrating wins, consolidating improvements and institutionalising new approaches will vary by group structure, organisation and sub-culture.

Carlile's (1999) aspects of change can be also be used to rigorously examine the effects of decentralised structure on the high level of change management. These aspects (source, scope, pace and process) are considered below for a decentralised company.

5.4.1 Source of Change in Decentralised Companies

Change in a decentralised organisation is less likely to be top-down since a high-level leader has less power to dictate unilateral changes across the organisation. If a high-level leader could be found to drive such a change, the leader's role would likely be limited to stimulating interest, since actual motivation, results and implementation would depend on the local function, organisation, structure and culture. In other words, this leader would likely take the role of setting vision and motivating change rather than be a micro-manager.

According to the recommended attributes of an effective change leader, this person would need to understand the various structures, organisations and cultures existing in each subgroup. In a large, decentralised organisation, understanding the nuances of each group would be very difficult and time consuming. With respect to these difficulties, making recommendations for change based on accounting or financial data alone could be very dangerous, so local understanding of culture should not be omitted. Likewise, it would be difficult for the leader to recommend appropriate schedules, strategies or incentive systems for each of the sub-groups, since the motivation and methods of change vary from group to group.

5.4.2 Scope of Change in Decentralised Companies

It seems to be easier to implement large-scale change on an incremental scope rather than a radical scope in a decentralised company. For the change process to commence, leaders and agents need to be convinced of the need to change. In a decentralised organisation, it is unlikely that all local leaders would simultaneously decide to implement the change, and the pace at which they planned the change would likely vary.

Based on Beckhard and Harris' model (defining the future, assessing the present and managing the transition), radical change would be difficult since assessing the present and defining the future are difficult tasks in a decentralised organisation. Various groups may find it difficult to agree on their "future", and assessing the present would reveal a wide range of current scenarios and capabilities. Conversely, incremental change would allow local leaders to work at their own pace, to define their own future toward a common goal or improvement and to assess their present situation with the appropriate metrics or measures.

5.4.3 Pace of Change in Decentralised Companies

With respect to pace, discontinuous seems more likely for large-scale change in a decentralised organisation. Continual learning or a continuous pace for change requires a learning organisation, which in turn needs efficient communication channels and common values for learning and knowledge transfer. These factors seem difficult in a decentralised organisation since communication is more formal and limited, and values such as continuous learning and knowledge transfer will not be shared across the organisation unless communicated and enforced as a global value. Fewer informal networks are expected in a decentralised company due to the lack of exposure or familiarity across business units or geographic boundaries.

The time needed for "unfreezing – change – refreezing" stages will vary for different groups within the decentralised structure. Without empirical evidence, it is impossible to estimate whether these stages would flow more smoothly in a decentralised or centralised structure. One could argue that a decentralised structure is more flexible and entrepreneurial and so can move more rapidly through change management, whereas a centralised company could be slower and more bureaucratic. It could also be argued however, that due to more cumbersome communication, varying business needs, and unique management styles in a decentralised company, the time gap between the first and last groups to "refreeze" in a decentralised group would be much larger than in a centralised group.

5.4.4 Process of Change in Decentralised Companies

Considering the above observations – lack of high-level leader, the variance of motivating factors to change and so on, one can predict that an *emergent* style of change dominates in a decentralised structure. Even if a high-level change strategy were put in place, local managers would likely want some flexibility to tailor the initiative to suit their needs and fit into their local culture and structure. As each factory adopts the change initiative, the initiative would mutate and redefine itself for each new application.

5.5 Summary

According to academic literature, the traditional change model is top-down, radical, discontinuous and planned. In the decentralised structure, this type of change is particularly difficult, so much literature on effective change is not applicable on a high level. Powercomp's accepted model for change was presented in Section 5.3.1, where it was seen that incremental change is most common for manufacturing initiatives in Powercomp.

CHAPTER 6: Execution of Manufacturing Initiatives

6.1 Introduction

This chapter describes the type of manufacturing initiatives that are included in this study and defines the steps included in their execution. High-level and low-level changes are contrasted to determine the different levels of change in a decentralised company. An execution model, referenced in later chapters, is included in this chapter to classify the mix of high-level and low-level changes, and the amount of interaction between factories within the decentralised structure. Execution scenarios are introduced and pre-evaluated to discuss the tradeoffs of different plans.

In the latter part of this chapter, various implementation scenarios that were tested at Powercomp for the Agile Manufacturing project are summarised. By planning and testing implementation scenarios, the Manufacturing Technologies Group was able to consider which combinations of high-level and low-level execution roles and responsibilities were most appropriate for a decentralised company. Characteristics that are unique to Powercomp, such as Manufacturing Technologies' role as a leader and the level of knowledge transfer between factories are also considered. Working through the execution matrix, we started by considering Collaborative and Directed change (traditional top-down initiatives), then moved into Co-operative and Collective changes.

6.2 Steps in Execution

Execution begins with a trigger stimulating management to rethink the current manufacturing strategy, driving plans for new manufacturing initiatives and finally resulting in the implementation of these plans. Each of these four steps (acknowledge the trigger, rethink the strategy, plan the initiative and implement the initiative) are described in the following sections. Although these steps are best followed in this order, there will be some movement within steps as plans are adjusted and as the learning process evolves.

6.2.1 Execution Step 1: Acknowledge the Trigger

Changes in the environment act as triggers for change in the factory including:

- Increased competition leading to price wars;
- New technology causing a shift in demand;
- Industry changes which affect supply chain efficiency or norms;
- Change in customer needs driving an increase or decrease in volume;
- Change in labour teams resulting in increased or decreased productivity.

This is not a comprehensive list, and there are many possible triggers. Management's role is to acknowledge which of these triggers has the strongest effect on the factory either in terms of risk or opportunity on business performance. If the company fails to acknowledge and prioritise triggers, the factory employees may lack guidance for their improvement teams.

The trigger for the Agile Manufacturing project at Powercomp was a volatile demand environment. The Agile Manufacturing team broke down volatility over time into radical swings in demand volume, shorter product life cycles, greater product variety (product mix) demanded, shorter technology life cycles and frequent changes to processes. A particular factory would be responsible for acknowledging which of these triggers (if any) is most relevant to their environment as the first execution step of Agile Manufacturing execution. These triggers are important to acknowledge since accommodating the demand volatility can add customer value (i.e., keeping up with volume during peak demand) or by controlling costs (i.e., reducing spending as demand falls).

Depending on the level of foresight and planning, some triggers are pro-active and some are reactive. Proactive actions may be taken to avoid a potential future issue, or to take advantage of an expected upcoming event. Reactive actions are thus taken to control or maintain a certain situation. Regular development and maintenance of high level strategies may help to focus on upcoming triggers in the environment to help a company be more pro-active in manufacturing performance development.

6.2.2 Execution Step 2: Rethink the Strategy

Once the trigger has been acknowledged, the next step in execution is to rethink and possibly redefine the manufacturing strategy. Since Agile Manufacturing is more of a vision or strategy than an actual tool, strategy in that case was being directed by Manufacturing Technologies. Factories would still be responsible for setting their own strategy, but the identification of the volatile demand environment leads to some adoption of agility into the strategy. Otherwise, each factory can be responsible for setting its own strategy based on their particular trigger.

6.2.3 Execution Step 3: Plan the Initiative

Planning the initiative includes defining the scope, scale, goals and schedule of the project. The planning team should include those who are aware of the current capabilities and available resources, and who are also able to identify the appropriate stakeholders, change leaders and change agents in the factory. Planning can be done at either high-level (company wide) or low-level (factory) depending on the structure and norms of the company.

Change leaders should be aware of culture and structure of the company when they are planning the initiative. The manufacturing environment, how it is perceived and accepted in other functions, and how manufacturing initiatives have proceeded in the past are all examples of how culture should be examined. For a decentralised company in particular, both high-level culture and functional or regional sub-cultures should be considered.

6.2.4 Execution Step 4: Implement the Initiative

Implementing the initiative is the series of action steps that allow you to meet your goals. Implementation is highly dependent on the understanding and application of change management. As discussed earlier in this study, strong change management is in turn dependent on understanding the company culture and structure. Implementation must be done at the factory level, but factory-level manufacturing initiatives can also be complemented by company-wide implementation of new metrics, high-level manufacturing targets, et cetera.

The areas of academic study described in previous chapters (culture, manufacturing strategy, and change management) are important areas to understand before implementing a manufacturing initiative. It is important for this study that the effect of a decentralised structure upon these areas have been considered.

6.3 Characteristics of Manufacturing Initiatives

Manufacturing initiatives can take many shapes and forms depending on the triggers and strategy of the company. This particular study is focused on initiatives with the following characteristics:

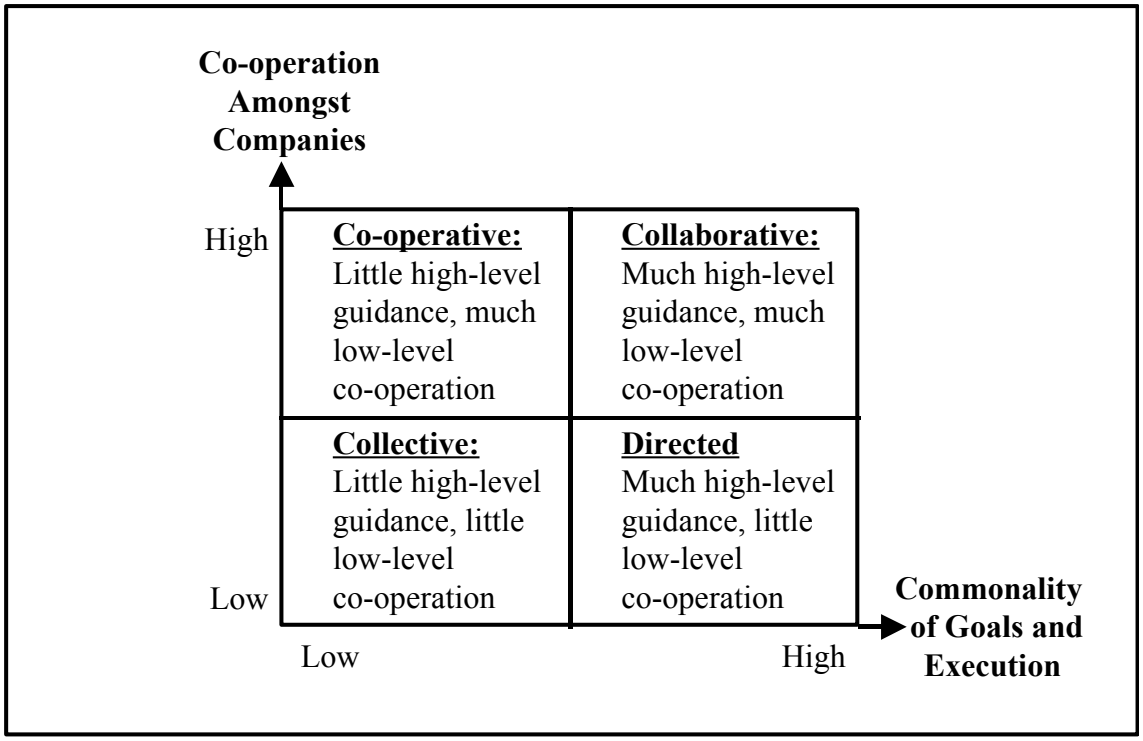
- Large scale – affecting a large number of factories within Powercomp
- Large scope – affecting factories across a large variety of business units and regions in Powercomp
- Focus on process improvements rather than product improvements

As with many company initiatives (including manufacturing initiatives), there is an expectation that the initiatives will provide a reasonable return on investment and will use a minimal number of resources (people, time and cash).

6.3.1 The Execution Matrix

To demonstrate the level of co-ordination between factories and the blend of high-level to low-level leadership in the implementation, four categories are proposed in Figure 6.1. A Co-operative initiative is one where companies are sharing information or ideas with one another, but each company is independently executing his own initiative. In a Collaborative initiative, companies are not only co-operating with one another, but they are also following the execution plans of a high-level team to meet a common set of goals for all factories. If companies are working independently (without co-operating with other companies) to follow execution plans and goals set at a higher level, this is defined as a Directed initiative. Finally, the Collective initiative is one where all factories are executing their own changes, set to their own individual goals and plans without the help of other factories or high-level guidance teams.

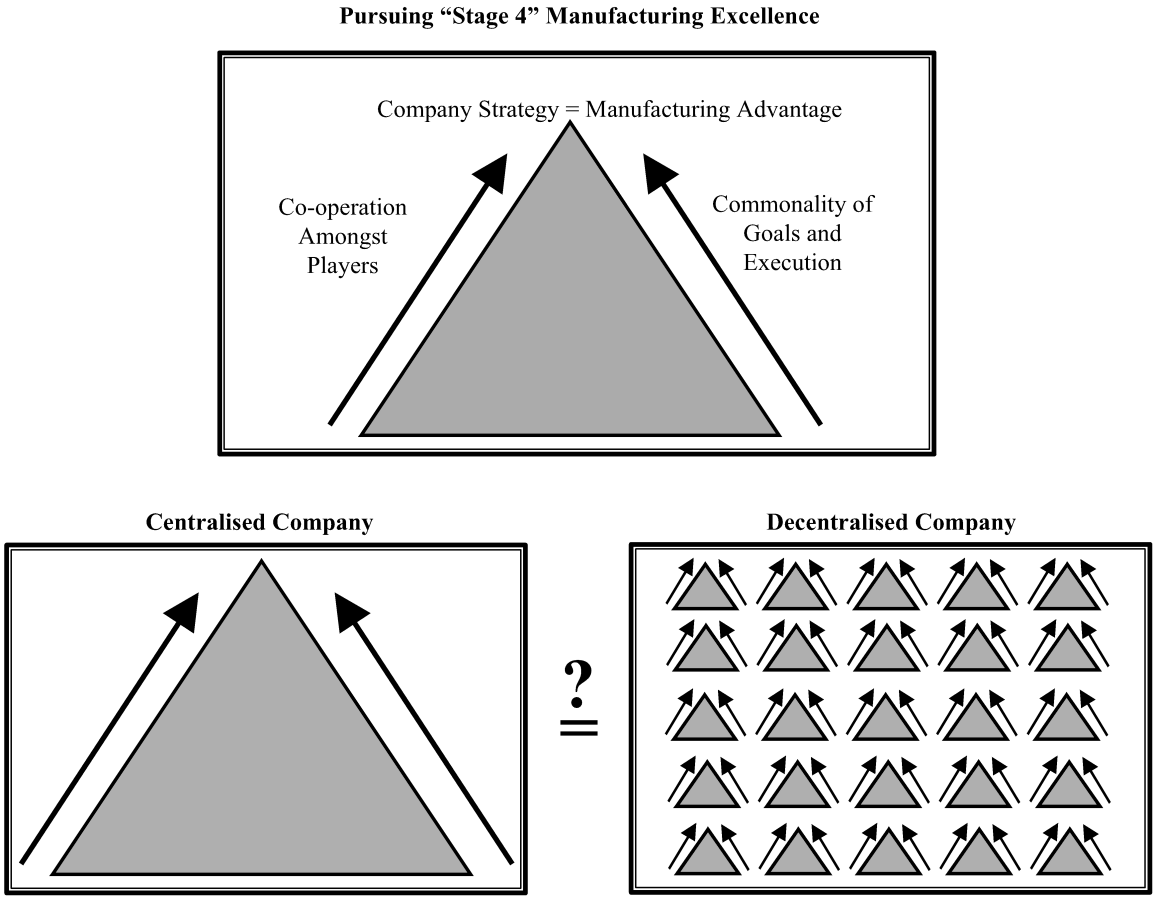
Figure 6.1 Execution Matrix



In a decentralised company, the execution of manufacturing initiatives may need to be planned at both the high-level and local level. The high-level planning and analysis may be more vague and based on high-level company targets. Low-level planning and execution will be more action-oriented and detailed, focusing on the actual changes made in the factory or supply chain to achieve the higher level targets. It is important to recognise that it is the low-level planning and execution of manufacturing improvements that achieve results in a decentralised company. High-level targets should be communicated but may not be sufficient motivation for local companies to respond to.

Figure 6.2 shows a simplified diagram of the possible differences between centralised and decentralised companies. One of the central questions here is whether the sum of many factories working independently to achieve Stage 4 would be equally as effective as many factories working together towards a Stage 4. Or according to the terminology given above, we may ask, is a Collective Stage 4 as effective as a Collaborative Stage 4?

Figure 6.2: Stage 4 in Centralised and Decentralised Companies



6.4 Two Levels of Change

Change management theories give us guidance on how to execute the manufacturing initiatives or changes. These theories help us to recognise and evaluate how the change should be executed, and provide support in crucial areas such as identifying leaders and setting roadmaps for change. However, for the decentralised structure, there are two distinct levels of change to consider. First, change at the higher level where overall manufacturing performance in the organisation is improved. And second, change at the lower level where a particular factory implements a specific initiative to improve its manufacturing processes. In all companies, change should be considered and managed at both levels, but this is particularly challenging to do in decentralised companies.

One of the difficulties in planning manufacturing initiatives in a decentralised environment is that a small-scale change project is very different from a large-scale change initiative. Although an individual factory

pilot may run smoothly, larger level (BU, BA or segment) changes are difficult to replicate. This is true due to the range of sub-cultures, the difficulty in communicating within and amongst groups, the variety of relationships with the higher level change leader, increased risk and investment for the business area, and finally, the wide array of business and manufacturing environments.

On the factory level, change leaders and agents only need to consider one company culture. The number and variance of sub-cultures within one factory level is much fewer than the number and variance of sub-cultures at the segment or corporate level. Thus, at the company level, change can be planned and managed according to local culture and norms, and the factory leader is assumed to be familiar with working in this environment. But as more than one factory is included in the initiative, there may not be a common communication style or channel, similar change management styles, or even a suitable implementation schedule for the mix of factories involved. Planning a manufacturing initiative at a high level is difficult in a decentralised company.

Next, the difficulties in communicating within a decentralised company also make it difficult to scale changes. While there is little variance in terminology, hierarchy and communication style at the factory level, the variation between factories or BAs is much larger. It becomes difficult to re-use presentation or written material across various groups because the same level of understanding, agreement or enthusiasm may not be reached in two or more separate environments. Due to the amount of research and preparation required to commence the initiative in a new group, there are few opportunities for economies of scale, and the high-level change process becomes quite slow.

Another consideration is the relationship that various change agents have with the change leader. In a factory environment, we can assume that change agents are responsible in some way to the change leader, and thus they have motivation to support his initiatives, and execute their part of the project to the best of their ability. On a larger scale, the change leader may be further removed from the change agents, and the agents may not have any responsibility or loyalty to the change leader. The leader can not hold them accountable, and so they have less external motivation to implement the change.

When large-scale changes are to be made in one business group, there is higher risk and investment for that group. More time, resources and investments are needed to support a larger project, but there are few economies of scale when growing from a factory-level pilot to a BU-wide initiative. If changes are disruptive to factory operations, and the factories undergoing change serve a common set of customers, there is a risk that service levels, quality or efficiency could temporarily drop during the change process. In general, higher levels of resources and investments mean that the resistance to change is greater, and so it becomes more difficult to convince the leader to act on the idea, to obtain support from local change agents, and to maintain momentum from all groups throughout the change.

Finally, a key reason that scaling a particular manufacturing project from the factory level to the group level is difficult is that the business and manufacturing environments vary from one factory to the next. Factories will have different manufacturing capabilities, various priorities with respect to manufacturing strategy (cost, quality, dependability and flexibility), a range of customer values and different goals to focus on. This means that to properly convince each factory within a group of a change to be made, their individual capabilities, issues, needs and goals need to be assessed. This slows down information gathering and analysis, and eventually slows down the entire high-level change process.

6.5 Tradeoffs in Execution Scenarios

For now, we will assume that the goals for the project were clearly defined and the correct initiative has been selected. The only remaining decision is the execution style. So in the execution-planning phase, various execution scenarios will be listed and compared. Sources to develop potential scenarios include

previous initiatives, current projects, external benchmarking or innovative solutions. Combining one or more of the scenarios may also develop further scenarios.

To evaluate and prioritise execution scenarios for manufacturing initiatives, a company should determine the key parameters for judging the success of an initiative. For Powercomp's Agile Manufacturing initiative, management was searching for an execution plan that fit with existing culture and structure, used minimal resources, and achieved above-average results. These criteria were grouped and defined as:

1) Ease of Implementation – how easily the proposed implementation plan is expected to be realised in the organisation
2) Potential for Results – maximum potential scope, scale, and speed of implementation
3) Resources Required – fixed and variable costs, time, and people required to implement

Implementation scenarios that are easiest to implement *with* minimal resources *and* maximum potential success should be considered first. To establish a fair system of scoring and evaluation, a further level of detail was given to each criterion. Details were defined based on change management theory for "Ease of Implementation", based on the type of manufacturing initiative we were trying to achieve in "Potential for Results", and finally based on the main sources of costs for "Resources Required". These details and allotted scores are found in Appendix 1. Statements were created for the evaluator to agree with (3 points), neither agree nor disagree with (2 points), or disagree with (1 point).

The evaluator should understand each of the scenarios being proposed, and have a clear sense of the organisation's goals, structure, culture, change history and manufacturing environment. This level of understanding can be gained from work experience and interviews in the given company. It is acknowledged that these categories are all subjective and actual scores will vary depending on who the judge is. For this reason we focus on relative scores rather than absolute scores, and also encourage more than one person to score the scenarios for comparison.

Once these criteria are defined, it may be found that not all categories are equally important, and so weights could be assigned to each category. The actual weight that each category should be assigned will be particular to an organisation and to a specific initiative. Ideally a team of people should work together to assign weights, and an effort should be made to achieve a range of weights and not simply a "mediocre" rating for all. For simplicity, one could use a "high-medium-low" weighting system, but more differentiation could be added if necessary.

This scoring and weighting system provides a rigorous method for comparing scenarios, and especially to identify the tradeoffs that exist in planning the implementation. For the three criteria given above, we stated that execution plans that were easiest to implement *with* minimal resources *and* maximum potential success would be selected. In reality, there are tradeoffs to be made, and the execution team must agree on how to proceed knowing that not all three criteria may be met.

6.6 Powercomp Case Study

For the Agile Manufacturing project at Powercomp, Manufacturing Technologies identified the triggers (volatile demand environments), rethought the strategy (Agile Manufacturing), and planned the execution (Agile diagnosis and tool recommendation) at the high-level. The next decision was how to share the Agile Manufacturing initiative throughout lower levels of Powercomp. In other words, the high-level planning was done, but these new strategy and execution plans needed to be transferred to the low-level. Once transferred to the low-level, factories would be able to adapt the strategy and plans to best fit their particular environment.

Manufacturing Technologies' role was to act as the high-level execution leader, and in so doing, motivate companies to strive for breakthrough changes in manufacturing by providing the necessary resources. This section examines the high-level rollout strategy that Manufacturing Technologies considered for providing motivation and resources to support Agile rollout in factories.

With respect to the Execution Matrix (Figure 6.1), the Agile Manufacturing team was setting goals and execution plans from a high level. The amount of co-ordination between companies was not determined, and so Collaborative and Directed scenarios were initially evaluated. High-level guidance seemed logical to "rally" the factories with a common theme and to achieve economies of scale in improving manufacturing across Powercomp.

In this high-level execution planning stage, a wide range of scenarios were developed, and then assigned to four categories: consulting, workshops, structural change and "passive". The assumed change model (recall Figure 5.1) was considered when developing the execution scenarios. It was important to include a mix of execution scenarios, ranging from existing solutions to completely new scenarios. The scenarios groups are described below, and more detail can be found in Appendix 1.

6.6.1 Consulting Scenarios

Within Powercomp Production Technologies Organisation (including Manufacturing Technologies' projects), consulting is the traditional method to share new ideas with factories. For this reason, consulting is generally seen as a non-intrusive implementation plan. For a large-scale initiative however, the consulting approach is slow, and projects in the past have been limited to growth on a factory by factory basis, eliminating possibilities for economies of scale over time. To achieve larger scale under the consulting model, new consultants would need to be hired and trained.

An observation on consulting solutions is that consultants are acting as change leaders in the planning phase, but actual changes are the responsibility of local leaders or change agents. The hand-off or transfer of responsibility may limit the follow-through of ideas, could lead to resistance at the local level, or may limit progression over the long term due to lack of planning experience. For Powercomp's PTO and CRC consulting teams this has not been a major issue, but should be a precaution that is considered before increasing consulting work.

6.6.2 Workshop Scenarios

Workshops are seldom used in Powercomp, but have worked on occasion in the past. For workshops to be accepted in Powercomp, they should be action oriented and include group learning, practice and discussion. Although workshops have the opportunity to reach a larger number of factories at once, follow-through after the workshop is uncertain, so achieving complete implementation is perceived to be more difficult than for consulting.

The various workshop scenarios considered how factories could best be grouped in terms of common teaching material, similar change motivation and common functional leaders to increase the likelihood of follow-through after the workshop closes. Based on the relatively low cost and short time frame of workshops, they are considered to be relatively low risk.

6.6.3 Structural Change Scenarios

Another source of change scenarios was to consider how other successful manufacturing companies operate. Both decentralised and centralised companies were considered when looking for scenario ideas. It is difficult, if not impossible, to copy the success of other firms, particularly if structural or cultural

change is required to adopt the new methods. Structural change scenarios were generally based on hiring high-level manufacturing leaders in the organisation. The general result would be to treat manufacturing as a centralised group instead of autonomous operations, which in turn may lead to "Collaborative" execution of manufacturing initiatives.

To build a convincing case for structural changes towards centralised production, it should be shown that there are commonalties in production processes, opportunities for more efficient learning across business units, or better economies of scale. Based on the diversity of Powercomp products, markets and processes, the top-down centralised structure used by other global manufacturing companies is not appropriate. If structural changes were to be recommended, the top down leader should be responsible for building a stronger communication network and developing fair metrics that could equally apply to all factories (such as year over year improvement).

6.6.4 Passive Scenarios

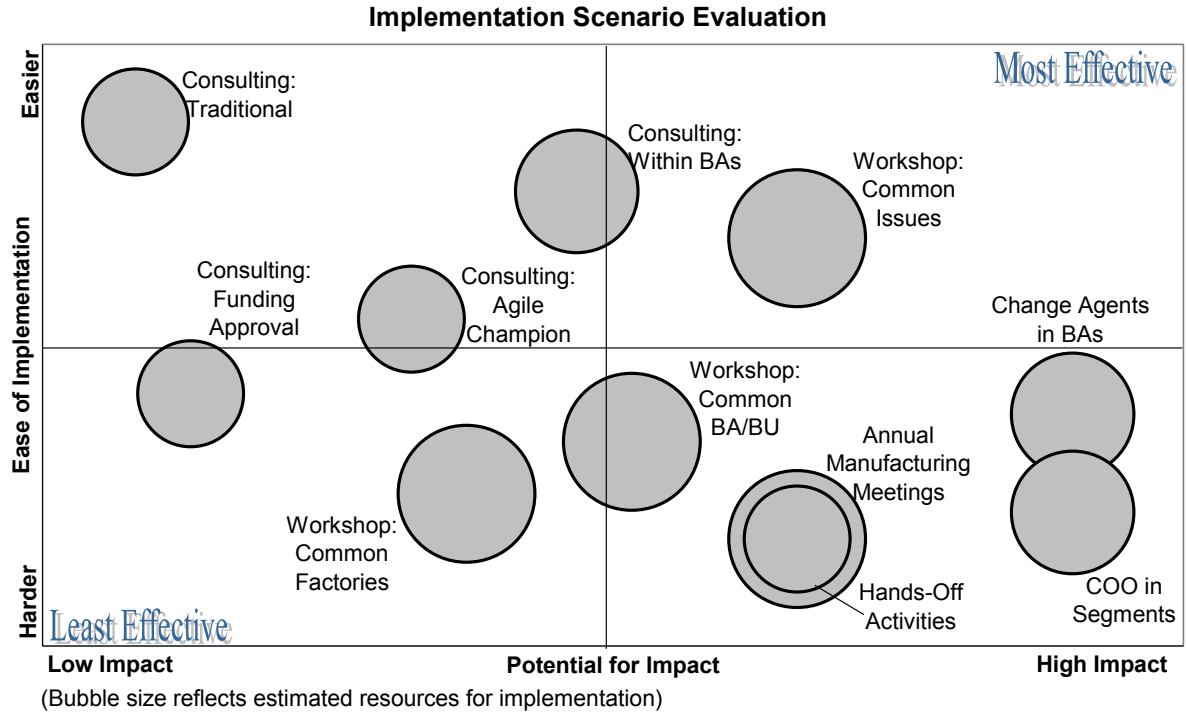
Finally, passive scenarios were included to offer alternative solutions that were lower cost and less aggressive. These scenarios are more information oriented than action oriented, and would require local teams to "pull" the relevant information from the Agile Manufacturing Team. The trade-off in these cases is that lower costs and resources can be applied, but end results may be limited.

These scenarios depend on active marketing and communication of ideas, and also rely on factories learning from one another and not only from Manufacturing Technologies. In these cases, Manufacturing Technologies would have more of a facilitating and marketing role rather than a change leader role. Passive scenarios would thus fall into either the co-ordinated or collective role since there is less high-level execution being done.

6.7 Implementation Evaluation for Powercomp Scenarios

By scoring and plotting the proposed scenarios (see Figure 6.3 and Appendix 1), the Agile Manufacturing team could logically discuss and compare the various options. Most importantly, the trade-offs amongst ease of implementation, potential for success and resources required became apparent. It is difficult, if not impossible, to impose so many constraints on an implementation plan, and still hope for large scale and large scope success.

Figure 6.3 Agile Scenario Evaluation



The evaluation method given above is subjective. Without testing every method however, it is difficult to objectively evaluate an execution plan. As a minimum benefit, the evaluation method provided grounds for discussion amongst team members, and allowed debate amongst the team on how to proceed next. The relative risks and rewards were contemplated, and recommendations on how to proceed were developed.

6.8 Top-down Approach

In planning the implementation of the Agile Manufacturing project, the team originally considered traditional, top-down changes. The hypothesis was that if the proper high-level leader could be found and recruited to drive the initiative, then the ideas would be easier to implement at the local level. While interviews were held to determine the proper high-level leader, it was soon discovered that Powercomp factories were highly autonomous.

The wide range in products, processes, market and geographies amongst Powercomp factories act as obstacles to top-down implementation. This variety in production needs and goals is common throughout many decentralised companies. If these companies find reasons to centralise (such as economies of scale, learning opportunities, etc.), then top-down initiatives should be considered. Under the decentralised structure however, top-down change is difficult because the reporting structures, range of sub-cultures, and difficulty in identifying change agents and leaders make it difficult to run top-down changes. Testing the top-down method could have been useful to gather concrete evidence on how the top-down method could be used since the evidence above is based on theoretical prediction.

It is expected that similar obstacles would be found in other decentralised companies, and that they are not unique to Powercomp. As recommended by Dreifus (1992), increasing communications, encouraging

team building and offering corporate training programs may increase the level of co-operation within a BU without changing company structure. In conclusion, practical efforts to implement top-down change in a decentralised company were proven to be very difficult, and this coincides with expectations based on theory.

If top-down initiatives are ruled out, only two of the possible execution scenarios are available for decentralised companies. Collaborative and Directed execution plans are not possible if companies are not following a leader. Without a leader, common goals and execution plans will not be made, so companies will independently set their own goals and plan their own manufacturing initiatives. This means the decentralised companies will follow either a Co-operative or Collective approach to executing manufacturing initiatives.

An alternative approach to top-down change initiatives is to change the common metrics rather than relying solely on a high-level change leader. The new metrics could be selected to emphasise improvements in a particular area. Although there may not be a high-level leader driving this change, it would have a similar effect since all profit centres would be equally motivated to improve according to these metrics.

6.9 Bottom-up Approach

Once evidence of the difficulty of implementing top down changes was unveiled, a bottom-up approach was pursued. Testing new ideas on a local site and demonstrating their success horizontally and vertically across Powercomp is a common way to propagate new initiatives throughout the company as shown in the Assumed Change Model of Figure 5.1. It is the culturally accepted way of sharing new ideas or practices. For this reason, the bottom-up approach of scaling manufacturing initiatives is highly recommended. When local success is achieved, one of the biggest challenges is to properly advertise or market the "wins" and demonstrate how the new ideas can be transferred to other companies. If this communication is successful, pull will be achieved from other companies, and the desired change model will be achieved.

The bottom-up approach makes sense based on the analysis of change management in decentralised companies, and the finding that non-traditional change may be easier to facilitate. Both the Co-operative and Collective execution plans can be classified as bottom-up initiatives, and they can be characterised as non-traditional change for the following reasons:

First, scaling manufacturing initiatives from the "bottom-up" means that a high-level manufacturing leader is not required. Rather than being driven from the top down, results would be reached on an increasingly larger scale until higher level leaders (BU or BA managers) would start to "pull" projects.

Second, the scope of changes would be incremental rather than radical. The scaling approach is to gradually incorporate more factories over time, which fits with the assumption that radical change in a decentralised company is more difficult to co-ordinate. Co-ordination would be complex due to a large variety of subcultures, cumbersome communication processes, and unique internal and external business conditions for each profit centre.

Third, the bottom-up approach uses an "emergent" change process. Since change management is dependent on culture, the implementation plan cannot be formed without proper knowledge of local environment, norms, pace of change and stakeholders for leader and agent selection. In a decentralised company, with its diverse sub-cultures, it is more logical to allow the change process to "emerge" throughout the implementation. In this fashion, each business group can be accommodated to capture the

particular needs of their local environment and culture. Planning the change process for a decentralised company would be very difficult to do, and the result could end up being too vague to be practical.

Finally, the fluidity of the change (continuous versus discontinuous) actually takes on both extremes. At the local level, the change is discontinuous by the nature of the Agile Manufacturing project. One of the ideals of the Agile Manufacturing initiative is that teams should be formed to create "breakthrough" improvements that were considered outside of normal continuous improvement activities. On the higher level however, change was seen as continuous. As each new group or level became involved in the Agile Manufacturing project, the knowledge of the Agile Team would grow, and the project would be adapted to the new learnings before being applied to the next area.

6.10 Summary

Steps for execution and an execution model have been introduced in this chapter. High-level or low-level leaders can drive each step in execution, and the amount of interaction between factories within a company also varies in each step.

This chapter illustrates a method for estimating the relative success of a particular implementation plan for a manufacturing initiative in a decentralised company. Based on the criteria of ease of implementation, potential for success, and minimal resources employed, it was shown that implementation plans that score high in one area would likely not score as high in another area.

Finally, it was shown that top-down manufacturing initiatives are difficult in a decentralised structure unless manufacturing is one of the functions represented at the corporate level. Based on these findings, it was concluded that Co-operative and Collective execution plans are more appropriate for a decentralised company.

It should be emphasised that all execution plans offer equal likelihood for success, and should only be used as a guide for judging the most appropriate type of execution under a given culture and structure. The Co-operative execution style appears to be an efficient method for large-scale change in a decentralised company if the structure and culture allow knowledge transfer amongst factories. Otherwise, the Collective execution style is recommended for large scale manufacturing initiatives in a decentralised company.

CHAPTER 7: Production Portal and Development Platform

7.1 Introduction

To accommodate the findings of manufacturing initiatives in decentralised companies, and the challenges of the Agile Manufacturing project, a new tool is being proposed for Powercomp to improve its overall manufacturing performance. This new tool, called the Production Portal attempts to provide information to a broader set of users in two ways. First, it will be web-based, and second, it has a wider set of tools to address the various capabilities, demand environments and manufacturing priorities of companies. Within the Portal lies the Manufacturing Development Platform, which links strategic priorities to specific process development tools. This chapter describes the Portal and the Platform, and the tools included in them.

7.2 Justification for a New Initiative

In previous sections, it was shown why it is difficult to drive high-level manufacturing initiatives in a decentralised company, and why top-down initiatives are not feasible. In this environment, even the change process itself is difficult to co-ordinate because of differences between high-level and low-level change properties. The autonomous nature of factories in a decentralised company may require tailored guidance for manufacturing initiatives. This individuality leads to execution styles that were termed Collective or Co-operative in the Execution Matrix.

Consulting has been a successful way to provide this autonomous, personalised treatment. Consulting is a Collective execution model where PTO or CRC is responsible for strategy and/or execution planning either after the factory has identified the trigger or by using root cause analysis to find the trigger together. The factory itself is usually responsible for implementation. On the down side though, some factories would rather solve challenges independent of consultants, and the scale and scope of consulting is limited. So the Manufacturing Technologies group needed a way to provide personalised problem solving and direction without using the consulting model. The Co-operative model would require companies to learn from one another rather than from relying on PTO or CRC consultants.

The Agile Manufacturing project was studied to determine how large scale manufacturing initiatives could be executed on a larger scale. It was found that initiatives based on a single trigger, strategy or execution plan would be limited due to the wide range of current capabilities, future vision, local structure and manufacturing priorities in factories. The Agile Manufacturing initiative provided high-level strategy and execution plans, but historically Powercomp factories have developed their own strategy and followed their own execution plans. Existing culture and structure make it difficult to execute Collaborative or Directed initiatives.

An additional point of difficulty for the Agile Manufacturing project is that not all factories are capable of immediately implementing such a complex tool, and not all operating environments are suited to an Agile Manufacturing solution. On a high level, the three criteria that should be present for an Agile Manufacturing project to be considered and implemented are: a volatile demand environment, management that is capable of using complex manufacturing tools, and leaders willing to adopt a new vision and strategy for their factory.

Based on these difficulties, the Manufacturing Technologies team began searching for a new solution. The goals were to enable Powercomp-wide improvements of manufacturing, to communicate Manufacturing Technology's visions of Agile Manufacturing and E-Manufacturing and to deploy these ideas with minimal resources and time. Remembering the Execution Matrix, the team wanted to

encourage Collective execution where all factories have the appropriate tools and motivation to make appropriate improvements in their manufacturing processes. A secondary goal would be to enable communication or knowledge transfer amongst factories and to facilitate a more Co-operative execution model.

7.3 Production Portal

A Powercomp Intranet "Production Portal" is recommended as a single point information source for production leaders throughout Powercomp. The Portal can help support "Collective" execution of manufacturing initiatives by providing resources and tools for a wide range of capabilities, issues and goals. With respect to Powercomp's accepted change model, the Portal acts as the communication hub to share success stories to motivate others to change.

If production leaders are encouraged to input information into the Portal, the execution model of Powercomp's manufacturing improvements may shift from Collective to Co-operative. For the execution style to become Co-operative however, production leaders need to be willing to teach to and learn from other production leaders throughout Powercomp. The shift from Collective to Co-operative would be effective since it is a better use of resources throughout the organisation. It would be a difficult shift however due to the difficulty in communicating across companies in a decentralised structure, and since knowledge sharing between factories is uncommon today.

The Portal can be built with stand-alone "modules" to offer a suite of information that is useful to production leaders. In this way the Portal can be scaled to test its application and usefulness over time, and reduce the initial risk and investment. The key to releasing new modules will be based on the success of previous models and the marketing and communication of new modules. The recommended first stage of modules to include is the Powercomp Production Profile, Strategy Assessment, Tool Selection, Tool Detail, and "Quick Info".

7.3.1 Production Profile Module

The Powercomp Production Profile contains high level information about manufacturing in Powercomp, including current initiatives, targets, and performance averages by BA, segment or other relevant groups. Basic information from each factory (key activities, core competencies, key production contacts) will also be available. Links to case studies according to factory, BA or segment will also be available. This module is important to provide business strategy and structure information to production leaders. It can also include internal and external manufacturing benchmark information.

Improving the collection of and access to information on production will help to create a more Co-operative manufacturing environment. Communication between plants would become less cumbersome if it was easier to see the activities, capabilities, and case studies of other factories. Easier access to contact names of relevant people in production would also facilitate communication.

7.3.2 Strategy Assessment Module

The Strategy Assessment and Tool Selection modules are part of the Manufacturing Development Platform. These two modules are designed to help the factory rethink the strategy and plan the initiative by suggesting particular tools for implementation. They can be used in sequence or independently. The Strategy Assessment Module is described in this section.

Before a factory can start to focus on which tools it wants or needs to develop, it must know what its manufacturing priorities. A web-based tool can not replace the entire manufacturing strategy development

process, and the Strategy Assessment Module should not try to accomplish this task. Instead, it should provide high level questions regarding internal operations, competition and industry to guide the production manager in ranking manufacturing priorities. These high-level on-line tools could be complemented with PTO and CRC strategy consultants for further information, and overall support for manufacturing strategy could be marketed or communicated by Manufacturing Technologies and the Manufacturing Council.

Manufacturing theory suggests the following five priorities: cost, quality, dependability, flexibility and innovation. For the Platform, speed was chosen to replace dependability because it is a more action oriented term and better reflects the focus of many Powercomp factories. Product innovation was not included because the Platform is geared towards manufacturing process development. It is recommended that product development tools be included in a later phase of the Platform. So, the four areas of manufacturing priorities for the initial phase of the Manufacturing Platform are cost, quality, speed and flexibility.

Skinner's (1969) strategy creation model outlined in chapter 4 was modified to acknowledge the roles and responsibilities of Powercomp's production managers, and to consider the amount of business strategy that is communicated to the factory management team. In particular, Skinner's manufacturing strategy development includes the formation of a company level strategy, which generally is not one of the functions of a production manager in Powercomp. The production managers can use the business strategy as a guiding tool or resource, however their ability to influence the business strategy varies from company to company within Powercomp. So for the purposes of the Powercomp Manufacturing Platform, it is assumed that the production managers can use the business strategy, but that they do not have the power to influence it.

To facilitate production managers' integration of existing business strategy into their plans, BA information will be provided in the Powercomp Production Profile Module. Improved access to information regarding Segment and BA targets can help the factory managers to align their targets and strategies with higher-level business strategies.

Based on these modifications and simplifications, steps for Powercomp production managers to prioritise the manufacturing priorities are:

1. Analyse top competitors' strengths, weaknesses and direction to find opportunities or risks in pursuing manufacturing advantages in cost, quality, speed or flexibility.
2. Assess the current capabilities of the factory to establish where gaps or opportunities for development are needed most (consider skills, resources, facilities).
3. Examine company business strategy, and consider whether manufacturing advantages in cost, quality, speed or flexibility will best support higher-level business goals.
4. Study economic and technological trends or constraints in the industry, and consider if cost, quality, speed or flexibility either take advantage of trends or are limited by upcoming constraints.

References and contacts should be given for production managers to create a more detailed and comprehensive manufacturing strategy if they are interested.

7.3.3 Tool Selection Module

The purpose of the Tool Selection Module is to guide production leaders towards a particular set of tools for development. It can be used in conjunction with the Strategy Assessment Module or stand-alone. Tool Selection is accomplished by asking which tools are already in place, then comparing these answers with a "pre-requisite map". The pre-requisite map was developed by considering which basic tools can facilitate the implementation of more complex tools. The comparison between the user's answers and the pre-requisite map will then generate a pictorial for leaders to see which tools may need to be re-considered or implemented. Once the tools have been recommended, the leader can find out more information about the implementation of a specific tool in the Tool Detail Module.

Tools included in the Platform were sorted according to the strategic priorities (cost, quality, speed and flexibility) that they addressed, and then sorted within these priorities according to the level of difficulty to use the tool. Because the platform will be available on the web, tools were selected based on their familiarity and simplicity, as well as for a broad potential application in the majority of Powercomp companies.

Four levels were created to symbolise the historical development of manufacturing capabilities within Powercomp factories.

The most basic level is called "Local", to represent those factories with little or no investment or development over time, who use local raw materials and suppliers, follow local norms for manufacturing capabilities and whose main customers are in local market. These factories are qualified as operating at a very basic level, and could benefit from mapping and measuring key processes and metrics. Mapping and measuring is recommended for factories employees to understand the flow of information, materials, orders, et cetera, throughout the plant.

By mapping a given process, the management team will be more prepared to critically analyse where there is waste in the system, how it could be more efficient, or find "low hanging fruit" for improvement. Measuring performance (such as part quality) will provide benchmark data for managers to monitor improvement when they implement new tools, as well as provide visual cues to how much variance or waste is currently in the system. As the platform is developed and populated with information over time, sample supply chain maps, quality tracking or material flow diagrams can be provided. It should be emphasised that Local companies should establish their manufacturing priorities, and focus on a narrow set of tools to develop basic competencies. As Local level tools become daily habits, more complex tools can be adopted.

"Regional" describes the next level where factories have slowly developed over time, but with few major developments or investments in manufacturing. They factories use regional materials and suppliers, follow regional norms for manufacturing capabilities and its main customers are in the regional market. For this set of users, tools are recommended to address a specific to a given function or process in the factory, and they are relatively straightforward to implement. Teamwork and change management skills learned by implementing these more simple tools will facilitate the implementation of more complex, cross-functional tools.

Within this level, companies should still identify their manufacturing strategy priority, and focus on a narrow set of tools. Specific functional teams (such as a quality team) can undertake specific responsibility for implementation of a tool such as SPC, but the tool should be shared with all relevant employees to be considered effectively implemented.

The third set of tools is for factories, termed "Global", which have made significant efforts to develop and grow manufacturing competencies. These factories likely outsource and purchase from global suppliers, follow best practices for their industry, and can compete for large contracts and orders from around the world. For these factories, recommended tools are cross-functional in nature, and a high-level understanding of factory operations is required. The time frame and resources for implementing these tools is greater, and higher-level understanding of operations and processes are required. Successful implementation of these tools depends on the factories understanding and application of some of the tools at the local and regional level.

Unlike tools at the previous levels, tools within this level can simultaneously support more than one manufacturing strategy priority at a time. Tools at this level have synergies that result in improvements in more than one area at a time. As these tools are applied, the company can start to consider more complex manufacturing strategies, such as hypercompetition, since the company is better prepared to compete on more than one dimension.

Finally, there is the top or "Benchmark" level, where the factory is not only Global but also innovative enough to become leading edge for many industries. At this level, the factory is continually improving and developing manufacturing competencies in an innovative fashion. They creatively manage production to continually be on the leading edge, adapt best practices from other industries, and are considered as the top supplier in their product group. Not only do they compete on a global level, but are considered best in class for manufacturing across many industries.

Tools included in this level require innovation and vision from the factory management team. They do not necessarily have a set of steps to follow for implementation, but rather they rely on a high level understanding of internal processes, external demand and the entire supply chain and value chain. These tools are relatively new and undefined, so there are fewer resources to find with respect to implementation. Web content for these tools will encourage users to dream of ideal systems, but very few "action steps" or deliverables will be included.

7.3.4 Tool Detail Module

The Tool Detail module gives basic steps for understanding and implementing a particular tool. Within Tool Detail, case studies should be included to show successful examples of implementation in other Powercomp factories either by PTO, CRC or production leaders. Also, case studies can include pitfalls to avoid from leaders who have made mistakes but captured key learnings. Basic information can be found on each tool. Questions such as "What is it?", "Why do I do it?", "How do I do it?", and "Where can I find out more?" will be included. The goal of this section is to give a high level understanding of tool's goals, how to implement it, and how to monitor the success of its implementation.

7.3.5 "Quick Info" Module

Quick Info can provide some timesaving information and applications for production managers. This would be a form of providing easy wins and useful tools for factory managers. This may include Return On Asset (ROA) models, information on SAP implementation and so on. The Quick Info Module could also use case studies as in the Tool Detail Module. This module may be less structured than the other modules since it contains a wide range of miscellaneous tools and information. It is a simple way to help reduce PTO or CRC consulting time on simple tools.

7.4 Using the Production Portal

There are two general groups of users for the Production Portal. First, there are those who have a general idea of the type of tool that they would like to implement, but would like some new ideas or resources. For these users, the Portal can be freely navigated so users can look for specific information such as how to implement a tool, or to find a certain definition. The second group of users may not know where to start for manufacturing improvement, and are looking for guidance on creating a strategy and selecting tools for implementation. In that case, the users can follow the Platform's modules (within the portal) to define their manufacturing priorities, select a set of tools for development, research these tools, and find recommended steps for implementation.

The best sequence for these users to follow is first to complete the Strategy Assessment Module, and then the Tool Selection Module. Once the strategy assessment is complete, the strategic priorities of that group will be used as part of the Tool Selection Module. The Tool Selection Module includes an assessment of current tools in place with a series of yes or no questions (found in Appendix 2) With these answers, the system will produce a pictorial representation of the factory's current activities. The following codes will be used:

Green light: No work required on this tool
Factory indicates they are using this tool AND all the pre-requisite tools

Yellow light: Suggest working on this tool
Factory indicates they are not yet using this tool BUT all pre-requisite tools are being used OR Factory indicates they are using this tool BUT not all pre-requisite tools are being used

Red light: Not ready to start working on this tool
Factory indicates they are not yet using this tool AND not all pre-requisite tools are being used

The tools with a yellow light will thus indicate where the factory could focus its efforts next. Users can click on each tool in the pictorial representation to find out more information, including a list of prerequisite tools, which is the same information users would find by navigating to a particular tool through the Tool Detail Module. Once the assessment is completed, the Tool Detail sheets will use these colour codes to show which prerequisite tools are in place, or need work also.

The company should save assessment information for future reference. This information can also be accessed anonymously by the PTO or Manufacturing Technologies to gather feedback on which tools are most often used in Powercomp companies. Similarly, the Tool Detail Module should include an area where users can indicate interest in one-on-one consulting or training in a tool, or if they would be interested in attending a workshop if other factories are interested.

7.5 Building and Marketing the Portal

Manufacturing Technologies role is slightly different in the Portal because it is less focused on leadership than in the Agile Manufacturing project. For the Production Portal, Manufacturing Technologies' role would be to gather information, provide resources, and facilitate co-operation (and knowledge management) amongst Powercomp factories. The focus would be on identifying potential "triggers" in the environment, providing models and resources for factories to rethink their strategy, offering information and contacts for learning about implementation, and communicating the value of manufacturing throughout Powercomp.

The Manufacturing Development Platform can be established in phases to test its acceptance and use, and to add functionality over time. Detailed phase descriptions are found in Appendix 3.

In the first phase of the Manufacturing Development Platform, basic process development tools, manufacturing strategy and the development roadmap will be used. There will be a basic manufacturing vocabulary, and a collection of manufacturing related equations. A basic list of resources should be available for users who are interested in finding out more.

In the next phase, we propose that additional groups within the PTO or CRC add content to the Platform. In particular, the Change Management, Strategy and Knowledge Management teams could add tools, articles and resources as appropriate. A more detailed manufacturing strategy tool could be added as well as some Change Management tools. These tools, which fit in with the Development Roadmap, could become part of a sequence of tools to be used by production managers. Another area to be added is product development tools, and team work or leadership development tools.

Each phase may include a development stage, a testing stage, a launch stage, and an active use stage. During the development stage, the Platform Captain is responsible for collecting and organising data from key consultants in PTO/CRC and users throughout Powercomp. PTO/CRC consultants can use the Platform during the testing stage. At this time any bugs, or suggestions for improvements should be sent to the Platform Captain. Successful use of launch stage requires extensive communications and marketing to the target audience. Finally, the active use stage is a time of evaluation of the tool by seeking feedback from users, and measuring the success of the tools that have been made available.

7.6 Summary

This chapter summarises the proposals for a Production Portal. The main goals of the Portal are to provide easier access to resources, tools and support for production managers from Manufacturing Technologies, PTO/CRC and from other production managers. The Portal should be built in stand-alone modules for easier construction and maintenance. Keys to success for the Portal include relevant information, easy to use interface and marketing and communication of its content to the appropriate users.

CHAPTER 8: Summary of Findings and Recommendations

8.1 Introduction

This chapter summarises the key findings and recommendations from this study of manufacturing initiatives in a decentralised company. The structure of this chapter follows the overall structure of the study that was introduced in Figure 1.1. Key findings and recommendations regarding culture, structure, manufacturing strategy, change management and execution are summarised here. Key recommendations such as the Production Portal and Manufacturing Platform at Powercomp are highlighted to show how they fit with key findings.

8.2 Culture Findings

Culture must be considered to understand the structure and workings of a company and to make appropriate recommendations for change processes. There are several key cultural assumptions that are in place in most decentralised companies. The first assumption is that the diversity of product, markets and technologies in the company is too complex to manage from a central location, which is also based on the assumption that gathering and managing data and information in such a complex environment would be too cumbersome. Also, it is assumed that local managers are capable of running their own business in an efficient manner, and that this independence will provide more motivation than if they were following a central leadership plan.

Observations and analysis of culture can help to predict how change can be made in a company. The level and style of leadership in the company, and the employees' interaction with the leaders provides evidence of how effective top-down change initiatives may be. Similarly, cultural norms may also reveal how much co-operation can be expected between factories or companies. In the decentralised environment, there is little reliance on high-level leaders for day to day activities, and there are few vertical communication channels and reporting structures for production leaders. For this reason, top-down change is challenging in a decentralised environment. Likewise there are few horizontal communication channels and so co-operation between factories is limited.

One of the strongest cultural characteristics of a decentralised company is the abundance and variety of subcultures. Sweeping statements or conclusions regarding the company's culture are difficult to make since culture varies by region, business unit, and company history. Due to these sub-cultures, top-down changes may be successful in pockets of the organisation, and certain groups may be quite willing to participate in knowledge sharing across factories. On the whole however, top-down or high-level change initiatives are difficult to pursue. The cultural assumption is that local leaders will have the knowledge, motivation and resources to analyse their own environment and make the appropriate changes as needed.

8.3 Structure Findings

Leaders dealing with complex business units in a large company choose the decentralised structure to allow speed, flexibility, customer orientation, management of diverse information, and employee motivation. This structure typically has few informal communication networks and flat reporting structures.

As the environment changes, certain operations of the company are integrated into or out of the set of centralised activities. Powercomp selected a common reporting structure for its finance and accounting, but for many years all other operations were decentralised. More recently, the Global Processes team has centralised other activities such as purchasing to take advantage of economies of scale. So far, production

has not been selected as a Global Process, yet decisions of Global Process groups such as the e-commerce team, purchasing and sales teams may impact the way that materials and information flows through factories. Manufacturing Technologies could assist production managers by keeping abreast of changes in Global Processes that may affect factory operations, and act as a representative and communication channel for production leaders throughout Powercomp.

Due to autonomy and variety (of product, process and strategy) found in decentralised companies, a traditional top-down or centralised structure may not be possible. Non-traditional top-down leadership could be achieved by setting up innovative production metrics or by building an effective production network. Year over year improvement or cash flow are suggestions for supporting and monitoring production progress in a decentralised company. Similarly, the high-level production leader in a decentralised company could help build the communication network for a Co-operative production environment by finding and marketing effective practices, product or process best practices and listing top performing change agents and leaders in the company.

8.4 Strategy Findings and Recommendations

Similar to the wide range of capabilities in production, the decentralised structure also allows a range of emphasis on strategy at the local level. If strategy is not communicated as a key tool for success at the local level, and in particular if manufacturing strategy is not seen as a value, then local factory managers may lack the incentive, knowledge and resources necessary to properly plan and implement a manufacturing strategy. Production leaders, particularly those who focus on day to day activities may not understand the importance of a higher level strategy, or feel that they lack the time for researching and forming a strategy. This study has shown academic reasons for valuing a strategy, and tools for strategy development have been included in the Manufacturing Platform.

This study included a new distinction for Hayes and Wheelwright's manufacturing stages. The traditional Stage 4, called Collaborative Stage 4 in this study, requires a high-level manufacturing leader, which in turn means that manufacturing process development would need to be a centralised activity within a decentralised company. A new Collective Stage 4 has been proposed to describe a collection of factories in a decentralised company who each independently qualify as a local Stage 4, but the factories do not collaborate higher than the local level. In the Collective Stage 4 each local manager works with the business manager to align manufacturing initiatives with local business goals, and the business manager values manufacturing as a key activity for sustaining competitive advantage.

A Collective Stage 4 is an appropriate target for a company with considerable product and market diversity. In such a company, high-level manufacturing strategy would be nearly impossible to create due to the complexity of understanding the current capabilities and establishing common future goals. If a BU or even a BA within a decentralised company can find ample commonalties in production activities, market needs and competencies, then the Collaborative Stage 4 could be achieved on a mid-range level within the decentralised company. For this to be true however, each local company would need to understand strategy development and execution process, so the Collective Stage 4 model is an appropriate stepping stone to future collaboration or co-operation.

8.5 Change Management Findings and Recommendations

Change leaders are responsible for planning and overseeing changes in a company, and the change agents carry out the goals of the leader. Within a decentralised company, there are high-level and low-level leaders and agents. The roles at high-level and low-level depend on the type of initiative, and can help to predict the outcome of certain change initiatives in a decentralised company. At the high-level, changes are considered non-traditional because they are generally more effective if they are bottom-up, on an

incremental scope, with continuous change and an emergent change process. At the local level changes are more traditional and reliant on a top-down process, with a radical scope, discontinuous pace and a planned process.

The team tried to motivate high-level leaders to buy in to their ideas, but this was hindered due to lack of commonality at a lower level, difficulties in assessing the present capabilities and building a common theme for future development. To find driving factors that are strong enough to overcome the resistance to change, manufacturing initiatives need to be tailored to the specific issues and capabilities of a particular factory, and higher-level initiatives may too vague to be meaningful for production leaders.

The Portal addresses fears of change management by providing easier access to resources and assists leaders on the learning curve to new manufacturing tools. Users are still responsible for their own assessment of strategy and capabilities, but there are more resources to help them through these processes. Simple implementation steps and case studies from other factories should help to overcome the fear of undertaking manufacturing improvement projects.

8.6 Execution Findings and Recommendations

Execution was segmented in this study into four steps: acknowledge the trigger, rethink the strategy, plan the initiative and implement the initiative. Four terms were created to clarify the mix of high-level leadership and low-level co-operation in change initiatives, and these were Collaborative, Directed, Co-operative and Collective.

Manufacturing Technologies can effectively support factories in Powercomp by identifying upcoming triggers and proposing solutions or best practices to adapt to these triggers. To reach a larger audience, focus should be centred on Powercomp-wide triggers. The wide variety of environments and markets of Powercomp companies means that most of these triggers will be company-wide rather than environmental initiatives. Recent examples of important triggers that effect Powercomp factories are e-commerce targets (i.e. 30% standard products sold on-line) and new financial metrics. Manufacturing Technologies should continue to predict the implications of the triggers on factory operations and propose possible solutions early in their implementation across Powercomp. Other resources can also be used to help understand the triggers rather than relying only on PTO and CRC resources. For the financial metric changes for example, a CFO forum on how to run operations to maximise cash flow could provide valuable insight for production leaders.

Once the trigger is identified, the next step is to rethink the strategy. If strategy planning is not stressed or valued at a high-level in the company, factories may tend to skip this step and jump right into planning the initiative. For effective execution at the low-level, these managers need to see the value of creating strategy and have the necessary resources for researching and analysing their capabilities, and industry and competitor direction. Without a clear strategy, initiatives may lack prioritisation or alignment needed for production to contribute to business goals. Manufacturing Technologies and the proposed Manufacturing Council can work together to communicate the value of creating a clear strategy for manufacturing initiatives. The Manufacturing Platform will help to provide the necessary tools, resource and steps for creating a basic strategy, but some factories will need more support to create a specific strategy for manufacturing development.

Once the strategy is clarified to accommodate the new trigger, the initiative needs to be planned. Different execution scenarios can be examined and the tradeoffs discussed by using metrics such as ease of implementation, potential for results and resources required. Culture and structure should be considered when selecting an implementation plan. This study included a comparison of high-level implementation scenarios, but a similar comparison could be done at the local level. The Portal may ease

the planning step by offering best case examples and simple, high-level implementation steps. Contacts in other factories and within PTO and CRC will also be available.

For execution, this study found that Co-operative and Collective strategies are most appropriate for decentralised companies. High-level leaders are not available as a result of the structure, high-level strategies are not applicable due to the wide range of markets and capabilities and high-level execution plans are not appropriate due to the variety in local cultures and change processes. A Collective execution is more appropriate, but to achieve a large number of participants independently involved in the change initiative, the value of manufacturing improvements needs to be communicated throughout the company. Finally, the Co-operative execution model may be more efficient, but decentralised companies need an efficient production communication network for it to be feasible. If knowledge transfer can be facilitated for example with the Portal at Powercomp, then the Co-operative change model may result in more participation with fewer resources, and result in overall higher profitability for Powercomp.

8.7 Summary

The Collective execution style of manufacturing improvement initiatives is most appropriate for beginning to implement large-scale changes in a decentralised company. Over time, the Co-operative style may offer economies of scale if the structure and culture accepts knowledge transfer between companies. Either the Collective or Co-operative execution styles can help decentralised companies to achieve a Collective Stage 4 Manufacturing Strategy.

The Manufacturing Development Platform was recommended to guide local production leaders to plan and implement a Stage 4 Manufacturing strategy at the local level. The Platform will be housed in the proposed Production Portal that will also facilitate knowledge transfer between factories. Increased knowledge transfer will shift the entire execution from the Collective to the Co-operative style.

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Appendices

Appendix 1: Scoring Sections, Scenario Definitions and Scores

Details of the scoring sections are based on the relevant theory, then used as categories for consideration in the excel spreadsheet which follows.

Scoring Sections:

1. Ease of Implementation

Leader
Source: Adapted from Beckhard and Harris (1987), Kotter (1995)
Categories:
- Easy to find and identify who the change leader should be
- Easy to engage this person into accepting change leader position
- Identified leader has sufficient and appropriate knowledge
- Identified leader has sufficient and appropriate power
- Identified leader recognizes and adopts change as their responsibility (motivated to act)
- Factory teams are accountable to this leader

Urgency
Source: Adapted from Kotter (1995), Schein (1999)
Categories:
- Audience can identify the need to change due to actual risk, potential risk, or new opportunity
- Audience will accept and be motivated to act upon this urgency
- Audience understands the limited amount of time to act and the risks/losses of not acting

Vision
Source: Adapted from Kotter (1995)
Categories:
- Common goals and visions exists between the potential members
- Common expectations of how to proceed or reach goal exists between members
- Buy-in to vision at local level can be easily accomplished

Communication
Source: Adapted from Schein (1999)
Categories:
- Efficient channel exists for communicating and organizing activities
- Clear channel (people understand one another) exists for communicating
- People are accustomed to speaking openly through this channel

Fit with Company
Categories:
- Fit with existing culture (high-level)
- Fit with existing structure (high-level)
- Fit with existing culture (low-level)
- Fit with existing structure (low-level)

Follow-through
Categories:
- Leaders can easily track progress (regular reporting, open sharing of challenges)

- Leaders can easily track results (identify appropriate metrics, receive updates and results)
- Teams are motivated to continue after the kick-off stage
- Teams can easily be supported later by leader if required

Change Agents
Source: Adapted from Beckhard and Harris (1987)
Categories:
- Easy to find and identify who the change agent(s) should be
- Easy to engage this person/these persons into accepting change agent position(s)
- Identified agent(s) has sufficient and appropriate knowledge
- Identified agent(s) has sufficient and appropriate power
- Identified agent(s) recognizes and adopts change as their responsibility (motivated to act)
- Factory teams are accountable to this agent(s)

2. Potential for Results

Scale
Source: Powercomp Goals for Agile Manufacturing project
Categories:
- Potential for impact on a large number of factories in the organisation

Scope
Source: Powercomp Goals for Agile Manufacturing project
Categories:
- Potential for impact on broad range of countries
- Potential for impact on broad range of business groups
- Potential for impact on broad range of factory types

Priority
Source: N/A
Categories:
- Able to proceed in the most logical manner for that particular initiative (for example, able to identify and target the lowest performers first)

Speed
Source: Powercomp Goals for Agile Manufacturing project
Categories:
- Able to achieve scope quickly after kick-off of manufacturing initiative
- Able to achieve scale quickly after kick-off of manufacturing initiative
- Minimal planning between decision of initiative and actual kick-off

3. Resources Required

High level team resources (as appropriate for implementation scenario)
- Minimal team resources required to support implementation

Factory level team resources
- Minimal factory level resources required to support implementation

Scenario Definitions

Consulting Scenarios

Traditional Consulting
- Factory managers independently approach the CRC and PTO consulting
- Factory manager already has a defined problem to solve or goal to meet

Agile Champion
- Higher level (BU or BA manager, high-level production manager) champion hires PTO consultants to improve Agility of a plant
- May not be a clear problem to solve nor goal to meet (or champion may not properly understand the local issues or goals)
- Local support of consulting project or Agile Manufacturing is uncertain

Funding Approval
- Use Agile Diagnostic tool to validate initiatives in a plant, use to approve higher level funding of factory-led initiatives
- Agile consulting team performs diagnostics, recommends tools/initiatives, and then either continues with implementation or steps back to allow factory to work independently
- Create the Agile "Stamp of Approval" for funding on plant led projects

BA Consulting
- Manufacturing consultants hired as full time employees of BA staff
- Dedicated resources to leading manufacturing initiatives in factories
- BA could tailor their specific Agile vision, goals and metrics as appropriate

Workshop Scenarios

Common BAs/BUs
- Agile workshops directed at all factories within a BA or BU
- Interactive workshops to share ideas on possible Agile Projects in BA
- Address specific issues/ideas common to the industry or products of that BA

Common Factories
- Agile workshops directed at factories with common production attributes
- Share ideas on possible Agile Projects for those production attributes
- Address specific issues/ideas common to that type of production

Common Issues
- Agile workshops directed at Agile solutions for a common issue in factories
- Interactive workshops to share ideas on how Agility can help address this issue
- Provide training or testimonials to help production managers solve this issue

Structural Change Scenarios

"Agile Agents" in BAs
- Full-time employees are hired in BA to lead Agile Projects in BA's factories
- Factory production managers are accountable to Agile Agent
- Agile Agents are supported by CRC Agile Manufacturing team

COO in Segments
- Production segments hire a Chief Operating Officer
- COO sets expectations for productivity of factories in that segment
- Factory production managers are accountable to COO

"Passive Scenarios"

Annual Meetings

- Establish annual meetings by country or BA to discuss production projects
- Certain topics for meetings guided by CRC (Agility, E-Business, etc.)

Hands-Off

- Provide on-line tools for managers to learn Agile Manufacturing at their own pace
- Diagnostics and action plans can be completed independently

Scenario Scoring – Ease of Implementation Data

Ease of Implementation

3 = True, 2 = Somewhat, 1 = False

		Consulting Alternatives						Workshop Alternatives			Other Alternatives		
	Scenario	Change Champion	Funding Approval	Traditional	Within BAs	Common BA/BU	Common Factories	Common Issues	Change Agents in Bas	Annual Mfg Meetings	COO in Segments	Hands-off Activities	
	Leader:	Champion	Budget Ld	Factory Mgr	Factory Mgr	BA Prod Ld	-	BA Mgr	Agile Agent	-	COO	Factory Mgr	AVG:
Leader	Identify	3	2	3	3	2	1	3	3	1	3	3	2.5
	Engage	3	2	3	3	2	1	2	3	1	3	1	2.2
	Knowledge	2	2	3	2	2	1	2	2	2	2	3	2.1
	Power	2	3	3	3	2	1	3	3	3	3	3	2.6
	Motivated	3	2	3	3	3	3	3	3	2	3	1	2.6
	Account	3	3	3	3	2	1	3	3	1	3	1	2.4
	Total	89%	78%	100%	94%	72%	44%	89%	94%	56%	94%	67%	80%
Urgency	Identify	3	1	3	3	2	1	3	2	1	2	1	2.0
	Accept	2	1	3	3	2	1	3	1	1	1	1	1.7
	Lim. Time	1	3	3	3	1	1	3	1	1	1	1	1.7
	Total	67%	56%	100%	100%	56%	33%	100%	44%	33%	44%	33%	61%
Vision	Goals	3	2	3	3	1	3	3	2	1	2	1	2.2
	Expect	2	2	3	3	1	2	3	2	1	2	1	2.0
	Buy-In	2	2	3	3	1	2	2	2	1	1	1	1.8
	Total	78%	67%	100%	100%	33%	78%	89%	67%	33%	56%	33%	67%
Commun.	Efficient	2	3	3	3	3	1	2	3	3	2	1	2.4
	Clear	2	2	3	3	2	1	2	3	3	2	1	2.2
	Openness	1	1	3	3	2	2	2	2	2	2	2	2.0
	Total	56%	67%	100%	100%	78%	44%	67%	89%	89%	67%	44%	73%
ABB Fit	Hi Cult	2	2	3	2	2	2	2	0	1	0	3	1.7
	Hi Struct	3	3	3	2	3	3	3	0	3	0	3	2.4
	Lo Cult	2	2	2	2	2	2	2	0	2	0	3	1.7
	Lo Struct	3	3	3	2	3	3	3	0	3	0	3	2.4
	Total	83%	83%	92%	67%	83%	83%	83%	0%	75%	0%	100%	68%
Follow-thru	Progress	3	1	3	2	1	1	2	2	1	1	1	1.6
	Results	3	1	3	3	2	2	3	3	1	2	1	2.2
	Motivate	2	2	3	3	1	1	3	3	1	2	2	2.1
	Support	3	3	3	3	2	2	2	3	1	2	1	2.3
	Total	92%	58%	100%	92%	50%	50%	83%	92%	33%	58%	42%	68%
ChangeAgent	Identify	2	2	3	3	2	2	2	3	1	2	1	2.1
	Engage	2	2	3	2	2	2	3	2	2	2	1	2.1
	Knowledge	3	3	3	3	3	3	3	3	2	3	3	2.9
	Empower	3	3	3	3	3	3	3	3	2	3	3	2.9
	Motivate	2	2	3	2	2	2	3	2	2	2	1	2.1
	Total	80%	80%	100%	87%	80%	80%	93%	87%	60%	80%	60%	81%

Ease of Implementation

3 = True, 2 = Somewhat, 1 = False

		Consulting Alternatives						Workshop Alternatives			Other Alternatives		
	Scenario	Change Champion	Funding Approval	Traditional	Within BAs	Common BA/BU	Common Factories	Common Issues	Change Agents in Bas	Annual Mfg Meetings	COO in Segments	Hands-off Activities	
	Leader:	Champion	Budget Ld	Factory Mgr	Factory Mgr	BA Prod Ld	-	BA Mgr	Agile Agent	-	COO	Factory Mgr	AVG:
Scale	**Total**	33%	33%	33%	67%	67%	67%	67%	100%	100%	100%	100%	70%
Scope	Country	2	1	2	2	3	3	3	3	3	3	3	2.5
	BA	1	1	2	3	2	2	2	3	3	3	3	2.3
	Plant Type	1	1	2	2	2	2	2	3	3	3	3	2.2
	Total	44%	33%	67%	78%	78%	78%	78%	100%	100%	100%	100%	78%
Priority	**Total**	100%	67%	33%	67%	67%	33%	100%	100%	33%	100%	33%	67%
Speed	Scope	1	1	1	2	3	3	3	3	3	3	3	2.4
	Scale	2	2	1	2	2	2	2	3	3	3	3	2.3
	Planning	3	3	3	2	2	2	2	1	2	1	2	2.1
	Total	67%	67%	56%	67%	78%	78%	78%	78%	89%	78%	89%	75%
Sum	**Total**	2.44	2.00	1.89	2.78	2.89	2.56	3.22	3.78	3.22	3.78	3.22	2.89
	Average	61%	50%	47%	69%	72%	64%	81%	94%	81%	94%	81%	72%

Appendix 2: Tool Selection Questionnaire

The following list of questions was proposed to use in factories as a high-level look at which manufacturing improvement tools are currently being used. The questions are in a simple yes or no format, and the questionnaire should take less than five minutes to complete. The answers would be fed into the Manufacturing Portal to subscribe a suggested list of manufacturing improvement tools to pursue.

Platform Assessment Questions

Do you know…	YES	NO
Cost breakdown of products by labour, material and capital use?		
Cost of quality (rework, scrap, field maintenance)?		
How to find the true "root cause" of problems, and not just "quick fixes"?		
All the steps (information, material, people) in supply chain process?		
All the steps (information, material, people) in value chain process?		
How to find the "bottleneck" in your operations?		
How material flows throughout your operations?		
How information flows throughout your operations?		
Details of product mix in your factory (volume, frequency, routing)?		
Have you been tracking/measuring…		
Waste in system?		
Equipment performance (down time, efficiency, maintenance)?		
Delivery performance (on time performance, order correctness)?		
Change over times between products (tool and process changes, set up times)?		
Have you applied low-level "tools" to simplify and control your process?		
Are you using visual systems to…		
Help all employees track factory performance?		
Maintain cleanliness and order in your factory (5S)?		
Replenish supplies with a Kanban system?		
Have your factory employees been trained in relevant areas…		
Has the "Beer Game" ever been played by your supply management team?		
Have your process owners played the "Process Samba" game?		
Does more than half of your operators understand Statistical Process Control methods?		
Is there a defined maintenance program for critical machines?		
Have change times been reduced to allow greater product variety?		
How are you controlling your processes…		
Do you schedule your factory by actual orders (i.e. forecasts not used)?		
Have excessive material movements or data entry been eliminated from your systems?		
If the bottleneck was identified, is it managed so that it is always at capacity?		
Are your products based on modular configurations?		
Are simulations used to test new ideas or optimise processes?		
Are you using tools that require cross-functional teamwork and high-level planning?		
Are you following Just In Time (JIT) supply chain processes?		
Do you source materials from around the globe to use in production?		
Are you outsourcing non-value-added activities?		

Have parts been designed with ease of manufacturing and assembly in mind (DFMA)?
Is Total Quality Management (TQM) implemented in your factory?
Are quality issues resolved with Failure Modes, Effects and Analysis (FMEA)?
Has electronic data been adopted and implemented throughout your processes?
Is Theory Of Constraints (TOC) flow used to govern your factory scheduling?
Have your supply chain employees played the RPS game?
Are flexible manufacturing concepts applied to allow greater product variability?
Are lot sizes as small as possible, and approaching one-piece?

Have you been innovative and applied high-level tools for excellence in manufacturing…
Are you using Lean Manufacturing principles?
Do you apply an Agile Manufacturing mentality?
Is 6-Sigma used to ensure the highest possible level of quality?
Have you taken advantage of e-Manufacturing solutions?

Appendix 3: Platform Development Recommendations

A. Manufacturing Development Platform

The key findings of the Agile Manufacturing Implementation project indicated that a broader set of tools applying to a wider range of environments and capabilities may be useful. The "Manufacturing Development Platform" is an assessment of current capabilities to recommend which manufacturing development tools best suit that factory's development needs. It has been designed to meet the spectrum of needs of Powercomp factories globally. The emphasis of the platform is to aid factory managers at any level to specify their manufacturing priority (cost, quality, speed or flexibility), and to recommend manufacturing development tools that will help the factory to achieve those goals.

Four levels of Manufacturing Development Tools are included in the platform, and they are roughly grouped according to the manufacturing priorities listed above. At the most basic level, mapping and measuring of key processes and metrics are found. The next set of tools is specific to a given function or process in the factory, and is relatively straightforward. The third set of tools is cross-functional in nature, and a high-level understanding of factory operations is required. Finally, at the benchmark level, tools require innovation and vision from the factory management team. In addition to these tools, manufacturing definitions, ratios and equations will be provided to build a common vocabulary of production metrics for factory leaders.

B. Production Portal

An Powercomp Intranet "Portal" is being recommended to act as a single point information source for Production Leaders throughout Powercomp. Stand-alone "modules" will be developed to go into the portal to offer the suite of information that we believe is useful and meaningful to Powercomp factories. These modules include:

a. Strategy Assessment – assessment and guidance for identifying and prioritising areas of manufacturing strategy. The output from the assessment can be used alone, and can also be used in the Tool Selection module.
b. Platform Tool Selection – assessment and guidance for identifying which manufacturing development tools are best suited to the factory's needs and current capabilities. The Strategy Assessment module can be used as input for the tool selection. Once tools are recommended to a production leader, the production leader can go to the Platform Tool Detail module to find specific information on these tools
c. Platform Tool Detail – basic information on what each tool is used for, how it helps to improve manufacturing, and high level implementation steps. Links will be provided to find additional information on the web, a short list of recommended books, contacts in PTO, CRC and Powercomp, and finally case studies and key learnings from other Powercomp managers who have used this tool
d. Powercomp Production Profile – high level information about manufacturing in Powercomp, including current initiatives, targets, and performance averages by BA, segment or other relevant groups. Basic information from each factory (key activities, core competencies, key production contacts) will also be available. Links to case studies according to factory, BA or segment will also be available
e. "Quick Info" – miscellaneous tools and information that would be useful for Powercomp managers including ROA or ROI models, information on Free Cash Flow, SAP implementation and so on.
f. Search – allows users to search for information on a particular tool, initiative or Powercomp group. Search will return all relevant links to information, contacts, and case studies within the portal.

Recommended phases for the portal's development are included in the Portal Proposal in Part C, and a "Portal Captain" job description is included in Part D. Marketing the Portal and measuring its' success will be difficult, and recommendations can be found in Part E. One of the advantages of the Portal is that information regarding manufacturing priorities, development tool capabilities, and interest levels in various tools can be anonymously gathered and used by the Manufacturing Technologies group.

The Portal Captain and his team should ensure that CRC Knowledge Management, Change Management and Strategy teams are involved in future development. In addition to being a useful tool for Powercomp factories, the Portal can also provide knowledge sharing amongst various teams in CRC and Powercomp. Users of the platform should be able to express interest in a particular tool online. Workshops or training sessions could be developed for those tools with significant interest.

C. Portal Proposal

Goals of the Manufacturing Development Portal:

- Deliver complete set of information for factory managers to select and implement manufacturing development tools
- Increase knowledge transfer in Powercomp regarding manufacturing process improvement
- Reflect the diversity of skills, resources and plans of Manufacturing Technologies and Powercomp production managers
- Supply information to PTO regarding skills, goals and interests of Powercomp factories

Project Description:

General manufacturing tools, definitions, contacts, case studies and equations will be collected and submitted to an Powercomp internal web page by one Portal Captain. To do this, each manufacturing development tool will have a "Tool Owner", normally within PTO and CRC. These Tool Owners will be responsible for submitting content, acting as a key contact for questions, and developing training or workshop material if sufficient interest exists.

Manufacturing development tools should be placed on the web in a short and simple one-page format. Factory managers of *any* level should be able to understand tools' purpose, and learn some high level steps for implementing the tool. One page Powercomp case studies will show how tools were used, what the challenges were, what level of results were achieved from using the tool, and further contact information. Case studies will be submitted to the Portal Captain to ensure high quality, easy to understand cases that are stored in the proper location.

The Production Portal can originally be used and tested by PTO consultants. Later, the tool will be available to all Powercomp production leaders. Marketing and discussing the Portal with production managers will be important to judge the usefulness of the tool. PTO tool owner's contact information should be easy to find for factory managers to contact for further information. In this respect, the Portal is also a marketing tool for PTO's expertise, and helps to gather information for training or workshop needs.

Proposed Roll-Out:

A Production Portal "Captain" will be the key person responsible for its' development and deployment (see Part D). The following phases are proposed:

Phase 1: Manufacturing process improvement information, tools and case studies

Stage 1 (6 months)
- gather necessary web content from PTO consultants
- build, test and integrate modules
- find links, books, contacts, and Powercomp case studies
- build and test web functionality, integrate modules

Stage 2 (2 months)
- site tested by PTO consultants in Powercomp projects
- plan marketing and communications for platform

Stage 3 (2 months)
- launch platform to entire Powercomp manufacturing community
- advertise, communicate and market platform to managers

Phase 2:
- add content (change management, product development) depending on interest
- gather feedback from factory managers to understand usefulness of tool
- organise further training (workshops, online tools) for most useful areas

D. Portal Captain Job Description and Tasks

The Production Portal Captain is responsible for communicating with PTO consultants and Powercomp production teams to build and maintain the web-based Portal. It is an exciting, multi-dimensional role including manufacturing, marketing, Internet development and knowledge management.

Platform Building

- recruit "tool owners", gather content, edit content for clarity, simplicity and usefulness
- work with knowledge management team to plan case study collection and sharing
- work with web developers to organise web content links, layout and flow
- review books and web sites to select the most appropriate references

Platform Marketing

- prepare marketing material (articles, posters, etc.) to generate interest in portal
- train PTO consultants on how to build content and use portal with Powercomp managers
- collect feedback from consultants and managers on how to improve the portal
- maintain communications with other Powercomp teams to share web development plans and technology (i.e. change management web sites)

Required Skills:

- excellent verbal and written English skills, other languages useful
- high-level understanding of manufacturing development tools and vocabulary
- pro-active nature - able to find, contact and communicate with a wide range of employees
- excellent project management habits (scheduling, running workshops, planning and evaluating feedback)
- ability to create long term vision and schedule for the portal's development
- ability to co-ordinate and manage relationships with many international teams and contacts
- willing to travel internationally
- creativity to develop, advertise and market portal

- professional nature, able to communicate with wide range of teams and contacts
- basic understanding of web page development, databases and spreadsheets

E. Portal Marketing and Measurement Plans

For successful use of the Portal, sufficient marketing and advertising are required. Later, the effectiveness of the Portal will also be an important process.

Portal Marketing

- PTO consultants can be recruited as "tool owners". As such, they are the key contacts for providing contact and case studies, and can answer questions from production managers.
- The platform will originally be marketed to PTO consultants. Benefits to consultants include a format for high-level discussions about current production activities, and also to provide the production managers with a "map" of how they can develop manufacturing outside of the consulting project.
- Marketing to production managers is most important. Production managers should be aware that the Portal can help them identify a sequence of development tools, and will also provide a high-level implementation guide and further resources on the required tools. Marketing can include Powercomp web site articles, discussions with high-level managers, special material (posters, books, etc.)
- High-level business leaders can help to market this material, so their buy-in is important
- The Knowledge Management team has experience in marketing case studies and best practices. They should be contacted for information on how to gather case study information, including how to eliminate fears that production managers may have about sharing information.

Platform Measurement

- Effectiveness can be measured by the number of managers that complete the assessment, followed by determining how many managers are implementing the recommended tools.
- Consulting engagements that are kicked-off as a result of the assessment should be captured as positive evidence of the Platform's usefulness to the PTO
- One-day workshops can be developed and "sold" on-line in the future
- Monitor number of "hits" to site
- Interview users to provide more detailed feedback