Cranfield University

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An Investigation of the Factors Affecting Successful Sales and Operations Planning Activities in the UK

SCHOOL OF INDUSTRIAL AND MANUFACTURING SCIENCE

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ABSTRACT

With the advantages of globalisation and global sourcing, UK businesses have to manage longer, more complex, supply chains whilst facing increased competitive pressures. Such an environment has lead to a renaissance in Sales and Operations Planning (S&OP). S&OP is a decision-making process concerned with aligning the capacity of organisations with market demand whilst integrating the process with business strategy.

LCP Consulting, a leading specialist in customer-driven supply chain management, has recognised that companies formally implement some level of S&OP but for reasons unknown the process is often not sustained and the full benefits are not realised. Therefore, this research investigated and identified the principal factors that enable and inhibit the successful execution of S&OP.

The research first analysed literature to enable a four-phase S&OP model to be constructed that depicts the typical evolution of an S&OP initiative. Through a quantitative survey of 26 companies in the aerospace, automotive, and pharmaceutical sectors, twelve influential factors grouped into three categories: behavioural, technological and organisational, were identified. Their level of impact on each phase of the S&OP initiative was subsequently quantified. From conducting structured interviews, the varying levels of success and maturity for seventeen key S&OP activities were detailed. Finally the research findings and analysis were consolidated into a simple, practical tool that enables users to understand how to improve the success and sustainability of an S&OP initiative.

The conclusion of the research states that a good understanding of the process, committed top-level management, holistic performance measures, and data that is accurate, timely and pertinent, are the key factors that help ensure successful S&OP. Organisational complexity was found to inhibit successful S&OP, and aligning people's behaviours to the values of S&OP was found to be the hardest issue to address when embarking on an S&OP initiative.

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GLOSSARY OF TERMS

CSL – Customer Service Level

ERP – Enterprise Resource Planning

IT – Information Technology

JIT – Just In Time

KPI – Key Performance Indicator

MES – Manufacturing Execution System

MRPII - Manufacturing Resource Planning

MRP – Material Requirements Planning

MTO – Make-To-Order

MTS – Make-To-Stock

NPI – New Product Introduction

ROI – Return On Investment

S&OP – Sales and Operation Planning

SKU – Stock Keeping Unit

Chapter 1: INTRODUCTION

This chapter introduces the problem that gave rise to the research, summarises the aim and objectives, outlines the programme, and explains the structure of the thesis.

1.1 Overview of industrial problem

"The world market for manufactured goods is growing, and will continue to grow, but manufacturing globally is undergoing rapid change. The industrialised countries of Western Europe and North America face increasing competition from lower cost, increasingly sophisticated producers around the world. The UK must respond positively to the challenge of global change" (Department of Trade and Industry, 2004).

UK businesses keen to remain competitive, move up the value chain, and survive, have been quick to integrate waste-eliminating and value-adding principles whilst taking advantage of global sourcing. With these benefits come greater complexities in supply chain management and accelerating change. Stahl (2005) describes that with more complex and responsive supply chains having to evolve, better communication tools should be sought. Similarly, Ling (2001) agrees that industry is moving rapidly to a new model where competitive pressures, shorter product lifecycles, higher customer and market expectations, margin erosion and cost containment are driving businesses to become more responsive to market conditions.

Such an environment has lead to a renaissance in Sales and Operations Planning (S&OP). Competent S&OP is a decision making process concerned with aligning the capacity of organisations with market demand whilst integrating the process with business strategy. Inevitably tensions arise within organisations between those responsible for generating demand, who expect infinite capacity; and those responsible for managing supply, who have to contend with constraints. Reliable S&OP is about developing a process, and creating forums to enable business decisions to be made based on accurate data (Renshaw, 2006). Many companies formally implement some level of S&OP. In many instances however the full potential benefits of an S&OP

process are not realised or sustained; sometimes because a sound process becomes misused over time, and sometimes because the basic process is poorly implemented.

The sponsoring company, LCP Consulting, a leading specialist in customer-driven supply chain management, recognised the need to investigate the factors that enable and inhibit successful S&OP, thereby equipping itself to better serve its clients' needs and strengthen potential business opportunities.

1.2 Aim, objectives and summary of programme

The aim of the thesis was to investigate and identify the principal factors that enable and inhibit the successful execution of S&OP in the UK.

To realise this aim the specific objectives of the thesis were:

1. To define key terms relating to S&OP.
2. To identify key success factors.
3. To extract and quantify the issues that companies face with regard to their S&OP process.
4. To understand how to improve the success and sustainability of an S&OP process.

To achieve these objectives, a programme of four stages were designed:

> *Stage 1: Initial analysis of literature*. The purpose of this stage was to define the key terminology used to describe S&OP activities and to start to relate key influential factors to these activities. The method used to accomplish this stage was to consolidate and amalgamate findings from the literature review performed in Chapter 2. The deliverables of this stage were firstly a framework that the evolution of an S&OP initiative can be based upon, and secondly a documented list of initial factors that correspond to this framework.

Stage 2: Quantitative extraction and assessment of S&OP process issues. The purpose of this stage was to extract from industry the issues that are faced regarding S&OP and to subsequently quantify how much they impact on S&OP activities. The method used to accomplish this stage was through the execution of an industrial survey. The deliverables of this stage was firstly, a set of substantiated influential factors showing their associated impact on different phases of the S&OP initiative, and secondly, a collection of trends and characteristics that relate to real-life S&OP processes.

Stage 3: Qualitative extraction and assessment of S&OP process issues. The purpose of this stage was to further examine S&OP process issues and gauge levels of process success and maturity. The method used to accomplish this stage was to execute a series of industrial interviews. The deliverables of this stage were a series of case reports that provide an understanding of the different levels of process success and maturity.

Stage 4: Formulation of a method to improve an S&OP process. The purpose of this stage was to understand how improve the success and sustainability of existing S&OP processes. The method used to reach this consisted of analysing the results extracted from industry and relating S&OP activities and their influential factors to the level of success and maturity of an S&OP initiative. The deliverable of this stage was an improvement tool with visible links to influential factors, key characteristics, and improvement opportunities.

1.3 Structure of thesis

The thesis is structured into seven further chapters:

Chapter 2: LITERATURE REVIEW

This chapter reviews and critiques published work that has been carried out in the area of S&OP with a view to identifying areas that have not been explored thus justifying the need for this research thesis.

Chapter 3: RESEARCH AIM AND PROGRAMME

This chapter explains the research problem before stating the aim and supporting objectives used to accomplish it. The scope of work will be defined before describing each of the programme's four stages and deliverables.

Chapter 4: INITIAL ANALYSIS OF LITERATURE

This chapter describes Stage 1 of the research programme, which defines the key terminology used to describe S&OP and to begins to relate key influential factors to the process.

Chapter 5: DATA GATHERING AND ANALYSIS OF QUESTIONNAIRE

This chapter describes Stage 2 of the research programme, which extracts from industry the issues that are faced regarding S&OP and goes on to quantify how much they impact on the success of S&OP activities.

Chapter 6: DATA GATHERING AND ANALYSIS OF INTERVIEWS

This chapter details the Stage 3 of the research programme, which further examines S&OP process issues and gauges levels of process success and maturity.

Chapter 7: DESIGN OF AN S&OP IMPROVEMENT TOOL

This chapter details the Stage 4 of the research programme, which gains an understanding of how to improve the success and sustainability of an existing S&OP process.

Chapter 8: CONCLUSION

The final chapter summarises the key findings of the research. The chapter also discusses the limitations of the research and recommends future work to be undertaken.

Chapter 2: LITERATURE REVIEW

This chapter reviews previous work that has been published in respect to S&OP. Firstly, S&OP will be defined and its origin identified. Secondly, the main activities of the process and its implementation will be outlined and successful and inhibiting factors identified. Finally, methods used to measure the performance and maturity of process will be described along with more recent developments of the process.

2.1 The origin of S&OP and its definition

With the advent of globalisation, companies face growing pressures to remain competitive but also have the opportunities and benefits of global sourcing. Global manufacturing is rapidly changing and companies face considerable competition from lower cost, increasingly sophisticated companies from around the world (Department of Trade and Industry, 2004).

Muzumdar (2006) explains how this situation has left companies facing market factors including shrinking profit margins, reduced customer loyalty and increased supply chain velocity. All have altered the global competitive environment into one of high uncertainty and risk. A poor customer service level (CSL) may lead to the loss of sales revenue and consequently profit. Wallace *et al*, (2005) describe how companies have been quick to dramatically improve their efficiency by adopting lean principles to simplify operating environments and eradicate non value-adding activities. However, business complexity has increased due to managing extended supply chains, outsourced manufacturing, and global sourcing. Cecere *et al* (2005) also relates the increase of mergers and acquisitions to an increase in business complexity. Wing (2001) contributes shorter product lead times and customers demanding greater levels of customisation as contributions to more complex environments. Wallace *et al* (2005) describe how there is a positive relationship between a company's operating complexity and the need for effective tools for managing demand and supply. This relationship states that as a company's operational environment becomes more complex there is a greater need for coordination tools.

Muzumdar (2006) identifies different types of problems that companies experience as a result of such a complex operating environment:

- Retailers have excess inventories and high product shortages.
- Consumer product companies must build ahead of seasonal demand basing assumptions on questionable histories and uninformed hunches.
- Manufacturers put master production plans in place but often see them collapse in front of the customer.
- Distributors balance not wanting to have oversupply with having to concede hefty discounts usually resulting from having too much inventory.

Wallace (1994) confirms this by describing unreliable, slow customer service, and high levels of inventory as problems sought to be addressed by companies. Consequently this environment drives companies to seek proactive planning and communication tools to timely manage complex situations and meet competitive pressures. One such tool is S&OP. S&OP is one of the key strategies used to respond to an ever increasingly complex business environment. Fuelled by customers' demand for a faster response to market shifts, and for Make-To-Order (MTO) products and services, S&OP has the power to enable an enterprise to achieve an immediate and significant increase on return on investment (ROI) (Muzumdar, 2006).

S&OP can be described as tool used to balance market demand with operational capacity whilst integrating with business plans and corporate strategy. Ling (1988) outlines S&OP as a process by which the general manager of a company can harmonise its departments to work together by sharing information enabling production to be quickly matched to market demand. Frequent and regular executive management meetings take place to update the plans for all departments taking into account projections made by Sales and Marketing and resources available from Operations, Engineering, and Finance. Wallace (1994) describes S&OP as a decision-making process to balance demand and supply and to integrate financial and operational plans. Similarly, Muzumdar (2006) defines S&OP as set of business processes and

technologies that enable an effective response to varying levels of supply and demand. S&OP should also focus on ensuring that, in servicing demand, the end result should be profitable. Cecere (2005a) suggests that S&OP is a periodic business process that involves members from Sales, Marketing and Operations who determine how to profitably align demand and supply against a defined business strategy.

The fundamentals of S&OP are based upon four key elements: demand, supply, volume and mix. With respect to volume and mix: volume concerns decisions about how much to make and the production rates for each product family; mix is concerned with which individual products to make, in what sequence and for what customer orders. S&OP is a business process used to balance supply and demand with respect to volume. It is then that problems regarding mix are addressed (Vollman *et al*, 2005).

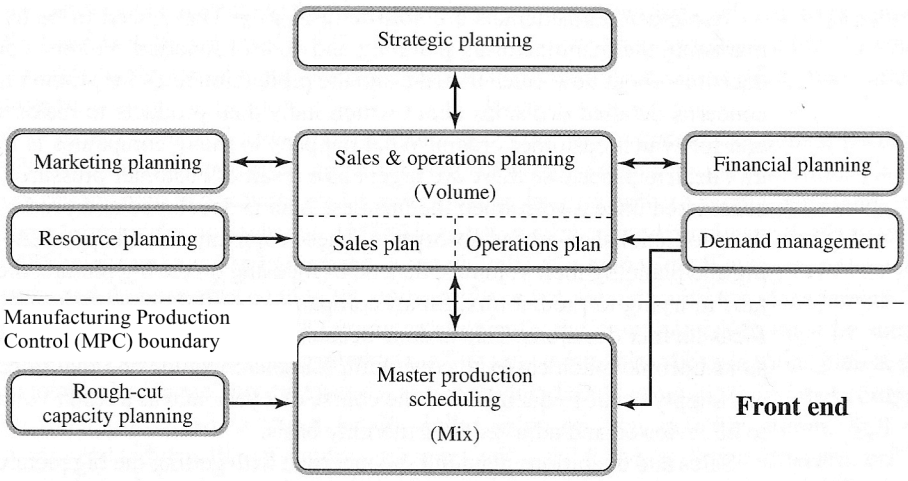

Figure 1 – Key Linkages in S&OP (Vollman *et al*, 2005)

Figure 1 shows how the four key elements are linked and how strategic and business planning act as drivers to the resource planning process.

Ling (1998) reinforces these linkages by stating that the six objectives of S&OP are:

1. To support and measure the business plan by synchronising the financial budget, the sales plan and the operations plan.

2. To ensure that any plans submitted are realistic and mutually supported.
3. To effectively manage change by replacing reactive responses with controlled and appropriate ones.
4. To better manage finished goods inventory to support customer service.
5. To measure performance to plan so out-of-control situations can quickly be brought to light, evaluated and resolved.
6. To build teamwork.

Ling (1988) describes the benefits of S&OP as: provides the link between business plans and department operations, provides a means of orchestrating all departments through horizontal and vertical communication, enables realistic plans capable of achieving company objectives and encourages integrated decision-making aligned to common goals. Landvater (1997) states similar benefits but extends them to clearly encompass improvement in business performance. The benefits are given in six key areas:

Business synchronisation. S&OP allows the high-level strategies of a business to be linked with departmental operational plans.

Communication. Better communication between Sales and Operations can exist due to S&OP converting the business plan i.e. dollars into the language of production i.e. standard hours.

Planning. Departments can function in harmony as S&OP produces a single plan that all departments can understand and work to.

Customer service. Through better management of finished goods and order backlogs, customer service can be improved.

Performance measurement. Having a single plan to work with, rather than many different types, facilitates the ability to measure the performance of the business.

Change management. S&OP allows companies to effectively respond to change due to the proactive nature of the processs.

Wallace (2004) adds to these benefits by stating effective S&OP leads to higher productivity through more consistent production rates and overtime levels as well as better visibility of future capacity problems. Muzumdar (2006) goes a stage further and states the benefits as simply that the S&OP process can have a direct impact on the profitability, operational performance, customer satisfaction and the product portfolio of a company.

2.2 The S&OP process

Prerequisites

Before the process can begin, Ling (1988) describes the prerequisites of the process. The first is that all departments must fully understand how the S&OP process works and its objectives. The second is the adequate commitment of time and resource. The third is defined product groupings. The fourth is a quantified, adequate planning horizon, which takes into account factors that influence supply and demand. The final prerequisite of the S&OP process is an established set of time fences that define when changes to the plan are feasible. Brander (1998) agrees that before conducting the process a basic S&OP framework should be constructed that includes company objectives, scope, participants, meeting frequency, agenda and product families. Wallace (2004) also agrees assigning responsibilities and establishing product families are prerequisites to the process. A more formal, detailed and comprehensive review of prerequisites is presented in later in this section.

S&OP cycle

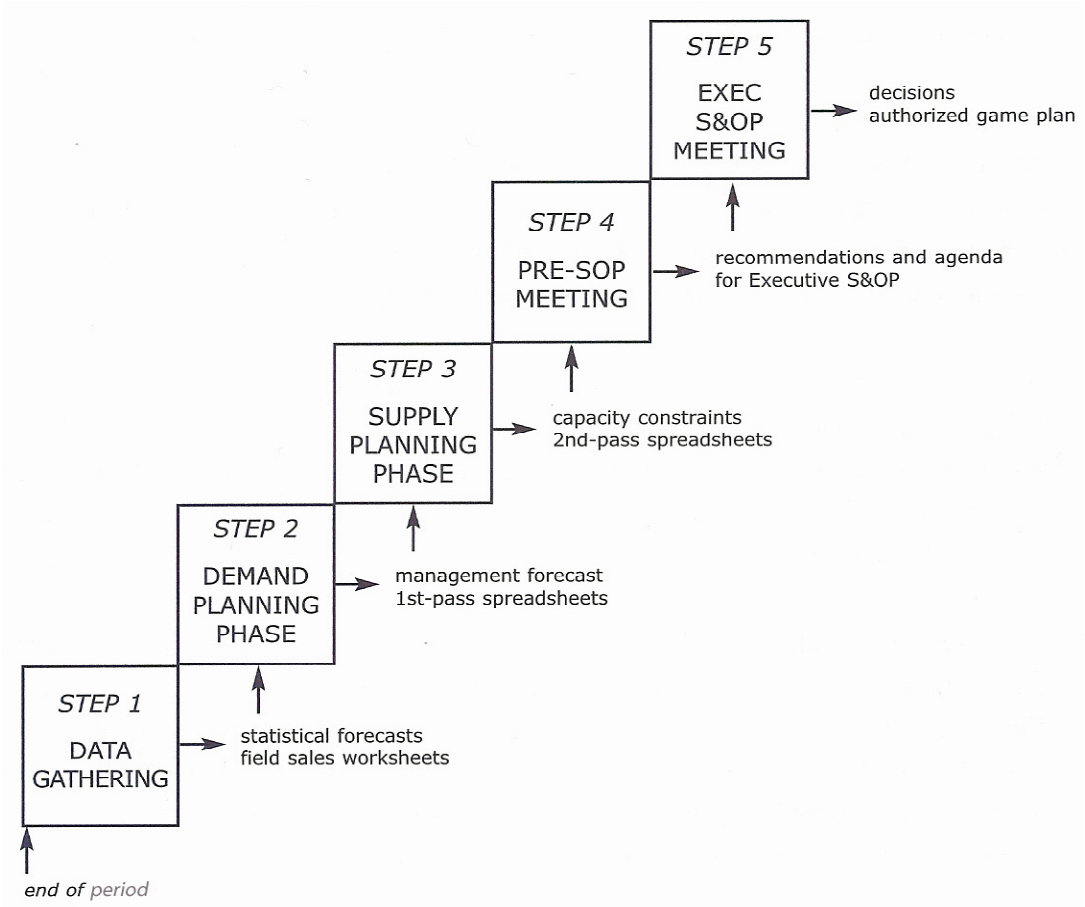

Figure 2 – The S&OP Process (Wallace, 2004)

The S&OP process was first documented by Ling (1988). Five basic steps were documented and have been corroborated by the later work of Wallace (2004) and Vollman *et al* (2005). These steps can be seen in Figure 2 and are explained below.

1. *Data Gathering*. Generate data from the previous month including actual sales, production, inventories, backlogs. Sales and Marketing then use this data to develop sales analysis reports.

2. *Demand Planning*. Generate a new management sales forecast covering the next time period that takes into account price changes, competitor activity, economic

conditions, field sales input. Override statistical forecasts where appropriate. Once authorised this is compared to the previous operations plan and differences made apparent hence a new operations plan is formed.

3. *Supply Planning*. Operation plans for each product grouping are compared with any changes made in the sales forecast, inventory, backlogs and, if necessary, the operations plan is modified and consequently financial justifications prepared if needed.

4. *Pre-S&OP Meeting*. Through involving relevant departmental representatives the balance of supply and demand is discussed, and where possible, problems resolved. Unresolved problems are discussed in the executive S&OP meeting. Alternative courses of action are also prepared ahead of the subsequent executive S&OP meeting.

5. *Executive S&OP Meeting*. Generate decisions and authorise the game plan. Decisions to include: the S&OP plans for each product grouping, the authorisation of spending for rate changes in production or procurement. Also relate value of the S&OP to business plans and strategic objectives as well as reviewing customer service and business performance (Vollman et al, 2005; Ling, 1988; Wallace, 2004).

Contributions

Each of the five basic steps of S&OP involves contribution from Sales and Marketing, Manufacturing, Engineering and Finance (Ling, 1988).

Sales and Marketing. This department's goal is to develop a statement of demand at both detail and aggregate level. For stable demand this is simple, as historic data can be used. For life-cycle products it becomes much harder to predict when demand increase / decrease will occur. For seasonal products it is also difficult to tell when stocks should be built and to what amounts. There is a need to generate an unbiased view of whether planned demand is equal to the actual demand. Usually deviations can be split into three categories: volume of

product, mix within a product family and order timing. It is vital to understand whether deviation is real, and indicates an increase or decrease in business, or is a short-lived phenomenon. Techniques that can be used to predict demand include statistical analysis, customer linking and tracking economic indictors. When planning or forecasting it is essential to identify assumptions as they may help understand why planned demand does not equal actual demand. Assumptions range from those relating to the general economy to market share and market outlook.

Manufacturing. This department's goal is to maintain a cost effective and responsive supply base. There must be a firm understanding of the impact that changes in demand will have on temporary and permanent resources. The cost and timeliness of possible responses must also be considered. If the production plan is decreased, responses such as halting production, building inventory, clearing backlog and redundancies should be considered. Manufacturing must communicate to suppliers to explain the decrease, and advise on how long to expect such a change for. If the plan is increasing, then numerous constraints (e.g. material, capacity, space, tooling) and how to adjust them accordingly must be considered. In planning materials, suppliers must understand the needs of Manufacturing and vice versa. Good communication and the sharing of information are essential. Manufacturing must work with suppliers, not just dictate to them. In capacity planning, requirements should be projected using either detailed capacity planning or rough-cut capacity planning.

Engineering. In environments where new products and engineer-to-order requirements are common, Engineering should use rough-cut capacity planning similar to that adopted by Manufacturing. Landvater (1997) confirms that an Engineering department's plan should also be considered especially in industries where product life cycles are shrinking and where a company's advantage is first to market.

Finance. This department's goal is to ensure that all end-of-period reporting and processing is completed on schedule. This includes ensuring costs and prices are up-to-date, and any data used by departments is accurate and complete.

Each department must ensure that the quality of data contributed to the S&OP process is of a high enough standard to aid communication, not hinder it. Data must be well organised and presented. Cut-off dates must be agreed for data processing. Data must be pertinent and accurate whilst remaining timely. Data should be consolidated to include past performance, current position and future plans. For the most part, endeavours should be made to keep data simple and preparations made to develop tools that support reporting needs (Ling, 1988).

Process Implementation

Although the five basic steps are seemingly simple and straightforward, much has been written about their successful implementation and how such implementation often holds the key for a successful end process capable of delivering the benefits described in Section 2.1. Different authors have adopted different approaches.

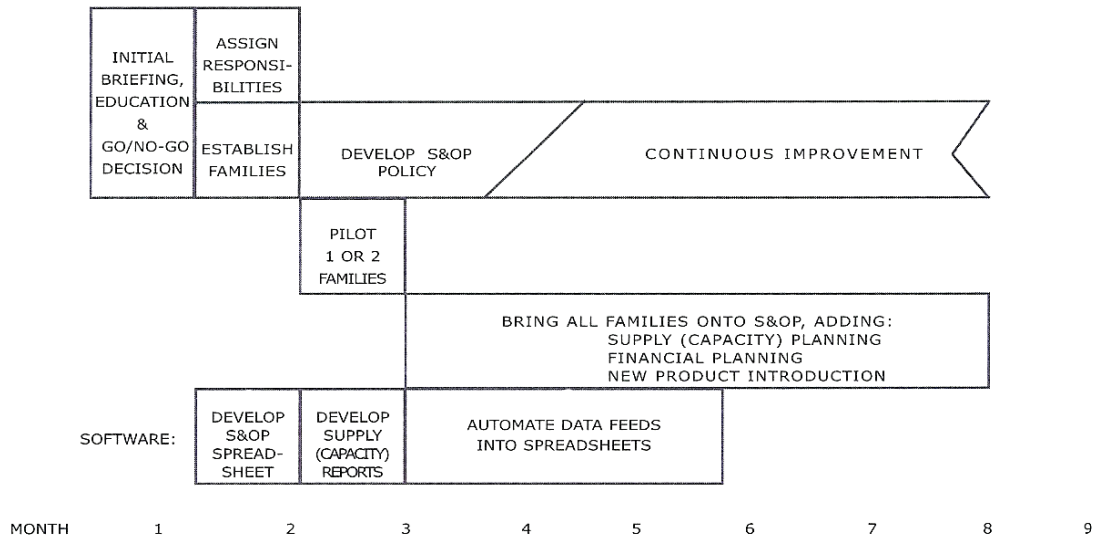

Figure 3 – The S&OP Implementation Path (Wallace, 2004)

Ling (1988) describes seven critical parts involved in implementation of S&OP: education, brainstorming meetings, product family specification, time fence setup, meeting scheduling, company policy and checklist review. Wallace (2004) has significantly contributed to the work of Ling (1988) and an overview of the resultant implementation path can seen in Figure 3. Both authors' work will now be reviewed.

It is explained that S&OP participants must have sufficient understanding to know what others expect of them and how to make the maximum contribution themselves. Basic topics would include Material Requirements Planning (MRP), Just In Time (JIT) and Distribution Resource Planning. Wallace (2004) takes this further and states that an initial briefing should be undertaken before education and a go / no-go decision should be made after education. An S&OP expert should be incorporated in the team, often in the form of an external consultant actively involved in supply chain management, in order to facilitate the briefing and education, but more importantly to keep people issues from becoming people problems and thus derailing the process. The executive briefing enables the capabilities of S&OP to be understood and how they fit with a company's business problems. Subsequently, the education sessions are described as means to convey the basics of S&OP, how to apply them and to create a detailed implementation plan.

Both Ling (1988) and Wallace (2004) report how many aspects of S&OP need to be assigned, established and specified. Both authors describe how brainstorming meetings should be conducted to explore and decide upon S&OP issues such as: number and types of product families together with inventory targets, units of measure, planning horizon, reporting format, system and data processing resource requirements, documentation of assumptions and vulnerabilities, time fences, and both the frequency and agenda of meetings. These issues have been corroborated by Brander (1998) who also recommends that such issues should form a basic framework to build upon. Wallace (2004) also explains it is at this point that people should be assigned to various teams: demand planning, supply planning, pre-S&OP and executive S&OP.

Ling (1988) states that a policy document should be created describing the purpose of the S&OP process: to include what it is, why it is important, what is to be accomplished by it, who will participate in it, what is the product family segmentation, what is the planning horizon and at what intervals are time fences set. Ling also recommends that the signatures of the senior management team should be included in such a document to show commitment. Wallace (2004) corroborates this policy document and its contents.

Although not discussed by Ling (1988), Wallace (2004) explains how it is important that software implementation be addressed in parallel with the phases of implementation already reviewed. This can be seen in Figure 3. It is described how S&OP spreadsheets should be developed for each product family so as to report measures of performance including actual sales to forecast, actual operations to plan, actual inventory/backlog to plan, customer service level and financial comparison to business plan. Muzumdar (2006) disagrees with such method and reports that companies relying on spreadsheets for S&OP end up with processes that have disjointed, inaccurate data, non-repeatable output from period to period, and an inability to scale up or down as business changes. Although no specific recommendations are proposed, Muzumdar generalises how important it is to utilise technology enablers by leveraging transaction, decision-support and business-intelligence capabilities in a real-time environment. Wallace (2004) does however explain that spreadsheets may provide a good short-term learning approach but the long-term aim should be to automate data feeds from enterprise software systems into front-end, dashboard-like spreadsheets and graphs. It is often the lack of priority this issue is given in the early stages of implementation that, after substantial growth, results in a slow, inaccurate, manual S&OP process requiring considerable effort to run.

As shown in Figure 3, Wallace (2004) suggests that the implementation of S&OP takes eight months. Ling (1988) suggests a shorter time of between three and six months should be achievable whilst Brander (1998) indicates a much longer time of fourteen months is more appropriate. All three authors recommend a learn-by-doing approach be adopted and that small incremental steps are employed.

2.3 S&OP Influential Factors

This section reviews key factors that inhibit or allow successful S&OP and goes on to explore how these factors can be assessed. This section is split into two parts: Types of Factors and Assessment of Factors.

Types of Factors

Factors have been grouped into three categories: behavioural, operational / technological and organisational.

Behavioural

Wing (2001 p. 25) clearly states "the ability to manage change is probably the most critical success factor". This is because S&OP is evolutionary and must be synchronised with changes in the market and respective industry. Brander (1998) agrees by explaining how important it is that enough time should be allowed for substantial change as well as giving participants enough time and resource to reach a single optimum working solution. Furthermore Brander reports that such solutions should maintain high levels of discipline, overseen by management. Bower (2005) agrees with this view by explaining how meeting at strict, regular time intervals to examine the business performance to plan is the best way to proactively address problems, identify trends and achieve business objectives. Lapide (2005) reiterates this and suggests routine meetings should occur periodically that have strict agendas with pre-specified time limits.

A strong belief in S&OP, gained through understanding the benefits to the business, should be rife amongst participants and all should be keen to actively participate in the process and not delegate responsibility to subordinates. Management should lead by example and convey to participants how important S&OP is and how seriously the process is taken. The atmosphere in which the meetings take place must encourage and promote an open and honest environment based upon trust (Ling, 1988; McGregor, 1960).

Brander (1998) partly relates the success of S&OP to the well being of participants. Participants should be congratulated when good work and results

have been achieved. Furthermore, Ling (1988) suggests how participants' contributions should be recognised and due consideration given by the management to participants' suitability for professional development.

Ling (1988) stresses the importance of top-management commitment. An understanding of the workings of the process must be demonstrated to the team and an innate ability to make tough decisions should be present. Ling describes how senior management must coach others and be prepared to resolve issues. This view can be substantiated by Bower (2005) who concludes it is essential, effective and efficient decisions be made by executive management, so as not to hinder the implementation process or delay the benefit to the business. Furthermore, Lapide (2005) indicates that participants must be empowered to make decisions during the meeting in order to support senior management. Landvater (1997) concludes that the ability of the whole team to reach consensus is vital to ensure a successful S&OP process.

Lapide (2005) describes how bias towards a particular department by the facilitator of meetings can be an inhibiting factor to the process. Ling (1988) agrees by expressing that bias will quickly lead to a divisive environment where there is resentment among participants. Bower (2005) agrees by reporting that it is difficult to have a truly unbiased meeting if the S&OP process owner is in anyway responsible for the success of an operational area included in the S&OP meetings e.g. Marketing Director.

Operational / Technological

Bower (2005) considers a disconnection between S&OP and corporate strategy as the most common threat to the process. Key performance indicators (KPIs) should be used to help review forecasts, plans and budget in accordance with strategic goals. Ling (1988) claims effectively measuring S&OP "provides valuable input into overall business planning and forecasting techniques". Furthermore, Wing (2005) describes how measuring, monitoring and communicating well-defined KPIs is a critical success factor. Planning cycle time, customer service, inventory levels and performance to plan should be

continually measured. Bower (2005) substantiates this work by reiterating that metrics are vital for success as they are able to reflect how a business is performing, provide insights into the effort and progress made by the S&OP team, and highlight areas for improvement. Lapide (2005) agrees that measurement is part of an ideal process however, relates this requirement to enabling learning, thus facilitating improvements.

S&OP is only successful when all participants prepare thoroughly before the preparatory and executive meetings. Departmental plans should be aggregated, synthesised and translated for senior management appraisal. There should never be any surprises at the executive S&OP meeting as all data should be thoroughly reviewed before the meeting (Lapide, 2005; Ling, 1988).

Lapide (2005) suggests that external inputs to the process are an aspect of an ideal process. The sharing of up and down-stream data such as retailer and / or supplier inventory data should be used as inputs to the S&OP process. Furthermore, Bower (2005) claims it is essential to also assess wider external business trends including economic and demographic as such external trends can be used to validate internal business trends.

The data used throughout the process must be accurate, pertinent, timely and of a format that facilities understanding and sharing (Ling, 1988). Lapide (2005) contributes by describing how technology is necessary (however not sufficient) as often the S&OP process can be concerned with a large complex set of needs that require a level of automation and computerised sophistication far greater than that of manual processes or spreadsheets. The S&OP process needs to be supported by three types of software applications:

1. *Demand-side Planning Systems*. Enable and support the development of demand plans and unconstrained forecasts.
2. *Supply-side Planning Systems*. Enable and support the development of inventory, production and procurement plans.

3. *S&OP Workbench*. Enable and support the development of dashboards with KPIs showing planned versus actual performance for discussions to be based upon and improvements identified.

These three systems need integrating with themselves and other business systems such as Enterprise Resource Planning (ERP), Manufacturing Execution System (MES) and Materials Resource Planning (MRP).

Organisational

Office politics can often hinder the S&OP team in reaching consensus in S&OP meetings. All participants must be held responsible for developing a productive environment. Resistive environments lead to a lack of communication, slow improvements and a lack of adequate participant participation (Bower, 2005).

Assessment of Factors

Much has been published regarding the specific factors that impact on successful S&OP however very little work has been found that explores these factors in greater detail, given the context of a company and industry, in order to improve them. Wallace (2004, p. 134) proposes factors should be identified using "The S&OP Effectiveness Checklist" but this generic list of 25 questions is more suited to helping S&OP initiatives through the early stages of implementation. Similarly, Ling (1988) suggests that in order to periodically audit an S&OP process, the checklist of Oliver Wight International (2005) can be used but recommends such a checklist be used to design and specify the process.

Lapide (2005) documents a four-stage maturity model and explains how it can be used to improve a company's planning processes and assess its technology needs. This is achieved by identifying gaps in the S&OP maturity and considering what stage of the model a company is currently at, and what stage is next in the model. The model consists of four stages: Marginal, Rudimentary, Classic and Ideal.

1. *Marginal Process*: Some planning process being used, but in a non formal manner and in a sporadic and chaotic fashion. Meetings frequently cancelled as participants perceive there are more pressing issues.

2. *Rudimentary Process*: Formal planning processes in place but they are not fully participated in and not fully integrated. Participants often do not prepare enough before meetings and interact poorly through not collaborating or reaching consensus.

3. *Classic Process*: There are formal planning processes in place that follow many of the aspects of the Ideal Process. Meetings are routinely held and fully attended.

4. *Ideal Process*: In Section 2.3 many of the aspects of an "Ideal Process" have been reviewed. The process should be considered as a benchmark where all the aspects of the "Ideal Process" are executed. Meetings are scheduled on demand only when a change or unbalance is detected. Plans become aligned with external suppliers and customers as well as on an internal basis.

2.4 Recent developments in S&OP

Cecere *et al* (2005) describes how today's market trends have put pressures on traditional S&OP practices through declining brand loyalty, increasing demand for customised / configured solutions and general market uncertainty. Furthermore, the increase in acquisitions, joint ventures and outsourcing are changing organisational structures and require rapid changes in planned objectives and targets. Companies are also realising that the risks and costs associated with poor decision-making have increased, particularly in the area of aligning supply and demand and linking that to profitability. In summary, today's market is less forgiving and much riskier. These market trends are pushing companies away from the traditional S&OP practices of balancing supply and demand, towards a more holistic practice where the most profitable strategy is sought from many possible scenarios enabling the business to maintain a sustainable competitive advantage. The traditional five-step process, shown

previously in Figure 2, has been redefined and morphed into a nine-step process, described by Cecere *et al* (2005) as:

1. *Collect sales and market input*. Collect sales and marketing data using collaborative forms.

2. *Develop a demand plan*. Generate a multi-period forecast using statistical analysis and / or management input.

3. *Demand refinement*. Compare the statistical multi-period forecast to a collective sales forecast. This then forms the base demand forecast.

4. *Shape base demand based on what-if analysis by demand*. Package key scenarios by developing plans that focus on demand shaping by considering promotions, price management, contract compliance and new product introductions. This forms unconstrained demand packages.

5. *Develop a constrained supply plan*. Analyse the base demand forecast for the most suitable business alternative based on profitability, revenue, inventory targets and customer service.

6. *Conduct a what-if analysis by supply*. Determine tradeoffs on the measurements and identify demand-shaping opportunities; to evaluate the different demand packages based on profitability, revenue, inventory targets and customer service. Clearly identify demand shortfalls as well as supply constraints and opportunities. This takes the form of a pre-S&OP meeting.

7. *Gain agreement on plan*. Review scenario alternatives and obtain consensus with regard to the constrained plan. Takes the form of an executive S&OP meeting.

8. *Publish the plan*. Communicate the constrained plan to the S&OP team(s).

9. *Measure and communicate the plan*. Measure the success of the plan by forecast accuracy, profitability, revenue, inventories and customer service.

Wing (2001) reports that high technology and electronic industries have already developed their S&OP practices to such a model whilst the automotive and consumer packaged goods are moving rapidly to do so. Furthermore, Wing describes how the evolution to this new model is achieved in three stages: an integrated planning system, collaboration with trading partners, and the creation of a network hub.

> *Integrated Planning System*. The system should be an optimisation engine closely linked to demand forecasting software that "simultaneously optimises and synchronises all material and capacity across the enterprise." The effects of forecast changes on the supply chain can then be made immediately apparent. The system should allow the planning cycle to be executed in hours rather than days thus facilitating problem solving.
>
> *Trade Collaboration*. Collaboration with trading partners should be subsequently developed to allow the faster exchange of data and information that impact on existing plans. Great improvements in forecast accuracy can be achieved by collaborating with trading partners where possible.
>
> *Network Hub*. Wing (2001) concludes with the third phase of evolution being when a virtual electronic network is implemented that connects all of the participants in all levels of the supply chain. Such a system enables continuous planning to become a reality. Few companies have managed to implement such a hub but many are making concerted strides to get there.

The implementation approach adopted by Wallace (2004) is still relevant. However, Muzumdar (2006) describes there being five components that should be key parts of the S&OP implementation to ensure its success: people, process, technology, strategy and performance.

People. This component can be described as ensuring the executive-level sponsorship is obtained and cross-functional teams are created to promote shared communication and collaboration. Only operational metrics approved by the S&OP team should be used and guidelines should be established for real-time responses. People should follow a formal S&OP system and collaborate with the business network.

Process. This component can be described as ensuring that the consolidated demand for all product families are reviewed, consensus on demand-side is achieved, the effect of plans on key constraints are tested, effects of new product introduction are gauged, special projects reviewed, all decisions and actions are documented, and possible process improvements are discussed. Metrics aligned to business strategy contingency plans, based on what-if scenarios, should be deployed to determine risks and opportunities.

Technology. This component can be described as ensuring necessary software upgrades and enhancements are implemented. Muzumdar (2006) proposes that spreadsheets should not be used as they result in unrelated, inaccurate data and generate non-repeatable output from period to period. Spreadsheets do not provide the capability to scale up or down and do not provide a comprehensive view across all business areas. As reviewed by Wing (2001) continuous planning systems should be objective of those wanting competitive advantage.

Strategy. This component can be described as ensuring that the formal alignment of supply and inventories to demand occurs. Planning scenarios must be measured on their profitability impact. Attention must be given to the value chain: work must be collaborative with customers and suppliers. By leveraging their capabilities, potential scope improvements can be expanded.

Performance. This component can be described as ensuring the performance of an S&OP process is measured using metrics that encompass the two-way impact

of demand and supply decisions, rather than having separate unrelated metrics for each. KPIs should be related to the value chain process, product and customer profitability, order fill rates, customer satisfaction or retention, sales per employee, percent volume growth and gross margin. Traditional metrics such as sales forecast accuracy and actual versus planned sales volumes should not be used in conjunction with the holistic approach to S&OP.

2.5 Chapter summary

In summary, this chapter described what S&OP is and why it is adopted. The S&OP cycle has been described along with the necessary prerequisites and path needed for implementation. Factors influencing a successful S&OP process have also been identified.

Chapter 3: RESEARCH AIM AND PROGRAMME

This chapter defines the research problem and establishes the aim and objectives. Furthermore, it explains the programme followed to achieve the objectives.

3.1 Research problem

As stated in Chapter 1, LCP Consulting wanted to better serve its clients' needs and strengthen potential business opportunities with respect to S&OP. LCP Consulting recognised that companies formally implement some level of S&OP but for reasons unknown the process is often not sustained therefore the full benefits are not realised. LCP Consulting wanted to better understand the cause of poor S&OP sustainability thus enabling proposals for the implementation of an effective and sustainable process to be generated.

From the literature reviewed in Chapter 2, an understanding of the latest S&OP practices was gained. Process activities were identified and described. Many inhibiting factors have been identified and outlined with their impact on the business highlighted. Three categories of factors were found: behavioural, technological and organisational.

Although the literature review allowed S&OP activities to be identified, a consistent and compelling process definition that assembled activities into a logical order was not found. Furthermore, little detail was found as to how to assess an S&OP process for effectiveness or address inhibiting factors given the context of a company and industry.

3.2 Aim and objectives

In response to the research problem detailed in Section 3.1 and 1.1, the aim of the thesis was,

> "to investigate and identify the principal factors that enable and inhibit the successful execution of S&OP in the UK."

To realise this aim the thesis had four specific objectives:

1. To define key terms relating to S&OP.
2. To identify key success factors.
3. To extract and quantify the issues that companies face with regard to their S&OP process.
4. To understand how to improve the success and sustainability of an S&OP process.

3.3 Programme

To realise the research objectives, a programme consisting of 4 stages was adopted. This section describes the framework for each of the four stages.

Stage 1: Initial analysis of literature

The purpose of this stage is to follow a series of steps that will result in the realisation of objectives 1 and 2, these being to define key terminology used to describe S&OP activities, and to relate influential factors found through reviewing literature, to these activities. Five steps, to be followed in series, make up Stage 1 of the research programme.

1. Amalgamate and consolidate the findings from the literature reviewed into their constituent parts.
2. Adopt a framework that encapsulates the evolution of an S&OP initiative.
3. Populate the framework with the findings from literature with a view to defining the scope, objectives and activities of each constituent part.

4. Compile a list of influential factors, gleaned from the literature, that describe the meaning and impact of each factor.
5. Rate the influence of each factor based upon literary occurrence and independent opinions of authors.

The deliverables of this stage of the process are firstly, an S&OP framework that the evolution of an S&OP initiative can be based upon, and secondly, a documented list of initial influential factors that relate to process activities, and include explanations and impacts.

Stage 2: Quantitative extraction and assessment of S&OP process issues

The purpose of this stage is to follow a series of steps that will contribute to the achievement of objective 3, this being to extract and quantify the issues that companies face with regard to S&OP. This stage will enable influential factors to be quantified in terms of how much they impact on each activity of an S&OP initiative. Five steps make up Stage 2 of the research programme with steps 1 and 2 being completed in parallel.

1. Secure industrial participation.
    a. Define company search criterion based upon LCP Consulting's current and potential clients.
    b. Search and compile a list of suitable companies and their contact details.
    c. Contact companies and obtain confirmation of participation in research.
2. Design and build survey.
    a. Design survey structure using the deliverables from Stage 1, and evaluate data collection alternatives.
    b. Build draft survey focusing solely on content (i.e. question themes and specific wording not style, format and presentation).
    c. Pilot survey to validate and finalise content.
    d. Build final survey using chosen data collection method.
3. Distribute survey to participating companies for completion.
4. Capture results of survey.
5. Perform initial analysis of the results of each company to determine common trends and relationships.

The deliverables of the stage are firstly, a set of substantiated influential factors showing their associated impact on different phases of the S&OP initiative, and secondly, a collection of trends and characteristics that relate to real-life S&OP processes.

Stage 3: Qualitative extraction and assessment of S&OP process issues

The purpose of this stage is to follow a series of steps that will result in the completion of objective 3, this being to extract and quantify the issues that companies face with regard to S&OP. This stage will enable S&OP processes to be further examined and levels of success and maturity gauged. Five steps, to be followed in series make up Stage 3 of the research programme.

1. Define a representative shortlist of companies.
2. Design interview structure using the deliverables from Stage 2.
3. Carry out interviews and capture results.
4. Perform further analysis of the results to collate scales of process success and maturity.

Stage 4: Formulation of a method to improve an S&OP process

The purpose of this stage is to follow a series of steps that will result in the completion of objective 4, this being to understand how to improve the success and sustainability of an S&OP process. Three steps, to be followed in series, make up Stage 4 of the research programme.

1. Collate all of the findings and analyses from previous stages.
2. Devise a tool linking the success and maturity of S&OP activities to influential factors.
3. Provide guidance notes enabling third parties to use the tool.

The deliverable of this stage is a simple assessment tool with visible linkages to influential factors, key characteristics, and improvement opportunities. In addition to the thesis, a short Summary Document will be written for those companies participating in,

and sponsoring, the research project. The document will summarise the findings of the research, list some practical observations and activities that companies can usefully engage in, and provide the tool devised as a result of Stage 4.

Chapter 4: INITIAL ANALYSIS OF LITERATURE

This chapter describes Stage 1 of the research programme, which defines the key terminology used to describe S&OP, and begins to relate key influential factors to the process. The method used to accomplish the first two objectives is detailed before presenting the initial analysis. Section 4.2 was produced in collaboration with Ngueveu (2006) and was to form a large part of a Summary Document produced for companies participating in the research.

4.1 Method

Objective 1 was to define key terminology used to describe S&OP. To accomplish this objective an S&OP framework was to be delivered that would encompass all the activities of an S&OP initiative. The method used to generate this deliverable was to firstly gather all of the many S&OP activities identified from the literature reviewed in Chapter 2. Key words relating to each activity were then extracted and brought together on a single A2 sized page. Activities were then ordered based upon their time of execution during the timeline of an S&OP initiative. Secondly, activities were consolidated to form a series of distinct phases with clear start and finish milestones. The scope and objectives for each phase were then defined. Finally, each phase was revisited and key activities described. The resultant S&OP framework and associated activities are described in Section 4.2.

Objective 2 was to identify key success factors. To accomplish this objective a list of influential factors that relate to the phases of S&OP were to be delivered. The method used to generate this deliverable was similar to that used to deliver the S&OP framework: factors were extracted from the literature and grouped into a series of categories, each factor's description and impact on the different phases of the S&OP framework was then documented. The resultant set of influential factors is described in Section 4.2.

4.2 Analysis and discussion

The analysis and discussion of the literature is split into two parts: S&OP Framework and Influential Factors.

S&OP Framework

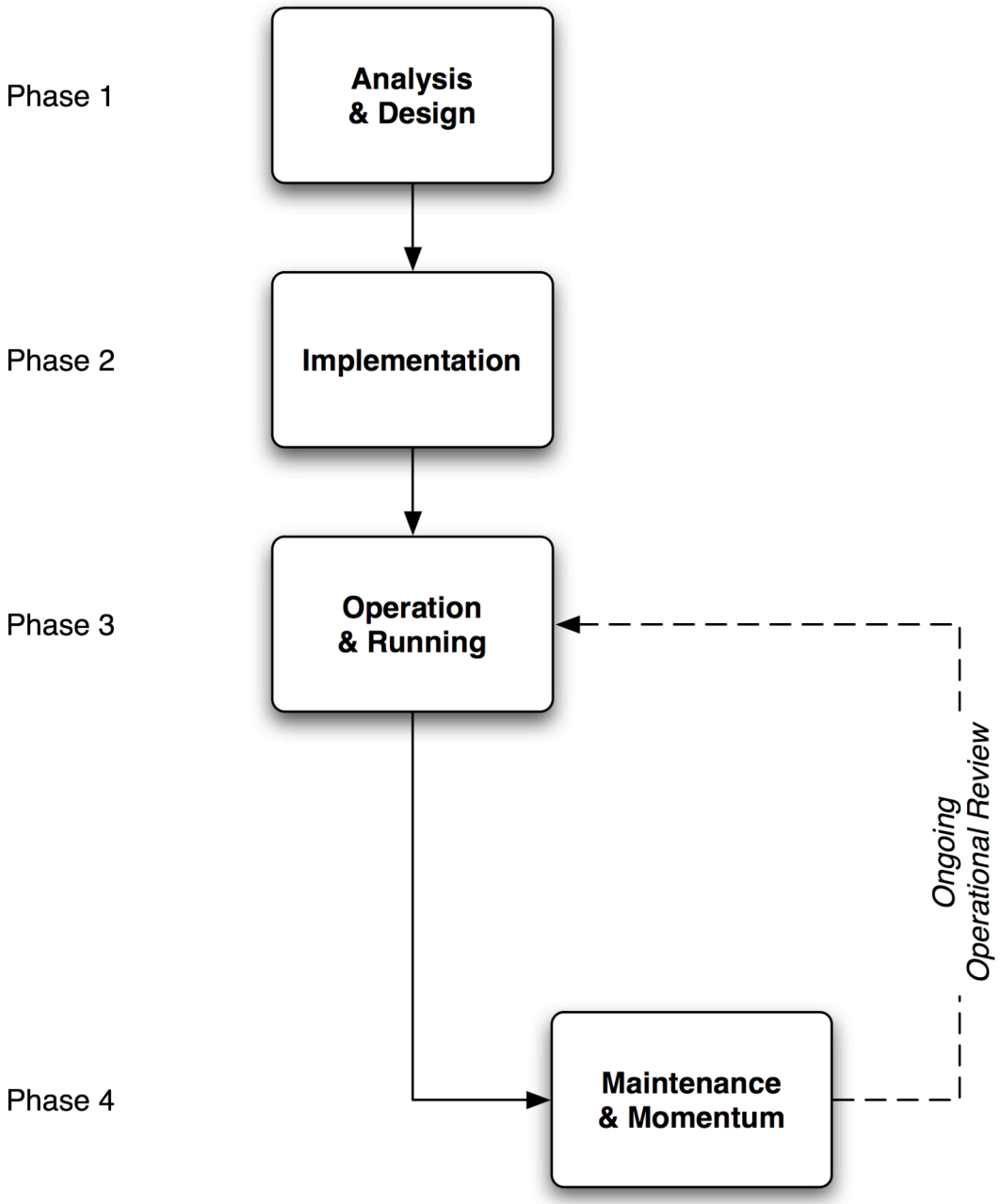

Figure 4 – S&OP Framework

Figure 4 depicts the four phases carried out during the evolution of an S&OP initiative. Phases 1 and 2 are both carried out once, whereas Phase 3 represents the periodic and cyclic process that is commonly found in companies operating S&OP. Phase 4 is also partly synchronised in this cyclic process in the form of short and regular operational reviews of the S&OP process. This usually takes place and the end of each periodic cycle.

For each of the four phases of the framework, the scope and objectives were described along with a description of the corresponding activities, based on literature reviewed. There are four phases of an S&OP initiative: Analysis & Design, Implementation, Operation & Running, and Maintenance & Momentum.

Phase 1: Analysis & Design

This phase begins when the need for S&OP is realised by a company, often as a result of a compelling event, and finishes when the general manager understands what should be communicated and to whom about S&OP to enable its successful implementation. The objective of this stage is to construct a specification upon which all of the characteristics of the S&OP process can be built around. The primary activities of this phase are as follows:

- Make the go / no-go decision
- Define planning horizon
- Establish time fences
- Define roles and responsibilities
- Obtain top management buy-in
- Setup meeting schedules
- Define report design
- Incorporate into company policy
- Design of a feedback system

Phase 2: Implementation

This phase starts when those responsible for the design stage agree that the specification is appropriate. This phase finishes when all of the participants

involved in the S&OP process understand what has to be done, why it has to be done, and how it will be realised within the company. It is important that this phase include a warm-up period consisting of a number of pilot cycles so as to fine-tune the process until it becomes a self-sustaining routine fully integrated into daily business operations. The objective of this phase is to ensure understanding of the process itself and the resultant benefits, so as to secure buy-in and facilitate the change process. The primary activities of this phase are as follows:

- Plan implementation milestones
- Change organisational structures
- Allocate resource
- Educate participants
- Obtain participant buy-in
- Communicate benefits
- Manage change
- Manage / mentor involvement of process participants

Phase 3: Operation & Running

The scope of this phase is the cyclical S&OP process (typically monthly). This cycle begins with the updating and distribution of data relating to actual sales, production capacities, inventories etc. that enables departmental plans to be generated. This cycle finishes with the outcome of an executive S&OP meeting where decisions have been made and consensus reached. The objectives of this stage are: to support and measure the business plan by varying resources (either up or down) to meet the business plan in a cost effective fashion, to ensure plans submitted are realistic and mutually supported, to move the company away from a reactive response towards a more proactive focus, and to ensure adherence and maintenance of the process in place (detailed in Phase 4). The primary activities of this phase are as follows:

- Data gathering and distribution
- Demand planning

- Supply planning
- Financial planning
- Pre-S&OP meeting
- Executive S&OP meeting

Phase 4: Maintenance & Momentum

The scope of this phase is the continual maintenance of the Operation & Running phase. The objective of this phase is to ensure a successful process continues and remains supported by senior management. This phase involves regularly reviewing the operational performance of the process and occurs at the same frequency as the executive S&OP meeting. Reviews should be short and informal lasting no more than 15 minutes. The primary activities of this phase are as follows:

- Measurement of participation
- Measurement of process adherence
- Recognition of participants' efforts
- Gauging of meeting atmosphere

The framework shown in Figure 4 and the associated activities are both significant findings as they provide a common base upon which subsequent work and discussions can be contextualised and referenced against. This framework has gone some way to address the concern that S&OP lacks a common process definition. This framework provides a base upon which the data survey in Chapter 5 can be constructed. Although four separate phases exist, there is a lack of clarity with respect to the contents of the Maintenance & Momentum phase and its interaction with other phases. This area could not be explained in sufficient detail from the literature reviewed and was therefore highlighted as an area for further investigation and clarification in the industrial survey.

From the literature there is also contradiction relating to the measurement of metrics. Muzumdar (2006) suggests how traditional metrics such as sales forecast accuracy and actual versus planned sales should be abandoned for more holistic metrics that encompass the two-way impact of supply and demand decisions such as profitability

and custom service levels. This topic was highlighted as an area in which further evidence would be sought in subsequent chapters.

Through analysing the literature, there also appears to be lack of consistency when explaining how S&OP should be integrated with a company's Information Technology (IT) systems. Pre-2000 publications tend to refer to spreadsheets, post-2000 publications refer to more of a closer integration with Manufacturing Resource Planning (MRPII) and Enterprise Resource Planning (ERP) systems. This is an area that was identified for further investigation both quantitatively and qualitatively so as to clarify the issues and gain a better understanding of IT implications.

Influential Factors

The factors that influence the process can be grouped into three categories: behavioural, technological and organisational. Table 1 provides a description of factors identified through analysing the literature reviewed.

	Factor	Description	Impact
Behavioural	Discipline	Obeying authority and regulations. Conforming to procedures.	Facilitates the continuity of the S&OP cycle.
	Understanding	Knowing and comprehending the purpose, processes, and contributions of S&OP.	Ensures the resultant S&OP cycle is effective and efficient in delivering benefits to the business.
	Recognition	Rewarding / acknowledging participants', and the group's, contribution to the process.	Encourages buy-in and motivates participants. Reduces resistance to change.
	Commitment	Following up decisions and agreements. Dedicating resources necessary. Respecting plans and agreed deadlines.	Helps reinforce importance. Facilitates successful implementation and ensures process execution.
	Involvement	Engagement of participants in the S&OP process.	Ensures a good specification. Facilitates Implementation phase.
	Trust	Confidence in, and reliance on, different participants' contributions.	Facilitates collaboration and the sharing of data.
	Communication	Openness and information sharing different between participants and departments.	Facilitates decision making throughout the process.

Technological	Data availability	Timely and accessible data, able to be made use of easily.	Affects the quality of input to the S&OP cycle, thus impacting on the robustness of the executive S&OP meeting outcome.
	Data format	Compatibility of data and ease of exchange between departments.	
	Data accuracy	Precise and correct data that provides a truthful representation of the business.	
	Information extraction	Probability and ease with which useful information can be obtained from raw data.	
Organisational	Communication	Circulation of information to other stakeholders throughout an organisation.	Facilitates decision making throughout the process.
	Hierarchy	Number and size of ordered levels within an organisation.	Affects the speed at which an organisation can successfully change. Can complicate Implementation phase.
	Culture	The ideas, beliefs, values and traditions intrinsic to an organisation.	

Table 1 – S&OP Influential Factors

The factors in Table 1 have been identified from the literature reviewed. Further investigation was decided upon so as to discover the possibility of new factors and to substantiate existing factors. Although the amount of impact each factor has on the process was unclear at this stage, the factors identified provide focus with which to interrogate industry.

The majority of factors, especially behavioural, can affect many different activities of the S&OP initiative, in many different ways. 'Understanding' has an influence on the S&OP initiative from the very start - during the more strategic, specification activities -

whilst also influences the success of the more operational tasks embedded within the detailed S&OP cycle.

4.3 Chapter summary

This chapter has analysed the findings from the literature reviewed in Chapter 2. Four phases of an S&OP initiative have been identified along with an initial list of influential factors. This chapter has provided a foundation upon which the content of the industrial survey can be based.

Chapter 5: DATA GATHERING AND ANALYSIS OF QUESTIONNAIRE

This chapter describes Stage 2 of the research programme, which involves extracting and assessing issues companies face with S&OP. The method used to contribute to the third objective is explained before presenting the findings and analysis of this second stage.

5.1 Method

Objective 3 was to extract and quantify the issues that companies face with regard to S&OP. This section details the method used to contribute to objective 3. The method used can be split into three areas of work: Company Selection, Survey Design and Analysis Method. The first two areas of work were conducted in parallel.

Company Selection

The method for selecting companies was split into two further sub-sections of work: Identify Companies and Contact Companies.

Identify Companies

Through discussions with LCP Consulting an initial search criteria was defined based on existing clients and emerging markets. This included UK companies operating in the food, automotive, pharmaceutical, and capital equipment industries turning over between £100M and £2,500M. This criterion was then developed specifically to enable it to be used with FAME. FAME is a database that has access to contact and financial information for 3.4 million companies in the UK and Ireland (Bureau Van Dijk Electronic Publishing, 2006). The specific search criteria used can be seen in Appendix A. Through performing the database search 132 companies were identified as a population of suitable industrial participants. Assuming a response rate of 20% this translated to a sample size of 26.

Contact Companies

Contact details were extracted into a spreadsheet enabling mail-merge to be employed. An initial contact letter was sent to a senior supply chain manager in each company explaining the need for research and the likely benefits for participants. The initial contact letter can be seen in Appendix B. Telephone calls were made to follow-up the initial contact letter inviting each company to complete a survey, and to emphasise the benefits of participation to the company. The purpose of the follow-up call was to secure participation.

Survey Design

The design of the survey can be split into three further sub-sections of work: Format and Style, Question Content, and Pilot.

Format and Style

The method chosen to extract data from industry was a self-administered questionnaire. This was because a wide range of companies could be targeted, quickly enabling a snapshot of process issues to be collected and compared. These issues were then to be explored in greater detail through the use of structured interviews as explained later in Chapter 6. A range of different questionnaire systems was evaluated before selecting an online service provided by QuestionPro (www.questionpro.com). QuestionPro provides secure web-based software for designing, distributing, and managing the results of online surveys. Appendix C shows the evaluation of three questionnaire systems.

Question Content

The content of the questionnaire was designed based upon the deliverables achieved during Stage 1. The questionnaire was split into sections to match the four S&OP phases shown in Figure 4. Questions were designed to explore whether activities in those phases had been, or were being, carried out. Closed questions were presented in the beginning of each section to focus the mind of the respondent before moving to open, more demanding and valuable questions, at the end of each section. For each question the design was based upon the following evaluation criteria:

1. Easy to answer
    a. Speed and simplicity
    b. Likelihood of answer being readily available
2. Usefulness
    a. Segmentation
    b. Direct statement describing cause of failure / success

These criteria were used to maintain the balance between questionnaire completion time and valuable data. It was to be envisaged that the questionnaire should take no longer than 20-30 minutes to complete.

Pilot and Final Build

The content of the questionnaire was then prepared in Microsoft Word and sent to two pilot companies for feedback. The final questionnaire was then built using web-based software incorporating any changes before distributing to participating companies.

Execution

The online service provider, QuestionPro, handled all distribution and collection logistics.

Analysis Method

The method used to analyse the questionnaire results was based upon three approaches: Cross Examination, Pareto Analysis, and Impact Analysis.

Pareto Analysis

The approach was to collate all the open question results and perform Pareto Analysis enabling key successes and failures to be identified.

Impact Analysis

The approach was to use the influential factors identified in Chapter 3, and for each company, quantify the impact of each factor in each phase of the S&OP initiative. How companies responded to a question determined what score was

attributed to influential factors. Where companies reported a positive impact had occurred, scores of either +2 (big) or +1 (small) were assigned to a factor. Where companies reported problems that related to a factor, scores of either -2 (big) or -1 (small) were assigned.

Cross Examination

The approach was to cross-examine the closed question results to identify possible relationships between activities and factors, and S&OP success.

5.2 Findings

Through executing the method described in Section 5.1 an S&OP questionnaire was designed, distributed, and results collected. The questionnaire can be seen in Appendix D and the results can be seen in Appendix E. Due to the number of respondents being fewer than expected, the questionnaire results were merged with comparable research being conducted by Ngueveu (2006) in France and Germany. The number of participants from both research projects totalled 26. The respondents included aerospace, automotive, food, pharmaceutical, and electronic manufactures. The majority of the respondents had been running an S&OP for a number of years and different levels of process maturity and performance were apparent.

From the findings of the questionnaire, it was difficult to reliably identify key measures of success that could be associated to specific activities and characteristics. Identifying measures of success was therefore to be explored in Chapter 6, where in-depth interviews were carried out. The focus of the questionnaire analysis was therefore to highlight the most common activities and factors that companies found both problematic and simple.

5.3 Analysis and discussion

This section analyses and discusses the results obtained from the questionnaire. The analysis is split into approaches: Pareto Analysis, Impact Analysis and Cross Examination.

Pareto Analysis

From Pareto analysing the consolidated answers to open-style questions, an overall picture can be obtained that helps identify what companies find easy and difficult with respect to S&OP. Four key views have been obtained:

1. What companies find most difficult throughout their S&OP initiative
2. What companies consider the most successful aspect of the S&OP process
3. What companies consider the least successful aspect of the S&OP process
4. What companies would have liked to do different given the chance

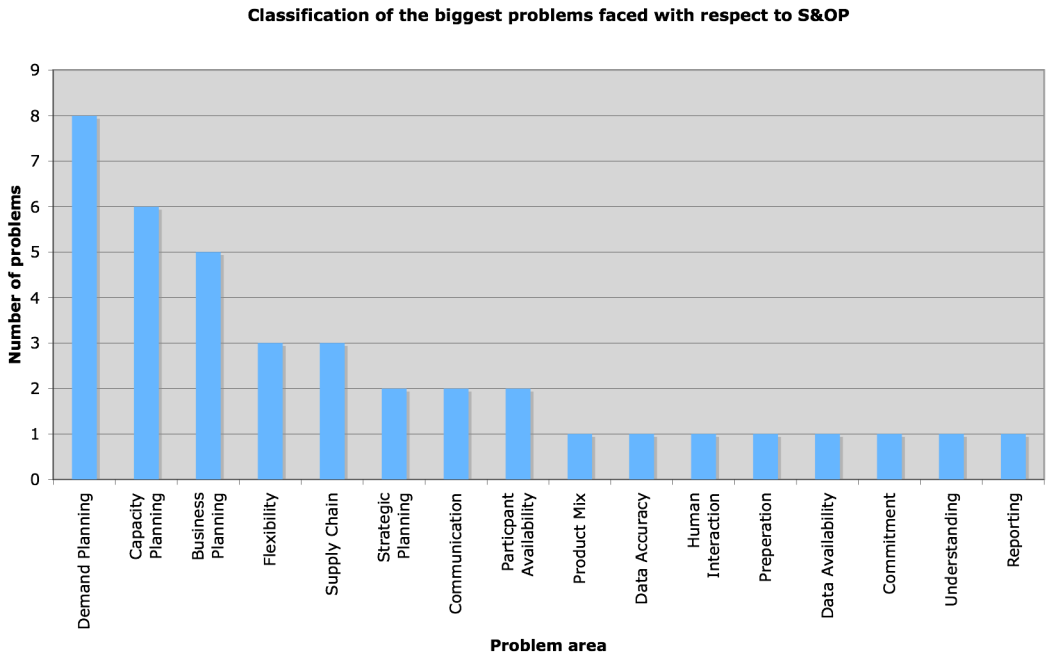

Figure 5 – Biggest S&OP problems faced by industry

Figure 5 shows that Demand Planning, Supply Planning and Business Planning are the three most problematic areas of S&OP by quite some margin. 50% of companies face problems relating to these three areas. Unsurprisingly, these three areas are essentially the core components of the S&OP cycle and are where the detailed operational tasks are carried out. Many of the behavioural factors appear less problematic, however, stringent route cause analysis is required to fully understand what is causing the problems in these three areas.

This analysis has generated the need to gain a further, more detailed, understanding of what specific activities are being carried out when companies conduct Demand Planning, Supply Planning and Financial Planning. This will allow a more precise picture of what causes these reported problems. The requirement was noted at this stage and reported in Chapter 6, where interviews were conducted.

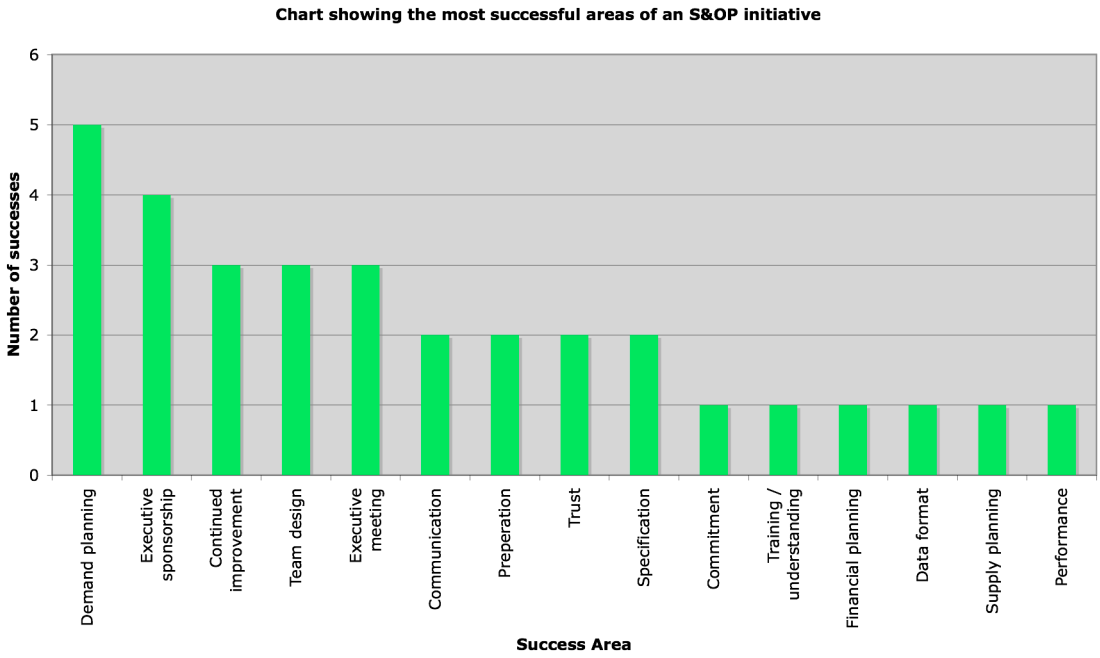

Figure 6 – Most successful S&OP aspects

Interestingly, Demand Planning is also the most successful aspect of S&OP along with the support of top management and Continued Improvement. This can be seen in Figure 6. Although established as the biggest problem area, companies must consider this area to have the greatest value in terms of success. It is here where companies should focus their improvement efforts in the first instance to improve performance of the whole S&OP process. Being able to accurately and routinely plan demand makes planning other activities, such as Supply Planning, a much easier process. This corroborates well with Ling (1988) and Muzumdar (2006) who describe that improving demand management allows the greatest risk to business objectives to be addressed. With Demand Planning being the most and problematical and successful activity, this

strengthens the view that S&OP helps companies to become market driven and have their products 'pulled' into the marketplace by customers, rather than a company forcefully 'pushing' products into the market themselves.

From the literature reviewed, top management support was a factor identified that often holds the key to successful S&OP implementation. Companies participating in this research also consider top management support a successful S&OP processes. To strengthen this analysis more evidence is needed that better explains how to improve top management support.

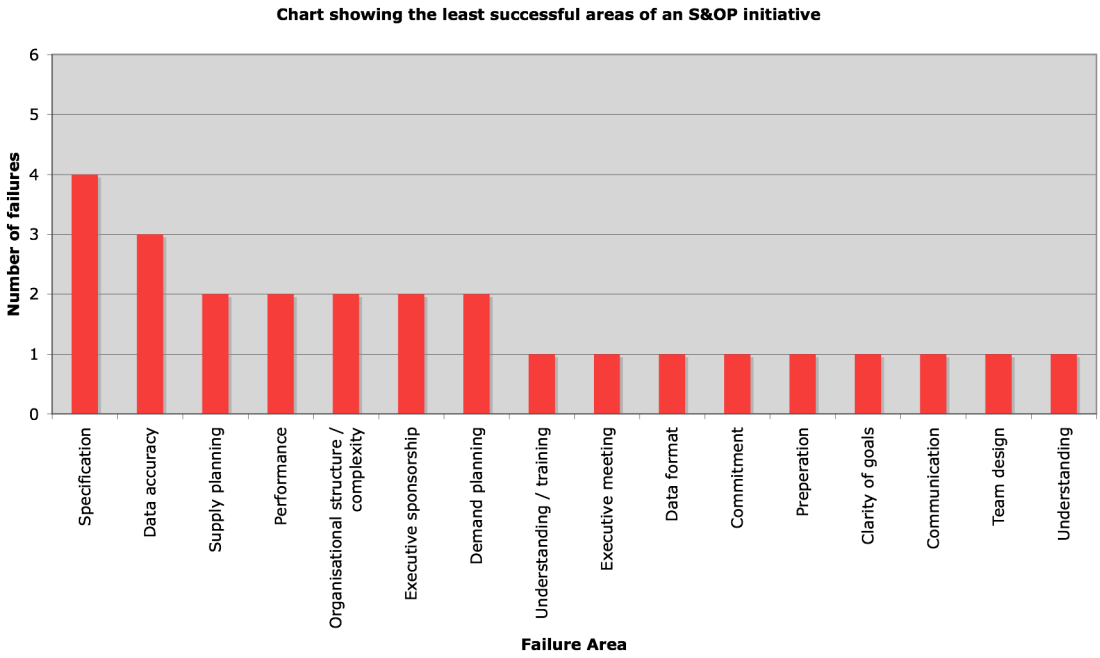

Figure 7 – Least successful S&OP aspects

Figure 7 shows that designing the process specification and having accurate data when operating the process are the least successful areas of an S&OP process. This is because often knowing what to specify at the beginning of a project is very difficult if no prior knowledge or understanding is available. Data accuracy may be perceived as an unsuccessful area of an S&OP initiative; companies must understand what level of accuracy is needed to make informed, cost-effective, decisions in an appropriate time

frame. Spending excessive time and resource trying to become more and more accurate can often prove inefficient. Striking the right balance is the key point.

Both Ling (1988) and Lapide (2005) agree that data must be accurate but do not stipulate what specific level of accuracy should be sought, or how different business environments impact on the level of accuracy required for successful S&OP. Therefore, the process of determining how to decide this level of accuracy needs further investigation. This requirement was noted at this stage and carried out in Chapter 6, where interviews were conducted.

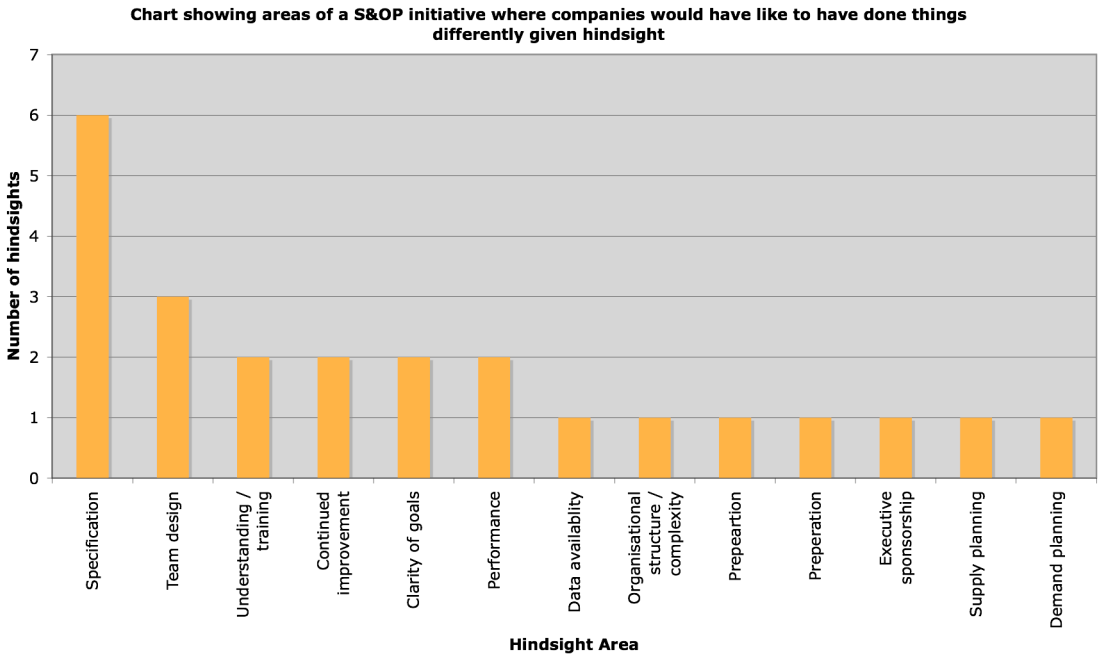

Figure 8 – Most desirable S&OP aspects to be revisited

Figure 8 clearly shows that, given hindsight, companies consider the Specification of the S&OP process as the activity that would benefit most from being done differently. This compares well to the least successful aspects of S&OP identified earlier.

This is an area where LCP Consulting could add great value to clients' processes and will form an integral part of the more qualitative extraction of process issues to be discussed in Chapter 6.

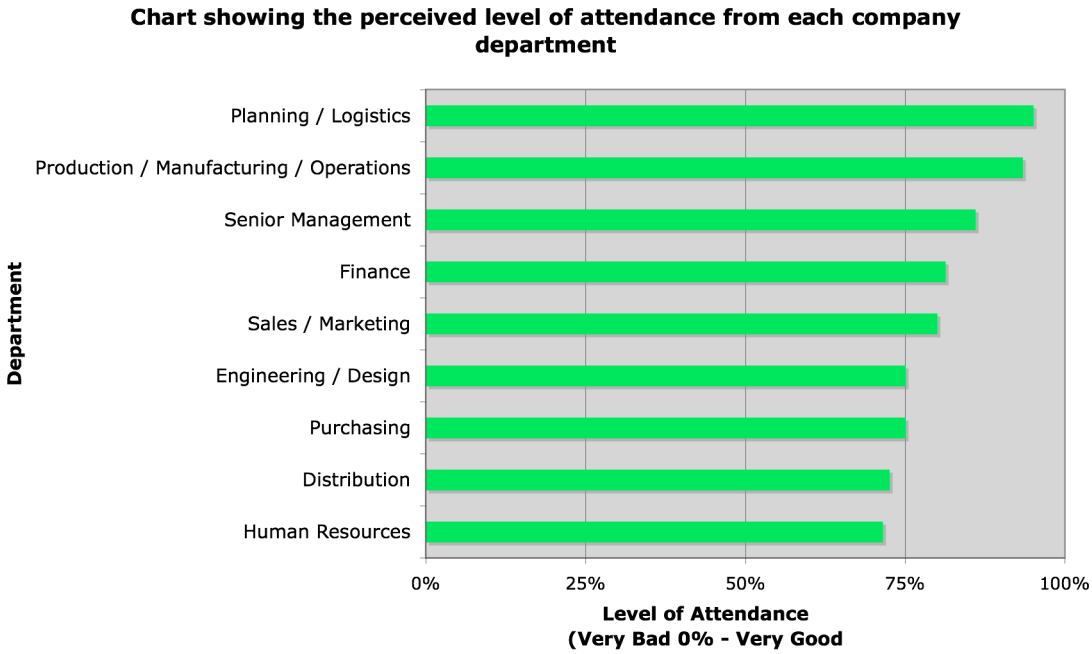

Figure 9 – Perceived departmental attendance levels at S&OP meetings

Figure 9 shows the perceived level of attendance of different departments at S&OP meetings. In general, attendance levels are good, and to gather understanding from industry that Senior Management is supporting the process strengthens the view that commitment is an influential factor.

The departmental attendance at S&OP meetings may be very dependent on the business environment in which a company operates. A MTO company with a high degree of customisation would be more likely to require input from an Engineering department compared to that of a Make-to-Stock (MTS) company.

Impact Analysis

For each company, the impact of each factor in each phase of the S&OP initiative was quantified. The full analysis for each phase can be seen in Appendix F.

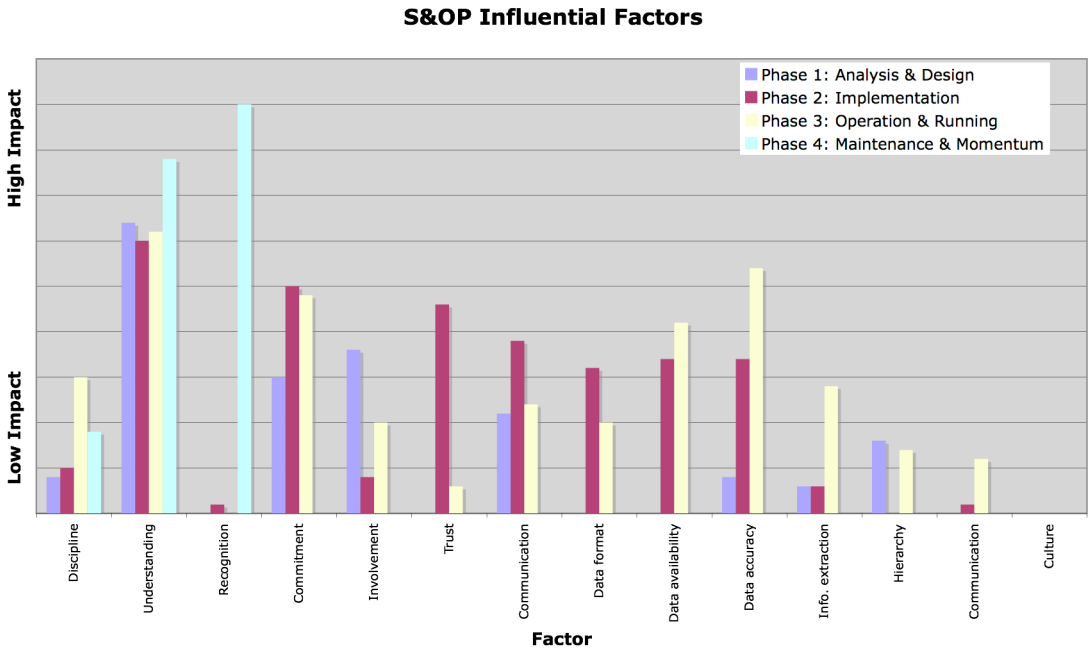

Figure 10 – Impact of influential factors on S&OP framework

Figure 10 shows the impact of all the influential factors, for each phase of the S&OP initiative for all 26 companies that competed the questionnaire. The description of each factor can be found in Table 1, Section 4.2. Below, each phase is analysed in turn before summarising the analysis of this approach.

Phase 1: Analysis & Design

This phase is heavily influenced by three Behavioural factors: Understanding, Involvement and Commitment. These may all be linked to the activities that involve forming teams and designing the process specification. Commitment at an early stage in the S&OP initiative demonstrates to stakeholders how important the process is. Ensuring participants are involved during this first phase is more likely to reduce resistance to change at subsequent phases.

Phase 2: Implementation

This phase builds on the Analysis & Design phase with the additional influences of Trust and Technological factors. It is the Implementation phase where the most amount of impact is found. The literature reviewed in Chapter 2 did not identify a particular phase or activity as the most critical to success however, from this evidence it is clear that the Implementation phase is the weakest link in the chain and the phase where significant effort should be placed to ensure success. Trust and Communication are essential parts of the Implementation phase and are often seen as the hardest factors to improve in a change management programme. These factors form part of the essential mix of ingredients in the recipe for change.

Phase 3: Operation & Running

Understanding and Data accuracy are the two most influential factors during this stage. Understanding relates to more of the intricate operational tasks performed during the S&OP cycle. The accuracy of data is critical during this phase, as executive decisions are later made based upon the analysis of data carried out during this cycle. If the input to the decision making process is poor, the effectiveness of the output is also likely to be poor. This relates well to previous Pareto Analyses that reported industry considered Demand Planning the most value-adding area of an S&OP initiative.

The impact of Discipline is greater in this phase than any other. One possible reason for this could the necessity for participants to regularly attend pre-S&OP meetings. Organisational factors including Hierarchy and Communication have more of an impact on this phase than any other.

Phase 4: Maintenance & Momentum

Recognition and Discipline are more prominent in the Maintenance and Momentum phase. This is due to the measurement of the process, and the participants themselves, being important so as to ensure continued success. This supports the activities that were identified during the analysis of Stage 1 of the research programme.

Impact Analysis Summary

Analysis & Design	Implementation	Operation & Running	Maintenance & Momentum
Understanding	Understanding	Understanding	Recognition
Involvement	Commitment	Data accuracy	Understanding
Commitment	Trust	Commitment	Discipline

Table 2 – Most influential S&OP factors collected from industry

Table 2 summarises the analysis, shown in Figure 10, by presenting the three most influential factors of each stage of the S&OP initiative. The most common factors throughout the evolution of an S&OP initiative are Understanding and Commitment. Commitment, both from senior management and participants of the process, is seen has one of the most influential factors from the literature reviewed. These two factors relate well to the previous analysis that found the Specification activity was the least successful S&OP aspect. The Understanding factor is closely linked to the specification activity.

Cross-examination

One hypothesis that was tested was whether the more complex a company was, in terms of number of product families, the more time was spent preparing before S&OP meetings.

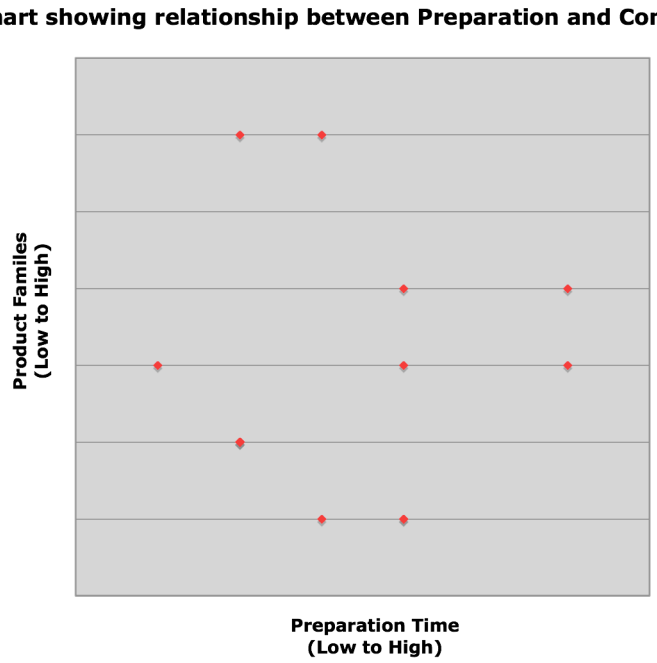

Figure 11 – Graph showing relationship between Preparation and Complexity

Figure 11 shows that there is no relationship between the number of product families and the time spent preparing for S&OP meetings thus disproving the hypothesis. Other factors must therefore contribute to the time companies spend carrying out preparation activities.

Similar analysis was also performed to understand if there were relationships between the number of Stock Keeping Units (SKUs) companies held and meeting preparation time, and between the length of companies' planning horizons and production volumes. These analyses also showed there was no clear relationships in either case. Further research of a larger sample size might allow such relationships to be discovered.

5.4 Chapter summary

This chapter has explained the method used to gather data from industry through using a questionnaire. The results of 26 questionnaires have been analysed and, in summary, found that four emerging areas need further investigation to substantiate their validity:

- Understanding is most influential factor especially when designing the process specification. What do company find difficult specifying and why?
- Top management support is crucial for a successful S&OP implementation. How it is first obtained? How it should be improved and support obtained?
- The biggest problems lie in Demand Planning. What specific tasks and procedures should be performed during this activity? What problems exist, and why?
- Data Accuracy is very important in enabling effective decisions to be made.

Chapter 6: DATA GATHERING AND ANALYSIS OF INTERVIEWS

This chapter describes stage 3 of the research programme, which further examines the S&OP issues that have become apparent in the previous chapter, and gauges levels of process success and maturity. The method used to accomplish objective 3 is explained followed by the findings and their analysis and discussion.

6.1 Method

Objective 3 was to extract and quantify the issues that companies face with regard to S&OP. This section details how objective 3 was accomplished. The method used can be split into four areas of work: Company Selection, Interview Design, Execution and Analysis Method.

Company Selection

A shortlist of potential interview candidates was created based on those companies that respond positively to the interview invitation question at the end of the questionnaire. A maximum of six interviews were planned, with the final set of companies exhibiting a wide as possible set of strengths and weaknesses across as many activities as possible. Those companies where the individual respondent was involved in all of the four phases of the S&OP initiative were to be priority targets.

Interview Design

To further extract data from industry, structured interviews were designed. The method used to design each of the interviews was based upon the same four-phase structure as the questionnaire. Specific questions were not targeted but rather topics for discussion identified, based upon prominent answers given in the company's questionnaire. For each discussion topic there were two key areas of interest:

1. What specific S&OP activities are (or are not) being carried out and why?
    a. What is the current level of success compared to other industries?

b. How was this level of success achieved? What problems were overcome? What worked particularly well, and why?

2. How do the influential factors identified relate to different activities?

Execution

For each interview candidate an interview structure was constructed, an example of which can be seen in Appendix G. Before attending an interview, the interview structure was emailed to the candidate along with a reminder of the meeting so as to allow some time for preparation. After attending the interview, comprehensive interview notes were written up.

Analysis Method

The method used to analyse the findings from the structured interviews was to collate the summaries for each set of interview notes and organise these key issues such that they relate to one of the four phases of the S&OP framework. For each issue, the S&OP activity was discussed making comparisons to other companies and referencing influential factors and published literature.

6.2 Findings

Through executing the method explained in Section 6.1, five structured interviews were carried out. The types of companies ranged from low-volume, high-value automotive and aerospace manufacturers, to high-volume, low-value pharmaceutical manufacturers. Each interview lasted approximately two hours from which an overview of the S&OP process was gained and answers to the pre-formatted structure were recorded. Appendix G provides comprehensive notes from each of the five interviews.

From the interviews conducted a series of issues were found that formed the base of subsequent analysis:

- Inception
- Specification
- Engineering Integration
- Education

- Commitment
- Pilot
- Meetings
- Collection of Data
- Quality of Data
- Measures of Success
- Continued Improvement

6.3 Analysis and discussion

This section analyses and discusses the findings from the structured interviews carried out Section 6.2. The salient issues found from the interviews are organised below such that they relate to one of the four phases of the S&OP framework described in Section 4.2 and shown in Figure 4.

Phase 1: Analysis & Design

Three key issues emerged during interviews that related to the Analysis & Design phase of the S&OP initiative: Inception, Specification, and Engineering Integration.

Inception

All companies interviewed had at least one compelling event that drove the decision to adopt S&OP. Compelling events included being acquired by another company, noticeably poor financial performance, or an inherent inability to win contracts for future work. Cecere *et al* (2005) corroborates that compelling events are a key trait of successful S&OP initiatives. A compelling event would make it easier for management to obtain participant buy-in, due to greater transparency.

Specification

All companies interviewed stated that their level of S&OP success was very much attributable to a well-designed specification. Defining what has to be done, how, when, and by whom provided companies with a very strong foundation on which to build and develop subsequent process activities. Achieving a well-designed specification was facilitated through the experience

gained of parent companies already operating S&OP, or through the use of experienced external consultants, notably Oliver Wight. Oliver Wight are global business improvement specialists who were the originator of MRPII and now educate companies to achieve business excellence. No companies interviewed tackled defining a set of practices alone.

This activity is strongly linked to the most influential factor identified in Chapter 5: Understanding. Whilst Understanding is key through the whole evolution of S&OP, it is during this Specification activity that it seems to have the most impact. To further support to this claim, Ling (1988) stresses how top-management must have an explicit understanding of the process in-order to inspire and motivate others into helping to design the process.

However, one company noted that there is an important step beyond obtaining a good level of understanding. Once everyone understands what physically needs implementing, aligning people's behaviours to suit is often the most overlooked and challenging aspect when compared to specific tools and processes.

Engineering Integration

Companies operating a MTO business claimed it was a huge mistake not to include a New Production Introduction (NPI) team from the Engineering department at the very beginning of the S&OP initiative. Ling (1988) states how important it is for Engineering to be involved in the S&OP cycle to advise other departments about new product introductions. This is also supported by the fact the many companies consider Business Planning and Flexibility, as amongst the biggest problems faced with respect to S&OP. Representatives from Engineering must be integrated into the process fully if such issues are to be addressed.

Phase 2: Implementation

Three key issues materialised during interviews that related to the Implementation phase of the S&OP initiative: Education, Commitment and Pilot.

Education

Companies all felt that training and educating participants in the concepts and intricacies of S&OP was key to a successful implementation. All companies required S&OP participants to attend 2 to 3-day workshops, often led by external organisations. One company, whose S&OP process was particularly mature, supported this education activity by publishing and maintaining all S&OP policy documentation and training material on the company's Intranet. This enabled a single-source of information to be referenced quickly, and provided the certainty that participants were all using the same latest standards.

This Education activity is very closely linked to the Understanding factor identified in Chapter 5. A good, well-structured education activity will enhance all participants' understanding of the S&OP. Obtaining buy-in from participants is key at the Implementation phase, and both Education and Understanding help achieve this through enabling the benefits of S&OP to be clearly understood.

Commitment

The commitment of both top management and participants is essential throughout the whole of the S&OP initiative, but it is here, at the Implementation phase, that companies agreed with the findings from literature that commitment has the most impact on a successful S&OP process. From the companies interviewed it was found that bigger, more complex, organisations need stronger top-management commitment. The work of Cecere (2005) supports this finding. The need for commitment is also supported by Ling (1998) and Wallace (2004) who both describe that top-management should lead by example and convey to participants how important S&OP is and how seriously the process should be taken.

Achieving high levels of commitment stems from clearly understanding and appreciating the benefits of S&OP such that they can be conveyed other stakeholders. This supports the findings from Chapter 5 that showed Understanding and Commitment as the two most influential S&OP factors.

Piloting

The two largest and most successful companies interviewed adopted a 'learn-by-doing' approach that merged the end of Implementation Phase and the beginning of the Operation & Running phase. The transition between the two is not as clear-cut as previously thought by Ling (1988). Wallace (2004) agrees with this concept by describing that one or two product families should be run through a pilot phase.

This is the area where most S&OP initiatives have the least checking or signing-off taking place. It is also the most likely area that will cause failure. A stepped approached to implementation with regular feedback checks would help companies ensure a smooth and successful S&OP implementation. Checks to gauge levels of commitment, understanding and belief would be particularly powerful in ensuring a successful Implementation.

Phase 3: Operation & Running

Three key issues materialised during interviews that related to the Operation & Running phase of the S&OP initiative: Meetings, Collection of Data, and Quality of Data.

Meetings

At some stage during the evolution of their S&OP processes, both pre-S&OP Meetings and the Executive S&OP Meeting were reported as areas of concern for nearly half of the companies interviewed. Poor levels of attendance and lack of discipline were commonly addressed by strong facilitation and strict agendas.

The influential factor, Hierarchy, negatively affects meeting activities when large companies, with many organisational structures, conduct S&OP meetings. Differing opinions become more commonplace and the ability to reach consensus quicker is reduced. Whilst conflict is healthy, companies often re-trained participants if more fundamental differences of opinions were apparent. This can be supported by the findings of the survey conducted in Chapter 5, however little literature has been found to support this issue. Focus should be placed on developing the meeting atmosphere and environment, as described by McGregor (1968), to encourage and promote an open and honest environment.

Collection of Data

During the S&OP cycle, 100% of companies had at some point found the collection of data during the core activities (Demand Planning, Supply Planning, Financial Planning), a hindrance to successful S&OP operation. One company spent approximately nineteen days collecting and processing data before any decisions were made regarding adjustments to supply or demand. In this time, new orders were often won that affected demand levels hence undermining the decisions being made. This problem was addressed by removing legacy systems and implementing a central database, where data was automatically populated, aggregated and distributed. Increased IT system training also helped the time taken to collect data. Another company had implemented a dashboard-style, Intranet-based, S&OP Centre that facilitated the collection and publication of key data.

Organisational structures where business units are intrinsically competitive also negatively impact on the collection of data, as participants do not want their often-poor performances, to be made more public than is necessary.

This analysis can be supported by the work of Ling (1988) who describes how data must be accurate, pertinent, timely, and be of a format that facilities understanding and sharing. Lapide (2005) states how technology can be incorporated to help with large complex needs requiring a level of automation.

Quality of Data

All but one company, expressed concern over the level of accuracy feeding their S&OP cycles, especially when planning levels of demand. All companies agreed that a considerable degree of error was attributable to human error and actively worked to reduce the levels human input. Companies appear to be fixated with improving the accuracy of data, before understanding what level of accuracy is actually needed in order to make quick, informed decisions. Only one company was aware of the level of accuracy needed, and understood that it often varied depending on business climates. This is an area that if companies understood better would vastly improve the speed of their data analysing activities. Muzumdar (2006) explains how plans can be held-up as a result of gathering

data of minimal importance and states that a business problem must be clearly understood and as well as the minimum amount of data needed to resolve it.

Ensuring data and information is of a format accessible to all stakeholders across the organisations, was found to be key in allowing a central understanding to be gained of supply and demand issues, and the pre-S&OP and Executive S&OP meeting(s) to be run efficiently and effectively.

This analysis may explain why the findings from Chapter 5, that showed that companies perceived Demand Planning as the most problematic area of an S&OP initiative, may be due to companies not fully appreciating what level of data accuracy best suits their current business climate.

Phase 4: Maintenance & Momentum

Two key issues materialised during interviews that related to the Maintenance & Momentum phase of the S&OP initiative: Measures of Success and Continued Improvement.

Measures of Success

Every company exhibited some form of success measurement. The majority of companies used traditional metrics such as sales forecast accuracy, actual v. planned production, and actual v. planned inventory. More holistic metrics including CSL and market share were measured but significantly less extensively than traditional metrics. Muzumdar (2006) states how companies must use holistic metrics that encompass the two-way impact of demand and supply decisions rather than traditional metrics that focus solely on either demand or supply. Measuring holistic measures, such as profitability, and attributing them to the S&OP is more difficult as market and economic factors can affect profitability. Companies should focus more on developing and improving this area in order to maximise the benefits of S&OP.

From interviewing companies it became apparent that it is very difficult to pinpoint success and claim it is attributable to S&OP. It can depend on when it was first measured, the current level of operational efficiency, and the objective/strategy of the business; be it to serve the customer at cost, or be more cost efficient at the expense of customer service levels.

Although the process output is measured, little evidence was found where the process being used and the people using the process were formally assessed. A company that had been operating the process nearly fourteen years, found this formal assessment crucial in proactively adapting to business change and assessing whether the fundamental process specification was still valid. An assessment of the planning horizon, product families, KPIs, reporting formats, and resources were typically conducted in a formal review. This is an area that current literature has not identified. The existing S&OP Framework, shown in Figure 4, was revisited, developed further, and is shown in Figure 12.

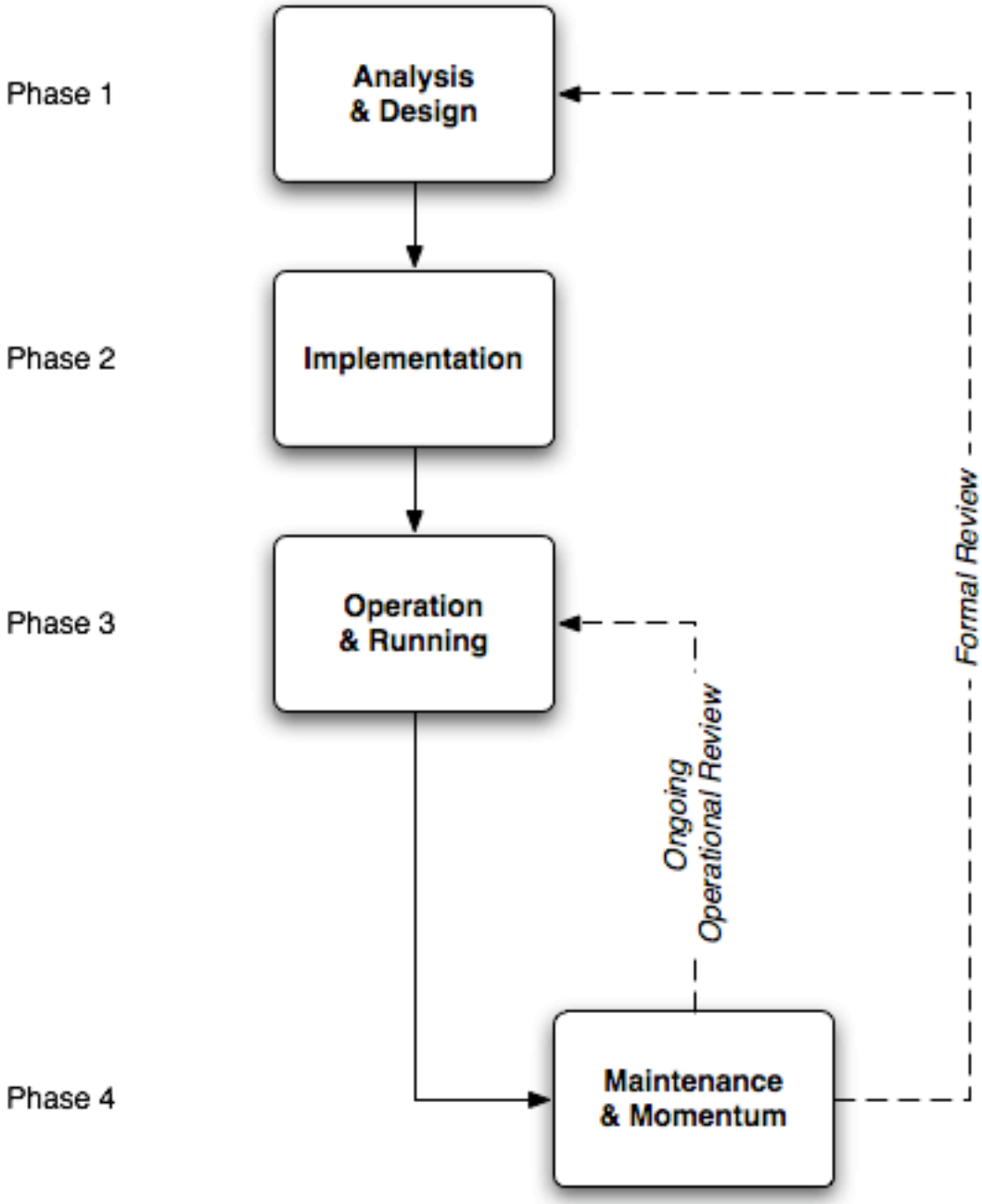

Figure 12 – S&OP Framework (including Formal Review)

A lack of evidence showing how participants' adherence to the S&OP process is controlled may be due to this issue being handled by the Human Resources department of a company. Measures were found to be in place that invoked discipline and commitment however might be classed as too distant to really have a profound affect on the performance of an S&OP process.

Continued Improvement

Of the most successful and mature companies, that had been using S&OP for more than four of five years, much of their focus was on continued improvement. Two key improvement areas were actively being undertaken to increase the success of S&OP: Outward Focus and Continuous Planning.

1. *Outward Focus*. Successful companies were found to be actively pursuing supplier and customer collaboration. Sharing data pertaining to supply and demand through an Extranet, and linking ERP systems, allowed for improved visibility and better demand management. This can be supported by Wing (2001) who describes collaborative relationships as an opportunity to synchronise with partners' plans and obtain more accurate forecasts whilst speeding up the exchange of information. The ability to collaborate with trading partners however, depends on the amount of leverage a company can employ with its partners.
2. *Continuous Planning*. Companies were also found to be actively trying to reduce the time taken to execute the S&OP cycle. Companies were aiming towards a Continuous Planning environment that would enable multiple what-if analyses to be conducted and the S&OP process to be modelled in real-time. Wing (2001) reports that few companies have managed to achieve this capability but describes how those companies that pioneer the process will have a long-term, sustainable competitive advantage.

6.4 Chapter summary

This chapter has explained the method used to gather data from industry by performing structured interviews. The findings of five interviews have been analysed and have shown the issues that companies face with respect to S&OP and how issues relate to success. Together with this analysis, and the prior analyses of Stage 1 and 2, the next chapter will explain how this information can be disseminated and made practical use of to improve S&OP processes.

Chapter 7: DESIGN OF AN S&OP IMPROVEMENT TOOL

This chapter describes Stage 4 of the research programme, which understands how to improve the success and sustainability of an S&OP process. The method used to accomplish objective 4 is detailed before presenting the objective's deliverable: a tool that will facilitate S&OP improvement.

7.1 Method

Objective 4 was to understand how to improve the success and sustainability of an S&OP process. This section details the method used to accomplish objective 4. The method used can be split into three areas of work: Form Activity Base, Describe and Scale Activities, and Link Activities to Factors.

Form Activity Base

To understand how to improve the success and sustainability of an S&OP process the method used was to bring together all of the findings and analyses relating to the S&OP Framework. The S&OP Framework revised in Figure 12, Chapter 6, was populated with a comprehensive set of S&OP activities for each of its four phases: Analysis & Design, Implementation, Operation & Running and Maintenance & Momentum. A list of S&OP activities can be seen in Section 4.2. S&OP activities were chosen as a base for improvement as they are the most recognisable items for users to identify with. Activities were collated from the literature reviewed in Chapter 2 and merged with the findings of the interviews performed in Chapter 6.

Describe and Scale Activities

The next area of work was to describe the varying degrees of maturity and capability for each activity. One end of the scale was representative of a company performing the activity during the very early stages of S&OP evolution, and the other extremity was representative of a company at the pinnacle of that activity's evolution. The scale was set such that each level reflected an iterative progression. If the top level was reached, it was to be assumed that all preceding levels had also been reached.

Link Activities to Factors

The last part of the method used to accomplish objective 4 was to associate the influential factors identified in Chapter 4 to the aforementioned S&OP framework.

7.2 Execution

From executing the method described in Section 7.1, an S&OP Improvement Tool was devised and built which can be seen in Appendix I. This section explains the constituent parts of the tool and how they link together, before providing some guidelines on how to use the tool. This section is split into two parts: Design & Development of Improvement Tool and Guidelines. The Guidelines section of work was produced in collaboration with Ngueveu (2006) and was to form part of a Summary Document produced for companies participating in the research.

Design & Development of Improvement Tool

Figure 13 shows how the concept of the Improvement Tool and how the three main components of the tool link together. The tool is made up of three main components: Process Activities, Activity Ratings and Influential Factors.

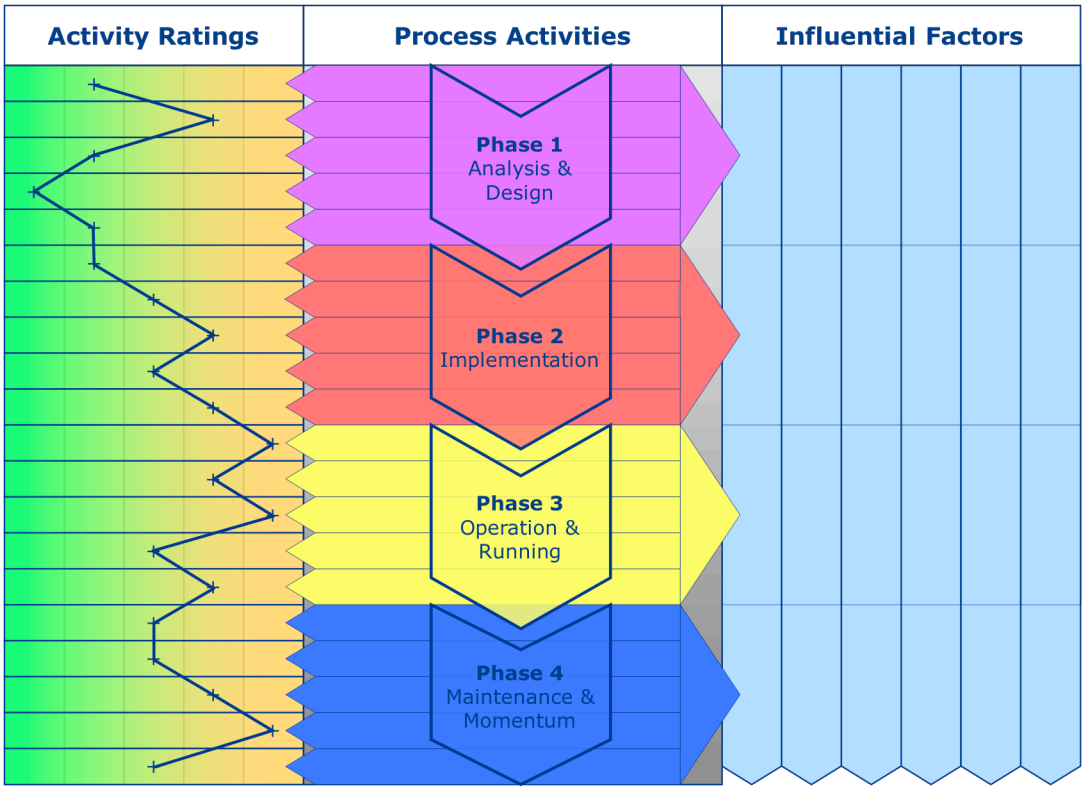

Figure 13 – S&OP Improvement Tool Concept

Process Activities

The backbone of the Improvement Tool is the four-phase S&OP framework and their respective activities. This makes up what companies should be doing during the evolution of an S&OP initiative. Table 3 lists these S&OP activities.

Phase	Activity
Analysis & Design	Team design
	Clarity of goals
	Inception
	Specification
Implement-ation	Systems infrastructure
	Training
	Executive sponsorship
Operation & Running	Demand planning
	Supply planning
	Financial planning
	Preparation
	Executive meeting
	Behavioural performance
	Process performance
Maintenance & Momentum	Effectiveness
	Efficiency
	Balance and focus

Table 3 – S&OP Activity Base

Activity Ratings

The activity ratings for each S&OP activity determine how well a company is performing the respective activity in terms of maturity and success.

Figure 14 shows the five incremental rating levels for the Demand Planning activity: 1 being the lowest and 5 the highest. The content of each of the five levels was derived from merging the findings and analyses from literature, the industry questionnaire, and industrial interviews. The scaling of activities was validated through speaking to industry professionals during the structured interviews carried out during Chapter 6.

Rating				
5	4	3	2	1
Market demand is shaped using what-if analysis of promotions, price, contracts, NPI to develop many plans. Key scenarios packaged with base level forecast	Forecast converted to shipping requirement using a formal process. Assumptions used with management input to generate base level forecast. Assumptions repository is available and is updated regularly	Entire market forecast is produced using formal statistical analysis of historic data. Families have been formally agreed with manufacturing or supply organisations	A forecast is produced on-time for each product family or SKU	A forecast is produced although formal agreement on product families may not have been reached

Figure 14 – S&OP Activity Rating for Demand Planning

Influential Factors

The fourteen influential factors show the level of impact each influential factor has on each of the four phases of the S&OP framework. This offers an insight into what factor(s) best aid the improvement of an S&OP phase. The impact is visually shown as either none, low, or high. Compared to S&OP activities, influential factors offer more of a general area of focus that would best enhance the success of S&OP. The three categories of factors are Behavioural, Technological and Organisational. This final part of the Improvement Tool was the deliverable of Stage 1 of the research documented in Chapter 4.

The full S&OP Improvement Tool can be seen in Appendix I

<u>Guidelines</u>

The purpose of the tool is to facilitate the performance improvement of an S&OP process. This is done firstly through benchmarking the current level of performance. Highlighted strengths and weakness can then be attributed to influential factors. This

provides a basis for focusing improvements. The tool can also be used a reference when designing and implementing a new S&OP process.

Running down the centre of the document are the four phases of an S&OP initiative and their corresponding activities. To the left of each activity a simple 1 to 5 scoring system can be used to audit each activity's level of maturity or success. To the right of each phase, the impact level of influential factors is shown based on the findings from literature and surveying 25 companies. Once the levels of success and maturity have been scored for each of the relevant activities the influential factors can be cross-referenced to understand which factors will most help facilitate the improvement of an activity.

7.3 Validation

To validate the Improvement Tool shown in Appendix I, the tool was sent to four independent manufacturing companies for constructive criticism and feedback. All the feedback received was positive and a common observation was that the tool was very useful, comprehensive, yet simple to use.

7.4 Chapter summary

This chapter has detailed the method used to devise a simple tool that facilitates the improvement of an S&OP process's success and sustainability. The tool enables third parties to understand what processes must be carried out, to assess how well they are how performing, and to understand the level of impact of influential factors, such that improvements can be carried out and sustained.

Chapter 8: CONCLUSION

This final chapter summarises the key findings of the research and shows how they have accomplished each of the four objectives, and ultimately the research aim. It also exposes the limitations of the research and makes suggestions for further work.

The aim of the thesis was,

> "to investigate and identify the principal factors that enable and inhibit the successful execution of S&OP in the UK."

8.1 Summary of key findings

This section summarises the key findings of the research. This section is split into three parts: S&OP Enablers, S&OP Inhibitors and Other Issues.

S&OP Enablers

- **Understanding**

  Understanding what has to be done, how, when, and by whom provides a strong foundation on which to build and develop subsequent successful process activities. Understanding allows S&OP benefits to be fully understood and buy-in obtained more easily.

- **Top-level management support**

  The support and commitment of top-level management is critical throughout the evolution of S&OP. It is most critical during the Implementation phase.

- **Data Availability**

  Leveraging technology, to increase the speed at which a sound S&OP cycle process can be 'refreshed', will enable companies to gain a long-term, sustainable competitive advantage.

- **Performance Measures**

  Holistic metrics, that encompass the two-way impact of demand and supply decisions, should be used rather than traditional metrics. Employing metrics of a holistic type enable the benefits of S&OP to be maximised.

- **Feedback**

  Feedback during the S&OP cycle is essential to enable formal fundamental reviews as well as regular operational reviews so as to adapt to changes in the business climate.

S&OP Inhibitors

- **Behaviours**

  Behavioural factors and people's perceptions are the hardest element of S&OP to align to S&OP policy, not tools, systems or processes. Changing people's behaviour is accomplished through helping them to understand, providing support and recognising their contribution.

- **Organisational Complexity**

  Organisational structures where business units are intrinsically competitive negatively impact on the collection of data, as participants do not want their often-poor performances, to be made more public than is necessary.

8.2 Limitations

The main limitation of the research was not being able to successfully measure some of the successes that are attributable to specific S&OP activities. This was an area where companies were not prepared to divulge financial information and an area that not all companies fully appreciated. Although some data was gathered about this area through conducting interviews, the questionnaire lacked sufficient questions relating to these measures of success.

There were also limitations that related to the sample of data. With only 26 companies choosing to participate in the research, the findings and analyses were therefore based

on a limited sample size. The cross-section of targeted industry types was also limited which might have biased the findings. This was due to the search criteria being based on companies that related to LCP Consulting's client base. Another limitation was the level of S&OP process maturity amongst companies participating in the research being of a similar level. The majority of companies had been operating S&OP for a number of years. Whilst an insight into the experience of these companies was invaluable, an insight into companies just starting on the journey towards S&OP implementation would have made an interesting comparison.

8.3 Recommended future work

The most beneficial area of future work would be in the area of Continuous Planning. Companies exhibiting mature and sound S&OP processes all wanted to speed up the time in which an S&OP cycle can be executed. This would enable a far greater number of scenarios and 'what-ifs' to be discussed and proactively planned for. Work is recommended that explores what behaviours, tools and processes are holding up companies in reaching a Continuous Planning environment and seek to address them.

Future work should also look to explore assigning weightings to particular activities to distinguish those that have more, or less, of an affect on the success of S&OP. This work could also be relevant to influential factors as well as S&OP activities.

Finally, work could be explored that allowed S&OP activities and influential factors to be tailored to specific industry types. By adding this third axis to the S&OP Improvement Tool, a more focused understanding of how to improve a specific industry's S&OP process would be gained.

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APPENDIX A: UK Industrial Search Criteria

Turnover	Industry	UK SIC (2003) Classification	Result
Between £100M and £2,500M	Manufacture of motor vehicles	3410	18
	Manufacture of machinery for mining, quarrying and construction	2952	11
	Manufacture of other plastic products	2524	28
	Manufacture of basic pharmaceutical products	2441	49
	Printing not elsewhere classified	2222	26
		Total	**132**

APPENDIX B: Invitation Letter

«Date»

«Full_Name_1»
«Company_Name»
«Job_Title»
«Address_1»
«Address_2»
«Address_3»
«Town»
«County»
«Postcode»

Sales & Operations Planning Research

Dear «Full_Name_2»,

Sales and Operations Planning (S&OP) can be one of the main factors of success enabling sustainability; but in many companies where the S&OP process is not as effective as it could be, a competitive edge is denied. Cranfield University, a leading academic institution, has worked with many world-class companies and is now instigating a project to investigate how companies can improve S&OP efficiency and therefore the probability of success.

This project will focus on current S&OP implementation, distinguishing between the standard textbook view and the real reasons why many companies find this difficult. The approach combines literature study with real world findings from participating companies. The output will include a list of practical observations and activities that companies can usefully engage in and will be available by October 2006.

To benefit from this research, participating companies will be required to complete a short questionnaire about their current S&OP activities and developments. Any data collected will be treated in the strictest of confidence. All companies supporting this research will receive a short document summarising the findings.

I will contact you in a few days to explore how you or one of your colleagues may represent your company and benefit from the findings.

Yours sincerely,

Bryn Sharp
MRes Student
Manufacturing Consultancy

School of Industrial and Manufacturing Science
Cranfield University
Bedfordshire
MK43 0AL
United Kingdom

APPENDIX C: Questionnaire System Evaluation

	MS Word	**MS Access**	**Online Web Host** (QuestionPro)
Learning Curve	✓✓ Easy	✗✗ Very Hard	✓ Moderate
Functionality (collect, store, analyse, report)	✗ Bad	✓✓ Excellent	✓ Good
Robustness	✓ Moderate	✓✓ Excellent	✓✓ Excellent
IT Support	✗ Need CU help	✗✗ Need CU help	✓ None

APPENDIX D: S&OP Questionnaire

Questions marked with a * are required

Thank you for accepting to participate in this research.

This research is being carried out by Cranfield University amongst leading companies in France, Germany and the UK.
All data collected will be treated with strict confidentiality. This questionnaire has been designed to take no more than 30 minutes to be completed. Please take time to consider your answers, the more accurate the answers, the better the output will be. After completing the questionnaire, a summary of the findings will be provided. This document will offer practical observations and activities which can be engaged to improve the Sales and Operations Planning (S&OP) process.

Sincerely,

Bryn Sharp
Sandra U. NGUEVEU
Cranfield University

Please enter or paste here one of the codes assigned to your company. *

Section 1: Company Background

Note: If your company is part of a multinational organisation please answer the following questions with respect to your local business unit and NOT the organisation as a whole.

1. Please complete the following personal details:

Job Title *

Department *

How many years have you been working in your current department? *

How many years have you been working for your current employer? *

2. How many people does your local site employ? If you are part of a multinational organisation please consider only your business unit. *

- Under 1000
- 1000 to 2499
- 2500 to 4999
- 5000 to 9999
- 10,000 to 19,999
- Over 20,000

3. What is your local site's current turnover in GBP (millions)? *

- Under 100
- 100 to 249
- 250 to 499
- 500 to 999
- 1,000 to 1,999
- 2,000 to 4,999

- ○ Over 5,000

4. How many finished products does your business unit produce per week?
(Where a product is classed as a single unit or item of production ready to leave the factory e.g. a car manufacturer would answer the number of cars that come off the end of the production line per week.) *

- ○ Under 10
- ○ 10 to 99
- ○ 100 to 999
- ○ 1000 to 9999
- ○ 10,000 to 99,999
- ○ Over 100,000

5. Approximately, how many stock keeping units (SKUs) does your business unit operate with? *

- ○ Under 100
- ○ 100 to 249
- ○ 250 to 499
- ○ 500 to 999
- ○ 1,000 to 1,999
- ○ 2,000 to 4,999
- ○ 5,000 to 9,999
- ○ Over 10,000
- ○ Other (please specify) _____

6. What is the average customer order lead time of your business unit's major products?
(Where lead time is classed as the time between when a customer places an order to when the customer receives the order. And where Customer is classed as the next recipient in the supply chain e.g. a dealer network.) *

- ○ Less than a day
- ○ Less than a week
- ○ 1 week to 1 month
- ○ 1 month to 3 months
- ○ 3 months to 6 months
- ○ 6 months to 1 year
- ○ Other (please specify) _____

7. With regard to S&OP, how many product families or groups (the highest level of agregation) does your company operate with? *

- ○ 3 to 5
- ○ 6 to 9
- ○ 9 to 12
- ○ 13 to 15
- ○ 16 to 19
- ○ 20 to 25
- ○ Other (please specify) _____

8. In general, the variation from normal customer order patterns is: *

- ○ Unpredictable: forecasts are not accurate at all or inexistent; the company reacts with the means possessed.

Roughly anticipated: the company always pocesses enough capacity, that can be matched with the different products the customer demands.

Predicted and anticipated: the company has the ordering pattern under control and easily adjusts capacity according to forecasts.

9. How much change in the normal customer demand pattern would you estimate easy for your business unit to cope with within the different periods of time?

	± 0 to 5%	± 6 to 10%	± 11 to 20%	± 21 to 50%	± 51 to 70%	± 71 to 100%	± 101 to 200%
Up to 1 day							
1 day to 1 week							
1 week to 2 weeks							
2 weeks to 1 month							
1 month to 2 months							
2 months to 4 months							
4 months to 6 months							
6 months to 1 year							
More than 1 year							

10. How often would you estimate the following amount of change happens in the normal customer demand pattern?

	Daily	Weekly	Monthly	Bi-monthly	Every 3 months	Every 6 months	Once a year	Less than once a year
± 0 to 5%								
± 6 to 10%								
± 11 to 20%								
± 21 to 50%								
± 51 to 70%								
± 71 to 100%								
± 101 to 200%								

11. Please select which statement best describes, IN GENERAL, the level of supply chain integration your business unit has with its largest proportion of Suppliers. *

None: the business unit presents its requirements to suppliers which provide the requested product, without any further collaboration.

Low: the business unit owns/controls a few suppliers and tries to develop a partnership to anticipate change.

High: the business unit controls the entire supply process, from the early raw materials.

12. Please select which statement best describes, IN GENERAL, the level of supply chain integration your business unit has with Final Customers. *

None: the business unit delivers to intermediate parties and mainly focuses on partner requests.

Low: the business unit delivers to retailers / distributors, cooperates closely, and has an indirect link to the final customer.

High: the business unit is directly linked to the final consumer and has clear visabiliy on the evolution of demand.

13. How many people, from the following departments are present at S&OP meetings?

Sales / Marketing

Production / Manufacturing / Operations

Distribution

Finance

Purchasing

Planning / Logistics

Engineering / Design

Human Resources

Senior Management

14. How often does the S&OP team formally hold its meetings? *

- Every few days
- Weekly
- Monthly
- Bi-monthly
- Quarterly
- When the circumstance arises
- Other (please specify)

15. What is the horizon of decisions taken at the S&OP meeting? *

- Up to 1 week
- 1 month to 2 months
- 2 months to 4 months
- 4 months to 6 months
- 6 months to 12 months
- 1 year to 2 years
- Until the next significant change
- Other (please specify)

16. How often does your company have to provide financial reports to its stakeholders? *

- Monthly
- Bimonthly
- Every 3 months
- Every 6 months
- Annually
- Other (please specify)

17. For each of the four sections below, please select which statement best describes the culture of your company

a. Ways of working *

- Individualist: you are are your own boss. Individuals decide most things themselves and know how to get along with their own business, without expecting others to look out for them.
- Collectivist: everybody works together. Everybody has something to say in the decisions that are made, and everybody can count on one another.

b. Criticism *

- Is aimed at the task and not the person

- Is only given when asked for.
- Is mostly negative and usually takes the form of blame
- Is avoided so as not to hurt the feelings of others.

c. Conflict *

- Is controlled by the intervention of higher authority.
- Is suppressed by reference to rules, procedures and definitions of responsibility
- Is resolved through full discussion of the merits of the work issues involved.
- Is resolved by open and deep discussion of personal needs and values

d. Hierarchy *

- Is redundant because each person is working for thier own professional development
- Is necessary because people have to know who has authority over whom.
- Is determined by the power and authority of the people involved.
- is relevant only if useful to get the task done.

18. Were you involved in the Analysis and Design phase of the S&OP evolution? *

- Yes
- No

This stage starts when the need for S&OP is realised by a company and finishes when the general manager understands what should be communicated and to whom about S&OP to enable its successful implementation.

The objective of this stage is to construct a framework upon which all of the characteristics of the S&OP process can be built around.

Section 2: Analysis & Design

Note: DO NOT answer this section if you were NOT involved in the Analysis and Design phase of the S&OP evolution. If you took part in this phase, please answer the following questions keeping in mind your opinions / perceptions at that point in time.

1. Where did the S&OP idea come from?

- Driven by company strategy
- From external consultants
- From internal managers

2. How much do you agree that the following activities were executed during the Analysis and Design phase of the S&OP process?

	Strongly Agree	Agree	Disagree	Strongly Disagree
A concise statement was agreed upon outlining: what S&OP was, what its aims were, what its objectives were; all of which was incorporated into the company policy.				
Product familes were agreed upon along with common units that would allow plans to be considered in aggregate and communicated in the most effective manner.				
A planning horizon was defined that allowed sufficient business planning, capacity planning, supplier scheduling and what-if analysis.				
Timefences were established as guidelines for managing changes.				
A cycle of events was clearly defined detailing the steps required between meetings.				
Resources were made available that were sufficient for a successful and sustainable S&OP process to be integrated with the business.				
A long-term recurring meeting schedule was planned and reserved well in advance of the first formal S&OP meeting.				

A common agenda was constructed outlining the steps to be followed in the S&OP meeting.	○	○	○	○

3. What, if any, supporting IT systems were adopted during the Analysis and Design phase?

- ☐ Global ERP system
- ☐ Software
- ☐ Website
- ☐ None
- ☐ Other (please specify) _____

4. How many representatives of the following departments were involved in the Analysis and Design phase?

	Senior Management	Middle Management	Operational
Sales / Marketing			
Production / Manufacturing / Operations			
Distribution			
Finance			
Purchasing			
Planning / Logistics			
Engineering / Design			
Human Resources			

5. How much do you agree that there were sufficient numbers of representatives present from each of the following departments during the Analysis and Design phase?

	Strongly Agree	Agree	Disagree	Strongly Disagree
Sales / Marketing	○	○	○	○
Production / Manufacturing / Operations	○	○	○	○
Distribution	○	○	○	○
Finance	○	○	○	○
Purchasing	○	○	○	○
Planning / Logistics	○	○	○	○
Engineering / Design	○	○	○	○
Human Resources	○	○	○	○
Senior Management	○	○	○	○

6. Was a formal procedure used to sign off the Analysis & Design phase of the S&OP process?

- ○ Yes
- ○ No

7. What percentage of the roles responsible for the Analysis and Design of S&OP are, as of today, still involved in its Operation and Running?

_____

8. Please provide some detail with respect to the following aspects of the Analysis and Design phase of the process:

The most successful aspect

The least successful aspect

What would you do differently, and why, given hindsight?

9. Please select any support you received for the Analysis and Design phase of the S&OP evolution.

- ☐ Academia
- ☐ External Consultant
- ☐ Internal Consultant
- ☐ Strategic Partner
- ☐ None
- ☐ Other (please specify)

10. Were you involved in the Implementation phase of the S&OP evolution?

- ○ Yes
- ○ No

This phase starts when the participants responsible for the design stage agree that the framework is appropriate. It finishes when all those participants involved in the S&OP process understand what has to be done, why it has to be done, how it will be realised within the company and do not need any support to carry out their responsibilities.

The process becomes a routine, is fully integrated into the business operations and is considered business as usual.

Section 3: Implementation

Note: DO NOT answer this section if you were NOT involved in the Implementation phase of the S&OP evolution. If you took part in this phase, please answer the following questions keeping in mind your opinions / perceptions at THAT point in time.

1. How much do you agree that the following activities were executed during the Implementation phase of the S&OP evolution?

	Strongly Agree	Agree	Disagree	Strongly Disagree
A clear description of S&OP was communicated to me.	○	○	○	○
The aim of S&OP was communicated to me.	○	○	○	○
The specific objectives of S&OP were communicated to me.	○	○	○	○
The benefits of S&OP for the department were communicated to me.	○	○	○	○
The benefits of S&OP for the company were communicated to me.	○	○	○	○
The benefits of S&OP for the customer were communicated to me.	○	○	○	○

2. Considering any training that you received during the Implementation phase, which of the following statements describes best your ability after its completion?

- ○ Did not receive any training.
- ○ Understood the main concepts.

- ○ Was able to work well but needed a little supervision and support.
- ○ Was able to work well alone and without supervision.

3. How would you rate the provision of tools that enabled the facilitation of the following?

	Very bad	Bad	Good	Very good
Data exchange	○	○	○	○
Data availability	○	○	○	○
Data accuracy	○	○	○	○

4. How would you rate the level of commitment and support that was available during the Implementation phase from the following departments?

	Very bad	Bad	Good	Very good
Sales / Marketing	○	○	○	○
Production / Manufacturing / Operations	○	○	○	○
Distribution	○	○	○	○
Finance	○	○	○	○
Purchasing	○	○	○	○
Planning / Logistics	○	○	○	○
Engineering / Design	○	○	○	○
Human Resources	○	○	○	○
Senior Management	○	○	○	○

5. How much do you agree with the following statements describing how you felt at the end of the implementation phase?

	Strongly Agree	Agree	Disagree	Strongly Disagree
Felt confident that S&OP would be a useful tool to satisfy customer demand whilst working within the constraints of the company's normal capacity.	○	○	○	○
Felt the implementation stage was a success.	○	○	○	○
Felt S&OP would be of value to the company and it would improve the competitiveness of the business.	○	○	○	○
Felt S&OP would be a tool used to make sustainable improvements to increase the competiveness of the company.	○	○	○	○

6. Please provide some detail with respect to the following aspects of the Implementation phase of the process:

The most successful aspect

The least successful aspect

What would you do differently, and why, given hindsight?

7. Please select any support you received for the Implementation phase of the S&OP evolution.

- ☐ Academia
- ☐ External Consultant
- ☐ Internal Consultant

- [ ] Strategic Partner
- [ ] None
- [ ] Other (please specify)

Section 4: Operation and Running

Note: Please answer the following questions with respect to how the S&OP process is running currently in your company.

1. How would you rate the importance of the following activities when carrying out the S&OP cycle?

	Very high	High	Low	Very low
Preparation	○	○	○	○
Data accuracy	○	○	○	○
Data format	○	○	○	○
Reviewing and documenting assumptions	○	○	○	○
Assessing past performance to plan	○	○	○	○
Resolving conflict and reaching consensus	○	○	○	○
Circulating minutes after the meeting	○	○	○	○
Identifying and assessing options	○	○	○	○

2. How would you rate the attendance of the following departments at S&OP meetings?

	Very bad	Bad	Good	Very good
Sales / Marketing	○	○	○	○
Production / Manufacturing / Operations	○	○	○	○
Distribution	○	○	○	○
Finance	○	○	○	○
Purchasing	○	○	○	○
Planning / Logistics	○	○	○	○
Engineering / Design	○	○	○	○
Human Resources	○	○	○	○
Senior Management	○	○	○	○

3. Considering the S&OP meeting itself, which of the following characteristics would you want to improve? Please rank a minimum of 3 in order of preference.

Agenda / structure	
Reporting format	
Schedule	
Minutes	
Handling conflict	
Listening skills	
Ability to reach consensus	
Honesty	
Atmosphere	
Meeting attendance	
Pre-S&OP meeting preperation	
Senior management involvement	

Rank values must be between 1 and 12

4. Please briefly list any useful tools you don't currently have that you feel would be of benefitial use in the running of the S&OP process.

5. How would you rate the quality of the following characteristics with respect to data that is automatically generated in order for reports to be compiled before the S&OP meeting?

	Very bad	Bad	Good	Very good
Detail	○	○	○	○
Suitability	○	○	○	○
Accuracy	○	○	○	○
Availability / timeliness	○	○	○	○

6. Approximately, how much time dou you spend preparing for the formal S&OP meeting. Please include any time spent in pre-S&OP meetings.

- ○ Less than 4 hours
- ○ 4 to 8 hours
- ○ 1 to 2 days
- ○ 3 to 5 days
- ○ 1 to 2 weeks
- ○ More than 2 weeks
- ○ Other (please specify)

Briefly describe the types of tasks and activities that you carry out in this time.

7. Please list the five biggest problems that your company currently faces with respect to S&OP.

1
2
3
4
5

8. Please list the job title(s) of the person(s) responsible for championing S&OP in your company.

9. Please list the job title(s) of the person(s) responsible for facilitating / chairing the formal S&OP meeting.

10. Please provide some detail with respect to the following aspects of the Operation and Running phase of the process:

The most successful aspect

The least successful aspect

What would you do differently, and why, given hindsight?

11. Please select any support you are receiving for the Operation and Running of your S&OP process.

- [ ] Academia
- [ ] External Consultant
- [ ] Internal Consultant
- [ ] Strategic Partner
- [ ] None
- [ ] Other (please specify)

Section 5: Maintenance & Momentum

1. What level of recognition have you received / did you receive for your contribution to the evolution of S&OP?

- [ ] Informal verbal congratulations
- [ ] Formal verbal congratulations
- [ ] Performance formally recorded within Personal Development Review
- [ ] Objectives specifically set within Personal Development Review
- [ ] Objectives formally reviewed within Personal Development Review
- [ ] One-off bonus payment
- [ ] Increase in annual salary
- [ ] Promotion
- [ ] None
- [ ] Other (please specify)

2. Approximately how often do you reconsider (feedback, review and change if necessary) the following elements to ensure the S&OP process remains valid?

	Not at all	When the need arises	Monthly	Bi-monthly	Quarterly	Every 6 months	Annually	Bi-annually
Timing / Planning horizon	○	○	○	○	○	○	○	○
Segmentation / Product families	○	○	○	○	○	○	○	○
Common Units	○	○	○	○	○	○	○	○
Reporting system and design	○	○	○	○	○	○	○	○
Measures (e.g. KPIs, PDRs)	○	○	○	○	○	○	○	○
Resources	○	○	○	○	○	○	○	○
Feedback system design	○	○	○	○	○	○	○	○

Section 6: Further Research

1. Would you be prepared to carry out a further on-site interview to help strengthen this research in order for you to benefit from more detailed findings? *

- ○ Yes
- ○ No

2. If you have been filling this questionnaire on the behalf of someone else, please enter your personal information

My own job

My own department

How long I have been working at the current position (in years)

How long I have been working for the current employer (in years)

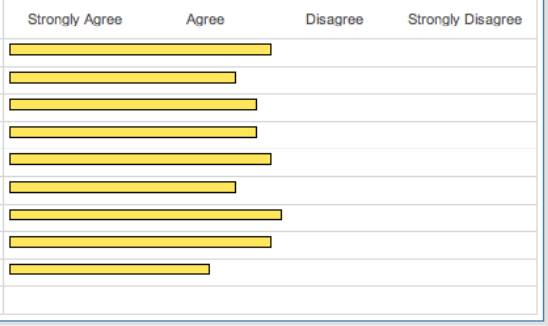
Please contact b.w.sharp@cranfield.ac.uk or s.u.ngueveu@cranfield.ac.uk if you have any questions regarding this survey.

APPENDIX E1: S&OP Questionnaire Closed Question Results

5. How much do you agree that there were sufficient numbers of representatives present from each of the following departments during the Analysis and Design phase?

Overall Matrix Scorecard

	Question	Count	Score
1.	Sales / Marketing	11	2.000
2.	Production / Manufacturing / Operations	11	1.727
3.	Distribution	10	1.900
4.	Finance	11	1.909
5.	Purchasing	11	2.000
6.	Planning / Logistics	11	1.727
7.	Engineering / Design	10	2.100
8.	Human Resources	10	2.000
9.	Senior Management	11	1.545
		Average	**1.879**



Sales / Marketing

Frequency Analysis

Answer	Count	Percent
Strongly Agree	**4**	**36.36%**
Agree	4	36.36%
Disagree	2	18.18%
Strongly Disagree	1	9.09%
Total	**11**	**100%**

Key Analytics

Mean	2.000
Confidence Interval @ 95%	[1.409 - 2.591] n = 11
Standard Deviation	1.000
Standard Error	0.302

Key Facts

72.73% chose the following options :
- Strongly Agree
- Agree

Least chosen option 9.09% :
- Strongly Disagree

Only an example of the results is given due to the vast quantity of data.

APPENDIX E2: S&OP Questionnaire Open Question Results

The most successful aspect

1483450	Regional Sales Input Recognition of importance of accuracy of Product Plan used for annual Planning Round
1488866	customer focus consistency
1495970	Evolution rather than revolution
1496727	Formal project , part of MRPII , some full time support , senior management involvement & support
1498552	Involvement of people
1499168	Involvement of senior management
1499461	RESULT
1499478	Have a global process , with the people buy in
1534609	Monthly gross & margin analysis
1544427	used Oliver white Consultants
1604380	Communication

The least successful aspect

1483450	Lack of Key KPI's identifying when Key decisions on Product supply were needed
1488866	low participation of middle management
1495970	Bureaucracy
1496727	none significant
1498552	Reduction of lead time
1499168	
1499461	TEAM
1499478	Could be inappropriate if managed by people without planning knowledge
1534609	Tender and project information
1544427	tried too much too soon
1604380	- S&OP format - Gathering ERP info (not everybody has an I.T. system under the correct specifications - standard format)

Only an example of the results is given due to the vast quantity of data.

APPENDIX F1: Impact Analysis A&D

Phase 1: Analysis & Design

	Behavioural							Technological				Organisational		
	Discipline	Understanding	Recognition	Commitment	Involvement	Trust	Communication	Data format	Data availability	Data accuracy	Info. extraction	Hierarchy	Communication	Culture
GA9YY														
GB3YW														
GH3YZ														
GN4YG														
GP3YS		2		1										
GT3YF		1		1	-1									
GT4YM		2		1										
GW7YD														
FF7EO		2		-1	-1									
FG6EE		1		1	-1		1				1			
FP8ET		-2		-1	2		2			2		-1		
FS9EP		-1			-1		1					-1		
FU9ES														
UL9KS														
UB7KY	-1	1		1	-1		2							
UA2KN	-1	2			-1						1	-1		
UK33KE	1	2		2	2							-1		
UB1KS	1	2		2	2		-1				1	-2		
UC2KR														
UD7KE														
20	4	32	0	15	18	0	11	0	0	4	3	8	0	0

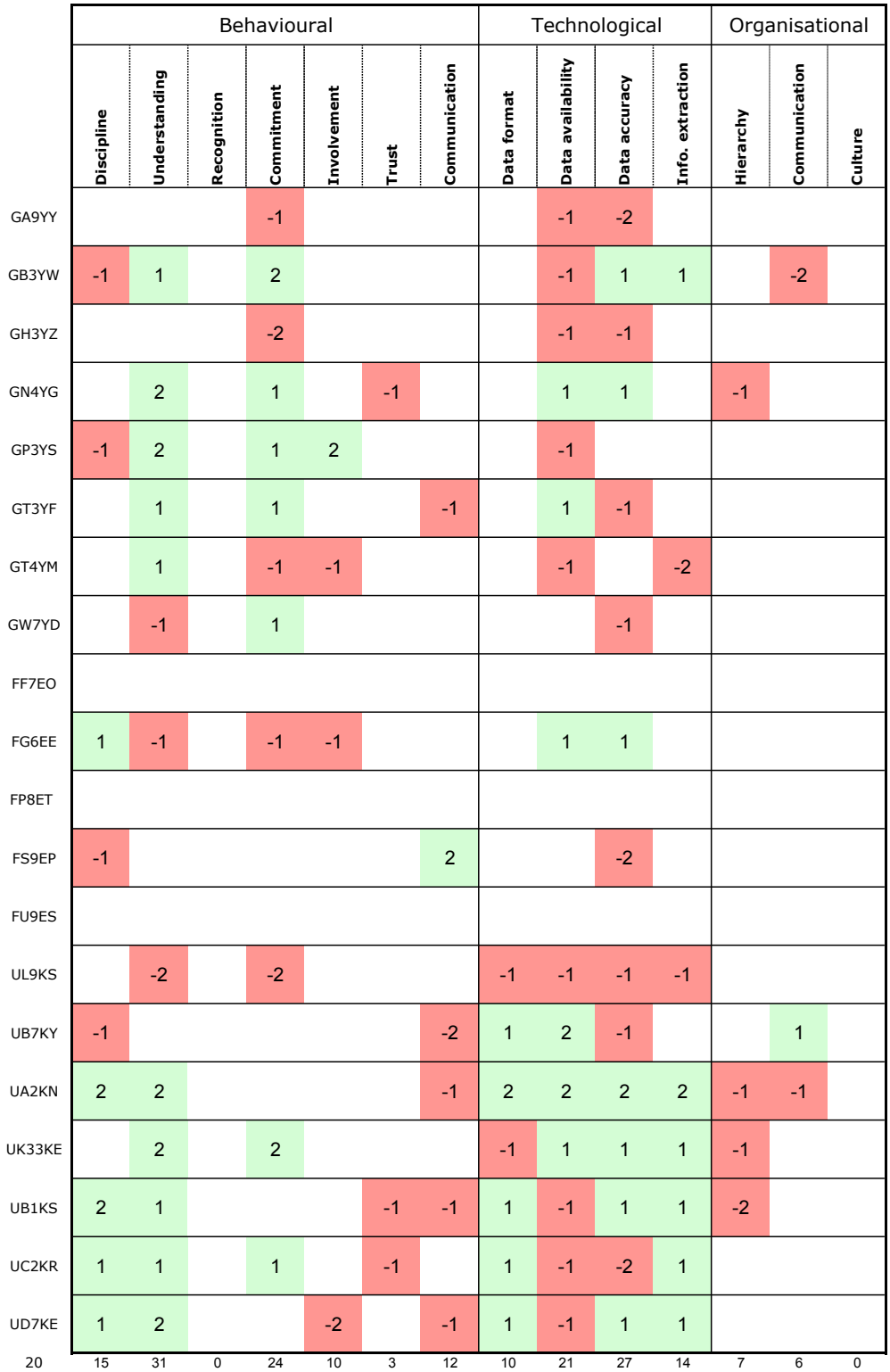
APPENDIX F2: Impact Analysis I

Phase 2: Implementation

	Behavioural							Technological				Organisational		
	Discipline	Understanding	Recognition	Commitment	Involvement	Trust	Communication	Data format	Data availability	Data accuracy	Info. extraction	Hierarchy	Level of communication	Culture
GA9YY		-2		-1		-1	-2		-1	-1				
GB3YW														
GH3YZ				-1		1	1	1	1	-1				
GN4YG														
GP3YS		1		2		2	-1	-1	-1	-1				
GT3YF		1			-2	1	1	1	1	1				
GT4YM		1		2		2	-1	-1	-1	-1				
GW7YD														
FF7EO														
FG6EE		-1	-1	1		1	1	1	1	1				
FP8ET		-2		-1		-2	1	-1	2	2				
FS9EP		2		-1		1	2	2	-1	-1				
FU9ES				2		2	1	-1	-1	-1				
UL9KS		-1		-1			1	1	-1	-1			-1	
UB7KY	1	1		2		1		1	1	-1				
UA2KN		2		-1			1	1	1	1	1			
UK33KE		2		1		1	1	1	1	1	1			
UB1KS	2	2		1			-1	1	1	1	1			
UC2KR														
UD7KE														
20	5	30	1	25	4	23	19	16	17	17	3	0	1	0

APPENDIX F3: Impact Analysis O&R

Phase 3: Operation & Running



APPENDIX F4: Impact Analysis M&M

Phase 4: Maintenance & Momentum

	Behavioural							Technologicaal				Organisational		
	Discipline	Understanding	Recognition	Commitment	Involvement	Trust	Communication	Data format	Data availability	Data accuracy	Info. extraction	Hierarchy	Communication	Culture
GA9YY		-1	-1											
GB3YW		2	2											
GH3YZ		-1	-1											
GN4YG		-1	-1											
GP3YS		2	2											
GT3YF		2	-2											
GT4YM		2	1											
GW7YD		-1	-2											
FF7EO														
FG6EE		1	2											
FP8ET		-1	-1											
FS9EP		2	2											
FU9ES														
UL9KS		-1	1											
UB7KY	2	1	2											
UA2KN		1	1											
UK33KE	-1	2	1											
UB1KS		2	2											
UC2KR		-1	1											
UD7KE	2	1	2											
20	9	39	45	0	0	0	0	0	0	0	0	0	0	0

APPENDIX G1: Company Interview Structure – UB7KY

Respondent's Profile

Production Planning Manager, Logistics describes a medium-sized business unit with a medium turnover (2500-4999 employees / £500-999m turnover) that produces low volume, high value automobiles. Customer lead time is 1-3 months and demand is roughly anticipated for. A strict S&OP process is support by monthly meetings with a balanced team consisting of Sales, Operations, Finance, Purchasing, Logistics and Senior Management. Of a committed, disciplined and successful process some hindrances appear to be data accuracy and supply planning.

Key factor identification

From the initial data collected the company's strengths, with respect to the S&OP process, lie in the following factors:

- Executive meeting
- Team design

Conversely, problem areas of the process and opportunities for improvement lie in the following areas:

- Data accuracy
- Data format
- Supply planning
- Performance measurement

Interview Agenda

The aim is to explore in more detail each of the four phases of the S&OP evolution: Analysis & Design, Implementation, Operation & Running and Maintenance. The objectives are:

1. To gauge the current level of process maturity and formal implementation for each of the key factors identified.
2. To understand how the company reached these levels of success and formality.

General questions

How long has S&OP been in successfully running? What were the timescales for each phase?

What is the level of customisation of your products?

How often are new products introduced?

How successful is the company in general at implementing change? Is this related to the culture of the company?

How is the success of the S&OP process measured/monitored?

Analysis & Design phase questions

Team design: How did the different departments become involved in S&OP? Why were they chosen? Why were some left out (senior management)?

Inception: The idea for S&OP came from internal managers. What provoked this idea? Was there a compelling event? How was S&OP integrated into the corporate strategy?

Process specification: How was the process specification arrived at? What made it a success? What level of collaboration with suppliers was sought? How were decisions made and a consensus reached? Were there any problems during this specification process? How was it known that this activity was finished?

What problems were overcome during this phase and how were they overcome? What still feels like it is in need of improvement?

Implementation phase questions

Executive sponsorship: How were high levels of executive sponsorship maintained throughout the S&OP initiative? How was the strong, clear specification driven through and implemented?

Communication: Tell me about how things were communicated to you during the implementation phase?

Data accuracy/format/availability: Tell me about the tools used to gather and format data for the monthly S&OP process? Why are they successful? What is the current level of technology infrastructure? Tell me about the accuracy of data and the problems encountered? How were they overcome?

Training / understanding: Why did you not receive any training for S&OP implementation? How was your level of understanding reached? How did you make use of the VW Group?

Commitment: Tell me about why you stated Purchasing and Finance as having poor levels of commitment and support during the S&OP implementation? How were levels of attendance maintained?

What problems were overcome during this phase and how were they overcome (ref: bureaucracy)? What still feels like it is in need of improvement?

Operation & Running phase questions

Supply planning: Why is there a relatively low level of collaboration and integration with suppliers (and customers)? What is stopping them being involved in pre-S&OP meetings?

Performance: How is the success of S&OP measured or monitored? How were these metrics arrived at? What have been the tangible benefits brought to the company as a result of S&OP? How were problems with KPIs overcome?

Preparation: The timeliness of data for preparation is good, as is the commitment of participants. Why is preparation hindered by accuracy and detail?

What problems were overcome during this phase and how were they overcome? What still feels like it is in need of improvement?

Maintenance phase questions

What will be focused on in the short and long term with respect to improving S&OP and why? Are executive meetings regularly critiqued?

APPENDIX H1: Company Interview Notes – UB7KY

Production Planning Manager, 14/07/2006.

Summary

Key points to be taken from the interview:

- Informal communication greatly increased the ability to get others to understand
- Executive sponsorship achieved through strong transparent benefits.
- Good specification due to being based upon an existing system.
- It was a mistake to not include NPI team from the beginning.
- Low volume translates to small leverage with outside suppliers which to instigate collaborative pre-S&OP meetings.

Introduction

The business is relatively complex with the level of customisation being high compared to the rest of the industry. Customers can choose from a vast array of standard options as well specifying to order. The company is prepared to design and make on a one-off basis as customers are prepared to pay for this service. Although SKUs are high, the number of product families remains low.

The values of the company before being bought by a global automotive manufacturer was that of a traditional hand-crafted quality service in very low volumes, rather than mass production and the latest technology, thus change over recent years has been forced from the top down. Merging the old with the new is proving difficult but the executive management has recognised a very proud workforce and is starting to realise empowering change from the bottom up is likely to relinquish greater long-term benefits.

S&OP has been in place since 2003. Its inception was due the company being bought by a global automotive manufacture and its strategy was to increase the product range and output volumes. To accomplish this strategy standardisation and integration with new,

sister supply plants had to be achieved. This meant better visibility had to be given to supply plants and consequently S&OP was chosen to do this. S&OP already existed in the parent company and sister plants.

The Design and Analysis phase of the S&OP initiative took 6 months to complete and approximately a further 12 months was taken to implement the process.

Analysis & Design phase

The specification for S&OP was adapted from an existing parent company's process. Two participants, one form Sales, the other from Manufacturing, were aware of this process and good friends. This helped to convey the benefits to senior management and understanding to other participants.

The specification of the existing process was adapted to suit mainly by adjusting the planning horizon.

A major problem was getting the design team to see why the planning horizon was so long. This was overcome with frequent meetings and presentations explaining in as much detail as needed, the different parts and lead times of the supply chain. Another problem, which in hindsight the company would have liked to address, was the inclusion of the new product introduction team as little real appreciation of lead times caused conflict.

Successful factors during this stage were the clearly visible benefits of another successful S&OP process and good formal and informal communication. This also aided the transfer of knowledge and understanding.

High collaboration with suppliers was sought however because of the low volumes of products supplied, leverage was very low. It was not worth the suppliers' efforts to become involved.

Implementation phase

Clear, well-documented procedures that are sent to any new team member ensure the level of understanding is maintained high throughout the group. No common intranet site was in use however S&OP Packs were distributed and maintained containing the key information. A learn-by-doing approach was adopted where 2 to 3 extra pre-S&OP meeting were held in the early stages to prove out any initial issues and fine tune the specification before going 100% live.

Operation & Running phase

Executive sponsorship throughout the process has been good and is maintained by ensuring benefits and successes of the process are always visible. An existing IT infrastructure allows for good data accuracy and extraction.

Problems exist in the current calculations for inventory levels. It is difficult to calculate and consolidate into a common display format that all participants will understand clearly.

Benefits of the process were perceived to be a clearer and better-justified picture of the future was visible and that this in turn could be used to help develop short-term business plans and longer term corporate strategies.

Maintenance & Momentum phase

To measure the process the following metrics are measured and monitored:

- Wholesales v. budget plan
- Retail sales
- Order coverage

Key areas to focus on improving in the future include:

- Designing and publishing a stock level KPI.
- Reporting changes to the plan.
- Understanding and presenting financial cost of different scenarios and options available to satisfy demand.

APPENDIX H2: Company Interview – U33KE

Supply Chain Manager, 17/07/2006.

Summary

Key points to be taken from the interview:

- Use of external consultants proved very influential to the success of S&OP
- One set of KPIs for every business unit across the globe gives powerful alignment to business plans and corporate strategy.
- Collaboration with suppliers was relatively easy due to a high level of vertical integration and high buying power.

Introduction

S&OP has been in place since 1994 where it was part of a larger implementation that also encompassed MRPII. The complete initiative was called Business Resource Planning (BRP). The Design & Analysis phase took approximately 6 months with Implementation taking a further 12 months. Much learning was done through doing. In 2000 six sigma was implemented which allowed numerous improvement projects to be launched including a green belt project aimed at improving S&OP data accuracy.

Benefits of the process are seen to be a common set of metrics aligns all business units and improved quality and service whilst reducing inventory.

Analysis & Design phase

The specification for S&OP was created under the guidance of external consultants (Oliver Wight) who together with the company followed the "proven path" method and laid a firm foundation on which to develop. This was considered the most successful aspect of the process's 12-year evolution

The process was started as a result of a new Production Director recognising major underperformance in the levels of quality, customer service and inventory levels.

Collaboration with suppliers was sought and easily found as much resource came from company owned plants and factories. Collaboration with external suppliers was also relatively easy due to the buying power of this company. This factors greatly aids the accuracy and visibility of supply planning.

Implementation phase

High levels of formal training were instigated with certifications awarded to individuals upon successful completion. The S&OP process also gained Class A recognition after meeting specific and stringent Oliver Wight standards. Training and understanding was facilitated through workshops and S&OP standard documentation templates were published which all future development enhanced. Everybody in the company was briefed in respect to the objectives and benefits of S&OP apart from personnel working at operator level on the shop floor.

The implementation of S&OP was reinforced with the addition of a new MRPII system and an i2 planning system. This eased problems with data extraction in the long term as a more robust foundation could be later developed. In the short-term data extraction routines had to be manually which was time consuming.

Dedicated project teams were used to implement the new systems therefore a lack of human resource did not cause any problems.

Operation & Running phase

The preparation before the executive S&OP meeting involves analysing demand data by product family. Graphs project the future 18 months and record the past 12 months in terms of actual sales against forecasted sales. New product introductions have taken time to become included but are now operational. Supply planning in collaboration with suppliers takes place where what-if analysis is performed along with manufacturing prioritisation. Pre-S&OP meetings resolve problems and package solutions before decisions are made in a single executive S&OP meeting.

Each participant of the process maintains good communication levels by having someone else in the team act as their mentor. This also helps keep communication channels short.

Data accuracy was seen as key is delivering success. Bill Of Materials and inventory accuracy has to be maintained to the highest accuracy due to industry legislation.

Key factors that are believed to be influential in the process's success are clearly visible benefits, consistency, commitment, a strong belief that data can be relied upon and a IT infrastructure that facilitates activities.

Maintenance & Momentum phase

To measure the process the following metrics are measured and monitored:

- Sales: forecast v. actual
- Production: forecast v. actual
- Inventory: forecast v. actual

Functionality also exists to be able to drill-down into specific products.

The main focus for continued developed will be to shorten the cycle of activities and aim for near real-time planning as adapting to changing business scenarios is becoming more challenging.

APPENDIX H3: Company Interview – UD7KE

Supply Chain Planning Manager, 19/07/2006.

Summary

Key points to be taken from the interview:

- Good, clear policy documentation exists and is widely available to participants.
- Excellent meeting facilitation has been developed over time to ensure structured, productive meetings.
- IT infrastructure and training can cause delays to the S&OP cycle.
- A central database has improved data accuracy and facilitates data aggregation.

Introduction

The company released two sets of profit warnings during 2003. Consequently, a new finance director was brought into the company whose initial focus was to improve the forecasting of sales. This was done by better understanding the risks and opportunities as well as communicating them in a more proactive manner. With assumptions being clearly visible and justified, a better central understanding of the demand in the market place was apparent across the business. With improvements on the demand side of the business focus was directed at the supply side of the business. It was here where the inception of S&OP took place. A tool was sought that would enable end-to-end planning of the business.

Over the following 3 months the company designed and implemented an S&OP process with the help of external consultants.

Information from the first and second phases of the S&OP evolution was gathered in a short telephone conversation with the Supply Chain Director, as he was unable to be interviewed as planned.

Analysis & Design phase

An initial team was formed consisting of representatives from Sales, Operations and Finance. The specification was created from scratch and involved understanding and deciding upon the planning horizon, product families and common units. An initial process map was developed that detailed all the activities and meetings that needed to take place during a single cycle. Clear policy documentation was written detailing objectives, functionality, scope, responsibilities, authorisation and change control.

No consideration was given to additional and / or supporting systems or their integration. Key objectives of the process were to better manage inventory and reduce lead times. To obtain buy-in from senior management the benefits of visibility and control were highlighted.

Implementation phase

Senior management carried out three-day workshops with those people involved in S&OP activities and meetings. This workshop focused on ensuring understanding of the process and the resultant benefits to the business. A clear link was made to those being trained about how S&OP is linked to both business planning and the corporate strategy.

Problems that were overcome during this phase included not being able to assign full-time representatives from Finance to their respective activities. This caused poor a quality of data to be generated and led to frustration within the team. This problem had to be highlighted to the executive management before any action was taken to resolve it. Others problems were a lack of data and data not in the correct format. These issues were resolved through increasing peoples understanding and developing IT infrastructure to

Although there is currently 75% collaboration with suppliers, these are all internal suppliers and this collaboration was not as a result actively sought during the implementation of S&OP. Integration of external suppliers also not actively sought.

The implementation of S&OP was also affected by there being a resistance to organisational change. This reduced over time and was helped by executive sponsorship and the communication of the aim, objectives and benefits of S&OP to the company.

Operation & Running phase

The activities and meetings carried out in the S&OP cycle can be summarised into six main activities:

1. Gather sales information: data from the previous accounting period is collected and sales data are combined to determine a sales forecast for every product family. These series of activities take 8 working days.

2. Convert into a global demand forecast: the sales forecast is then exploded to generate a total demand forecast for the whole business. This demand forecast is presented in a meeting before being signed-off.

3. Translate demand for each factory: the total demand forecast is then translated into specific demands for each of the company's factories. Meetings happen at each factory with the Operation Manager to review the demand before being approved each factory's Managing Director.

4. Review financial implications: budget targets are compared to demand forecasts as well as costs of meeting extra demand or costs operating factories at below optimum capacity.

5. Conduct Pre-S&OP meeting: a meeting is held to review the information collated in the previous activities and sales forecasts and / or demand plans are amended accordingly. This meeting happens on day 19 of the cycle.

6. Issue summary of pre-S&OP to Board: a summary of the pre-S&OP meeting is issued to the board on day 20.

The largest problem with the cycle to date is the time taken to generate financial data from the previous accounting period. This is due to new IT systems being recently implemented and new employees joining the department who aren't yet up to speed. Also there are 19 days occurring before any decisions are made to adjust supply or demand. In this time new orders are often placed and confirmed which occasionally can affect demand levels significantly. This issue is being addressed by increasing individuals understanding of the process and training people with IT system skills quicker.

Smaller problems exist including poor data accuracy. This is due to human interaction with data. S&OP meetings often degenerate and become disjointed due to it being one of the only times senior managers get together. Other, non-related issues are often raised sidetracking the S&OP meeting. This has been addressed by strong facilitation and strict agendas. Senior managers also perceive that attendance is only necessary when a problem exists. Although complementary to the participants this lack of sponsorship is addressed by the meeting facilitator sending agendas in advance and briefly telephoning each senior manager to remind and express the importance of the issues being discussed.

Early problems relating to populating spreadsheets and aggregating many different formats of data was addressed by constructing a central database that performed this activity automatically.

Benefits of the process have been a 27% reduction in inventory levels and a increased level of inventory accuracy. Forecast accuracy has improved through better methods used to predict demand. A central understanding of supply and demand by senior management has enabled better decisions to be made that all parties agree on.

Maintenance & Momentum phase

To measure the process the following metrics are measured, monitored and published:

- Delivery performance
- Actual customer lead times v. planned customer lead times
- Sales forecast accuracy
- Inventory levels
- Demand forecast accuracy

Key areas to focus on improving in the future are as listed below:

- Flow of information
- Shorten timescales
- Encompass all of the business
- Spares forecasting
- Better integrated systems

APPENDIX H4: Company Interview – UC2KR

Interview, Supply Manager, 21/07/2006.

Summary

Key points to be taken from the interview:

- Very powerful dashboard provides a common interface and timely access to S&OP performance measure and information.
- Clear and simple framework is formally documented and published.
- Data accuracy is the biggest problem however it is hoped this will be addressed with the implementation of a new ERP system.
- Forecasts of the entire market are predicted and a target market share is used to drive sales forecasts.

General

The business is currently aiming to become more responsive, increase its brand strength and prioritise research and development spending. Poor financial performance over recent years has driven the company to address it highly complex and vast product range by running new product introductions in series and not parallel whilst standardising across its product range. The company as recently embarked on a new global ERP system implementation to improve responsiveness, quality and delivery whilst updating many independent legacy systems.

S&OP has been in place since 1996, however no information was available as to why the process was originally conceived or the time taken to design and implement the process.

Analysis & Design phase

No information available for this phase.

Implementation phase

No information available for this phase.

Operation & Running phase

An S&OP Dashboard located on the company's Intranet supports the S&OP cycle. Here graphical templates ensure information is consistently represented and readily available. Policy documentation is published here along with training material and process maps.

The S&OP cycle starts with collecting sales data for the whole market. A target market share is then converted into an unconstrained demand signal for each product family. This unconstrained demand signal is converted into a constrained demand signal by taking into account factory capacities and inventory levels. This constrained demand signal is then compared to a supply plan and different scenarios considered. Forecast changes and order coverage are also considered before the findings are discussed and amended in a pre-S&OP meeting. The cycle finishes with the result of the pre-S&OP meeting being presented to the executive management for approval. All data is submitted and collated using an online S&OP Centre. The S&OP Centre automatically populates the S&OP Dashboard. Very little human intervention takes place after the initial data submission activities.

Data accuracy is the biggest challenge the company faces due legacy systems not being well integrated. The time and number of people needed to input data into the S&OP Centre limits how quickly decision-making information can be generated and used. The format of the data, although consistent, is considered not entirely pertinent. This is due to the level of understanding of individuals across the business unit being different.

Maintenance & Momentum phase

To measure the process the following metrics are measured and monitored:

- Sales forecast accuracy
- Market share
- Dealer repair frequency
- Forecast and demand changes
- Delivery to plan

Key areas to focus on improving in the future include:

- Common measure for delivery performance.
- Increased visibility both historically and into the future.
- Data accuracy and integrity

APPENDIX H5: Company Interview – UB1KS

Head of Integrated Resource Planning, 24/07/2006.

Summary

Key points to be taken from the interview:

- Using external consultants helped setup and specify the process.
- Clear and well-communicated policy documentation acts as a reference to help understanding.
- Informal communication greatly increased the ability to get others to understand
- Understanding the relationship between efforts put into collecting data and resultant value-adding information is key to ensuring a timely cycle.

Introduction

The business is involved in the delivery of a small number of vastly complex products with very long lead times. This business is milestone driven and customer negotiation is high so as to best understand supply flexibility. New product introduction is not as active as other industries as a base of technology is continually being developed in conjunction with customers. The business unit has a structure of 6 programmes each classed as a separate mini-company, each with its own executive management team. In conjunction with this structure 5 process teams exist including engineering and operations.

S&OP has been in place since 1996. Its inception was due to poor business efficiency and inability to win contracts. The executive management were told by shareholders to review the business and justify a range of improvement initiatives to address these problems. S&OP was one of these improvement initiatives generated by the executive management.

Over recent years the company has had to dramatically reshape the organisation. Such a volatile business environment is now better appreciated among most of the workforce resulting in a better understanding of the need to implement change.

This interview is involved with the planning process involved with labour resource that includes direct, indirect, in-house and on-site contractors. A separate process is undertaken with respect to planning materials and production capacities.

Analysis & Design phase

The specification for S&OP was created with the help of external consultants (Oliver Wight) with whom the company had had a relationship lasting 10 years. The specification focused in three main areas; processes, behaviours and tools. Behaviours were classed as the most important with a true appetite for S&OP being sought and ensuring people's understanding was complete. Policy documentation was created with the help of external consultants that included the aim, objectives, ways of working, terms of reference, attendees and typical agenda.

The senior management designed and constructed the S&OP team. Many people were interviewed and were successful depending on their ability to manage and influence stakeholders and them having a broad skill set and industry experience.

Implementation phase

Problems during the implementation phase focused around the quality of data. Maintaining organisational consistency and common toolsets proved difficult and is still currently one of the biggest challenges. Obtaining data quickly was difficult to begin with but with the development of custom-made IT systems to extract data, improvements were realised. As the process has developed more and more time has been spent balancing the effort invested in collecting data and the value of resultant information to enable decision-making. It is becoming apparent that the data may be able to become less detailed whilst still allowing decisions to be made.

Team members completed 2-day workshops with certification being awarded after successful completion.

Commitment was difficult during the implementation phase due to such a large business unit. A person could often be generating vast amounts of data and not be able to understand why they are doing such detailed analysis so frequently. The company provides 3 open forums per year where short lectures are given explaining business plans and corporate strategy. Anyone can ask questions to increase their understanding. The focus of these open forums is to communicate why things are done and what are benefits of doing them. These forums are well received by all who attend.

Difference of opinion was common during the implementation phase especially amongst middle management. This was addressed by re-training and education and highlighting benefits obtain buy-in. Due to the organisational structure being very competitive, honesty is a problem during some meetings. Participants are afraid to admit their programme's problems in front of other programme managers.

Operation & Running phase

The operation and running phase consists largely of collecting data from different programmes and prioritising issues for discussion at the pre-S&OP meeting. Overtime, outsourcing and sub-contractor levels are monitored against planned levels. Success has been associated with engaging those involved and ensuring milestones are achieved on time.

Problems in the operation and running are mainly due to the organisational structure being so competitive. Whilst this is advantageous in relation to other areas of the business, planning resource across 6 independent mini-business units is often very difficult due to a lack of compromising.

Maintenance & Momentum phase

Key areas to focus on improving in the future include:

- Becoming more integrated where possible.
- Improvements in efficiency.
- Ensure an outward focus on the recruitment industry.
- More accurate skills development and measurement.

APPENDIX I: S&OP Improvement Tool

◑ Low Impact

● High Impact

			Rating							S&OP Influential Factors													
										Behavioural							Technological				Organisational			
			5	4	3	2	1	Phase Activity		Discipline	Understanding	Recognition	Commitment	Involvement	Trust	Communication	Data Format	Data Availability	Data Accuracy	Data Extraction	Hierarchy	Communication	Anticipation	Culture
S&OP Formality			Aim and objectives integrated into team members' PDRs. Formal recognition awarded where deserved and opportunity for professional development available	A complete cross functional team design, participate in, and support the S&OP process including Sponsor, Owner and Expert.	Clear definition of roles exists within the team with each member understanding their purpose. Responsibilities amended to reflect new duties.	A formal group of participants are involved in the S&OP process	An informal group of participants exist with a bias in their make up towards Sales / Marketing and Operations	**Team design**	Analysis & Design	Analysis & Design	◑	●		●	●		●			◑	◑	●		◑	
			A well-communicated goal exists stating S&OP as an input to financial forecasting. There is clear distinction from other organisational plans.	A policy document, linked to corporate strategy, states the purpose of S&OP and why it is important. Includes executive team's signatures. Communicated through an Intranet.	A policy document exists detailing the objectives, activities, participants and actions to be taken of	Formal objectives of S&OP are communicated to the whole organisation through the use of notice boards.	Informal objectives outline how S&OP is linked to reviewing operational performance. Only communicated at executive level.	**Clarity of goals**															
			Timely instigation to support the corporate strategy	Significant event instigated the birth of the S&OP initiative e.g. decreased business growth, diminishing profit margins, competitive pressures	Middle management justified implementing S&OP to the executive team	Adopting S&OP was a requirement dictated by an outside customer or supplier	S&OP was implemented as a result of advertising or marketing influences.	**Inception**															
			Continuous planning exists where a virtual, electronic network exists connecting all participants through all levels of the extended supply chain.	A collaborative relationship exists with external trading partners to more accurately balance supply and demand. Credible benchmarks help define the specification	A balanced scorecard underpins business navigation and drives accountability. S&OP process frequency increases / decreases to take account of demand variation	Metrics have evolved that enable decision making. Framework includes time fences and order change guidelines that are generally adhered to	Framework of meetings has been documented with a set frequency. Process includes conversion of market facing family groupings to supply orientated facing family groupings.	**Specification**															
			Automated data feeds exists from ERP system into custom, intranet-based reporting mechanism. Little human intervention, accurate and timely data.	Well designed reports collate data automatically from ERP system. Data transferred manually into S&OP reporting mechanism.	IT infrastructure being actively aligned to support S&OP. Common and published framework exists for S&OP reporting.	Several, independent IT systems used to gather data manually. Clear process exists to populate S&OP spreadsheets. Takes time to generate S&OP reports and data format is often different.	Manual data collection exists where entry into spreadsheets is also manual. Process prone to errors and delays. Large amount of human intervention is common.	**Systems infrastructure**	Implementation	Implementation	◑	●	◑	●	◑	●	●	●	●	●	◑		◑	
			S&OP team understand the process and what is expected of them. A high level of belief in the concept exists. A link exists with academia or a research institute.	S&OP team undergone formal training from the Executive Team. All training material readily available electronically on company intranet and is regularly maintained.	Formal 2 to 3 day workshop facilitated by external consultants. Testing and certification included. Periodic refresher workshops undertaken for new team members.	Formal training in basic MRP, JIT and DRP carried out with the complete S&OP team.	Informal unstructured training carried out on an ad hoc basis with a small number of senior executives.	**Training**															
			Executive Team actively coach others and actively follow up any issues and actions. Ensures adherence.	General Manager arbitrates the S&OP process with no bias towards a specific department	General Manager attends the majority of S&OP meetings and understands the process, both as it is supposed to be, and how it is currently implemented	General Manager attends S&OP meetings when there are pressing issues. Has undergone S&OP training and understands the process	General Manager delegates all S&OP activities	**Executive sponsorship**															

S&OP Success			Market demand is shaped using what-if analysis of promotions, price, contracts, NPI to develop many plans. Key scenarios packaged with base level forecast	Forecast converted to shipping requirement using a formal process. Assumptions used with management input to generate base level forecast. Assumptions repository is available and is updated regularly	Entire market forecast is produced using formal statistical analysis of historic data. Families have been formally agreed with manufacturing or supply organisations	A forecast is produced on-time for each product family or SKU	A forecast is produced although formal agreement on product families may not have been reached	Operation & Running	**Demand planning (Sales and Marketing)**	Operation & Running	●	●		●	◑	◑	◑	◑	●	●	●	◑	◑	◑						
			S&OP meetings are conducted with key suppliers. Critical resources are reviewed regularly depending on mix and volume. New resources may become critical	Impact of different operations plans are analysed for best business scenario in terms of profit, revenue, customer service, inventory. Impact of NPI is assessed for aggregated planning	Supply planning risks and assumptions are documented and escalated to the S&OP meeting. Regular supplier communication happens on planned orders	Master Scheduling procedure supports an operations plan. Lead times for all SKUs documented and used for planning and forecasting. Constraints identified in supply chain.	Planning reports submitted monthly where lead times are populated but not reviewed regularly		**Supply planning (Operations)**																				
			Financial consequences of different scenarios are analysed before S&OP meetings	Financial Director is seen as driving S&OP as a means to underpin financial success	Costs and pricing are visibly and reliably up to date. Financial conversion of currency to planning units is agreed and available	Financial calendar is published. End of month reporting is consistently on schedule	Finance produces its summary each month but it does not get related to the need to balance supply and demand		**Financial planning (Finance)**																				
			Pre-S&OP meetings have a hierarchy so decisions are made prior to executive meeting. Assumptions are routinely documented and reviewed	Forecasts are routinely challenged creating a balance of understanding demand change, forecast error and hedging future orders. Enhances communication between sources of supply and demand	Any S&OP related meetings are scheduled into the participants' calendars at least 12 months into the future	Inputs to the S&OP process are timely and accurate with measures in place to demonstrate this	Inputs to the S&OP process are often late. Obtaining pertinent and timely data is difficult		**Preparation**																				
			Financial impact of different scenarios understood. Consensus reached quickly. Regular critique and recommendations for improvement discussed.	Alternate causes of action have been evaluated through a hierarchy of decision making and are presented at S&OP meetings for consideration.	Real insight of situation is gained through S&OP meetings. Effects of special projects are considered	Prior meetings filter decision making effectively. Regular decisions are made with little need for further data gathering and analysis	Meetings are held but often result in a list of actions to be executed after the meeting, little direct decision making is performed during the meeting		**Executive meeting**																				
			People are open and honest. Meeting atmosphere is informal, comfortable and relaxed. Team members trust fellow participants. Data is happily shared.	General Manager ensures adherence to the process. Those who do not adhere are taken to task. Criticism is frequent and frank.	The agenda is adhered to. Healthy disagreements occur frequently with conflict not being avoided.	Good attendance levels are common. A high level of discussion occurs but is often not pertinent to the task.	Participants are often defensive and have hidden agendas. Feelings within the team are unclear. Attendance levels are poor as is the ability of the General Manger to discipline others.		**Behavioural performance**																				
			Supply chain cost as a percentage of sales is defined with improvement plan in place. Metrics change accordingly with business changes	Metrics used to measure the two-way impact of demand and supply decisions e.g. profitability, revenue, percent volume growth, sales per employee	Forecast accuracy, customer service level and delivery lead times are measured routinely. Adherence metrics in place for S&OP cycle activities	Forecasts are produced but assessment of forecast accuracy is in its infancy. Supply plan adherence is monitored	Metrics primarily driven through financial processes with little consideration for translation from value driven metrics to supply or demand driven metrics		**Process performance**																				
			S&OP classed as an ongoing dynamic journey, not a project. Refinements have been taking place for many years. Efforts are focused on improving: demand shaping and profit maximisation.	A formal checklist that has developed over time and is used to routinely critique the effectiveness of the process. Includes reviewing time fences, assumptions and vulnerabilities.	Regular meetings happen purely to solicit improvements to underlying processes. Comparisons made to original specification and objectives. Actions assigned and have strong sponsorship.	Targets are continually modified to drive an increase customer service, decrease in inventory and /or improve financial performance.	A small amount of time is taken at the end of each executive meeting to critique the process.	Maintenance & Momentum	**Continued improvement (effectiveness)**	Maintenance & Momentum	◑	●	●																
			Costs associated to S&OP are compared to the financial rewards delivered.	Time performing activities by team is measured and has planned targets to drive lead time reduction. Costs associated with activities are beginning to be measured.	The level of data accuracy is constantly reviewed and adjusted to provide the best value of information	Maps are available that depict how the process should be structured in the future so as to reduce the time and cost of activities whilst adding value.	Current processes and activities are clearly mapped out and updated using flow charts to show the flow of information throughout the process.		**Continued improvement (efficiency)**																				
			Goal is to sense and shape demand. Supply is able to be balanced with demand. Frequency of S&OP meetings are as and when needed. S&OP provides inputs to the financial forecasting.	Goal is to become profitable. Collaboration between departments and external partners is common. Supply and demand start to become more balanced	Goal is to match supply and demand, not develop a strategic plan, financial budget or operations plan				**Balance and focus**																				

APPENDIX J: Thesis Summary Document

EXECUTIVE SUMMARY

The benefits of an S&OP (Sales and Operations Planning) process on inventory levels, customer service and profits are well known. However, the extent of improvements depends on the objectives and priorities of the company as well as the efficiency of the process itself.

This work is the output of a study carried out at Cranfield University where the research combined literature review with questionnaires and interviews of 25 world-class companies in France, Germany and the U.K.

The research identified the four phases of an S&OP process: Analysis and Design, Implementation, Running, and Maintenance. For each phase, investigations determined the activities, steps for improvements and explored the key factors that impact on the success of the efforts invested.

This document summarises the core findings and proposes a self-assessment tool to help companies evaluate their process. By following the steps proposed and focusing on enhancers or inhibitors for each phase, it should be able to realise the full benefits of an S&OP process at a limited expense.

1 INTRODUCTION

With the advantages of global sourcing and outsourced manufacturing, come more complex supply chains that subsequently need to be coordinated more effectively. S&OP facilitates this coordination and enables companies to improve their performance. Tangible benefits are hard to quantify as the type and extent of each benefit will be relative to a company's own efficiency and depend on its strategic objective. Companies adopting S&OP for the right reasons can realise hard benefits including reduced inventory levels, increased operational performance, better customer service levels and ultimately increased profits. Soft benefits include better decision making and financial plans using less effort and time, and greater control and accountability. Managers can gain a 'heads-up view of the future' and have 'less surprises at the end of the fiscal year'.

This document sets out to help companies achieve more successful S&OP processes and was based upon research from three sources: a quantitative survey of 25 companies in the aerospace, automotive, and pharmaceutical sectors; 12, two-hour structured interviews with senior management from a range of participating companies and from published literature.

The aim of this document was:

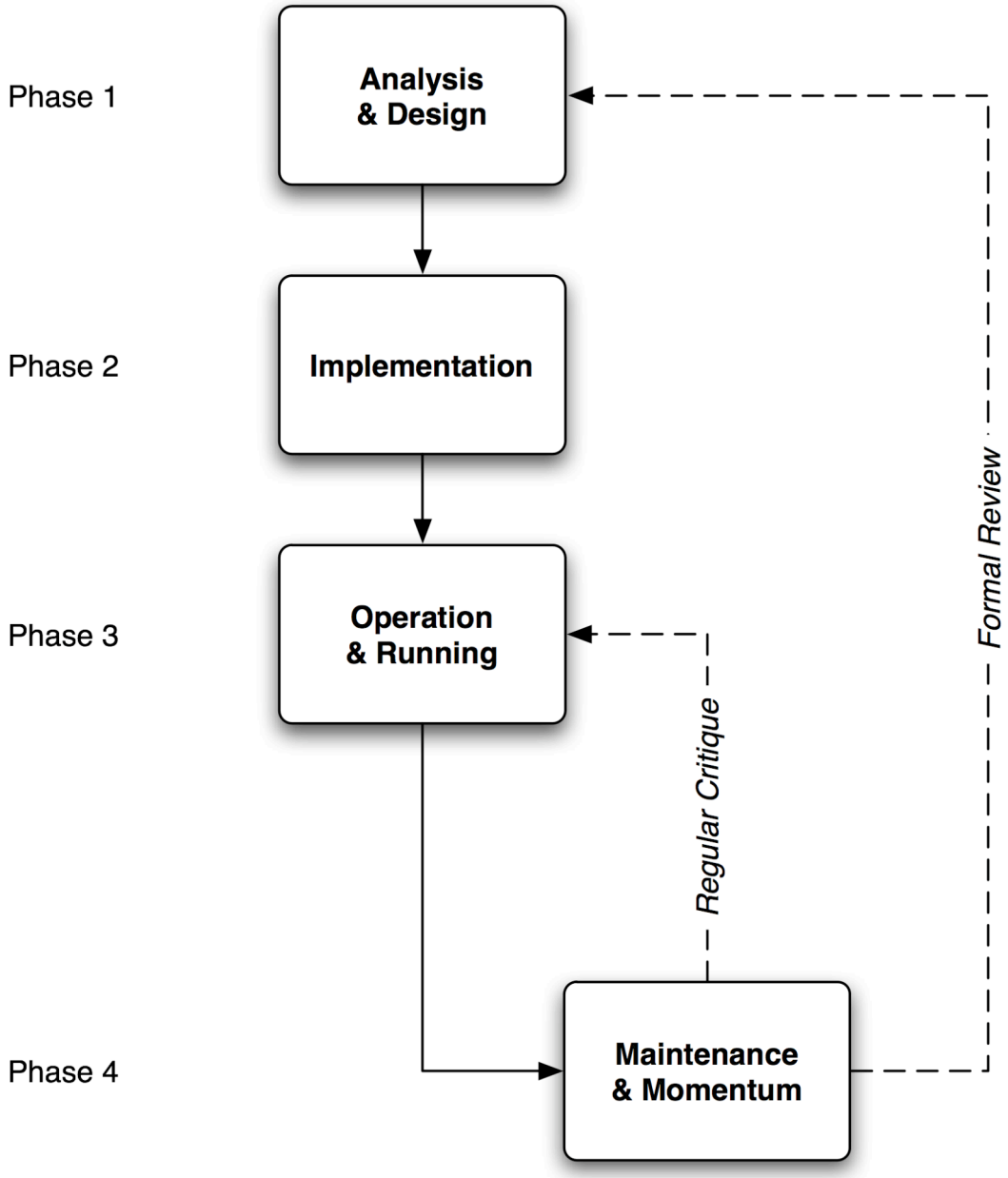
"to help companies achieve a more successful S&OP process".

To realise this aim the specific objectives of this document were:

1. To document an S&OP framework outlining the activities involved in a successful S&OP initiative.
2. To summarise the key factors that enable an effective and sustainable S&OP process.
3. To present a simple self-help tool that be used to improve an S&OP process.

2 S&OP FRAMEWORK

This chapter presents the different phases of an S&OP process, with the activities that need to be performed. A detailed description of each activity is available in Exhibit A. It is important that a champion be empowered to drive and enforce all of the process in the framework.



Analysis / Design

Starts when the need for S&OP is realised by a company and finishes when the general manager understands what should be communicated and to whom about S&OP to enable its successful implementation. The objective of this stage is to construct a framework upon which all of the characteristics of the S&OP process can be built around. The primary activities are the definition of a planning horizon, product families, time fences, participants' roles and responsibilities, schedules, measures, report design, incorporation into company policy, and the design of a feedback system.

Implementation

Starts when those responsible for the design stage agree that the framework is appropriate. Finishes when all those participants involved in the S&OP process understand what has to be done, why it has to be done, how it will be realised within the company and do not need any support to carry out their responsibilities. This phase includes a warm-up period containing a number of pilot cycles in order to fine-tune the process until it becomes a self-sustaining routine, fully integrated into the business daily operations. The primary activities are planning, education, communication, managing change, involvement, buy-in and the allocation of resources.

Operation / Running

The scope of this stage is the cyclical S&OP process. Each cycle begins with updating and distribution of data relating to actual sales, production, inventories etc. that enables departmental plans to be generated. Each cycle finishes with an executive S&OP meeting where decisions are made and consensus is reached.
The objectives of this stage are:

- To support and measure the business plan by flexing up and down resources to meet the business plan in a cost effective fashion.
- To ensure plans submitted are realistic and mutually supported.
- To move the company away from a reactive response towards a more proactive focus.

Ensure adherence to, and maintenance of, the process in place (see next section).

The primary activities are preparation, pre-S&OP meetings without managing directors and an executive-S&OP meeting with managing director.

Maintenance / Momentum

This phase aims as ensuring the Operation cycle continues successfully and is adequately supported by top management. It takes place at a frequency predefined during the analysis and design phase, at least on a yearly basis, and consists of two main activities:

- The review of the process ensures that the characteristics defined during the analysis/design phase remain up-to-date and valid.
- The feedback of the execution of the process is more focused on the meetings and day-to-day operations: measurement / recognition, participation, discipline, environment and honesty.

3 KEY INFLUENCIAL FACTORS

Understanding

Understanding is a key factor that impacts on all four phases of the S&OP framework described in Section 2. Understanding the process as a whole is critical when first designing the process specification. A strong foundation needs to be built that will allow small refinements over time to develop and improve the process. Understanding the benefits of S&OP will enable a strong belief in the process to be gained amongst participants. Senior management will support and promote the implementation if clear benefits are visible. Team members will be more likely to actively participate in the process if they can clearly see the benefits. Ensuring all participants understand the individual mechanics of their respective parts of the process, what is expected of them, and how to make the maximum contribution will ensure help ensure a successful operation of the process.

From the companies surveyed during this research the most common activity companies would have liked to have done differently, given hindsight, was the specification activity. 25% of companies felt they did not have enough understanding during the Specification activity, this number being double the number of companies when compared to successive activity.

Commitment

Support from the management is as important as the commitment from the different departments. The commitment of the different departments is illustrated by appropriate preparation and attendance to meetings, as well as the timely provision of data and information. For the management, commitment implies provision of necessary support and resources, communication and incorporation of the process into the company policy.

From the companies surveyed during this research, successful companies shared an excellent attendance to meetings by all the departments (100%), while unsuccessful companies deplored variable or poor attendance from participants.

Quality of Data / Information Technology (IT)

This factor becomes important from the implementation phase of S&OP. Before that, during the Analysis and Design phase, the understanding factor (see previous section) helps identify the appropriate requirements in terms of type of data and (IT) systems.
There are three categories relating to the quality of data:

- *Data exchange*. It is essential during the Implementation phase, to ease the transfer of data between the different IT systems used by the different parties involved in S&OP. The better the data exchange, the easier it is to establish dialog between the different departments. The implementation phase can be the occasion to put new systems in place.
- *Data availability and accuracy*. The timeliness and exactness of data is necessary for the success of the process.
- *Information extraction*. The capacity to extract the relevant information from the bulk of raw data available is critical during the running of the S&OP process, to be able to make appropriate decisions.

From the companies surveyed during this research, the quality of data appears to be a key determinant of success or failure of the process. For example, 70% of companies with successful processes combine good data accuracy and availability, while 70% of unsuccessful companies are struggling with these factors.

Impact of culture

The results of this research did not permit a definitive conclusion regarding the impact of culture on S&OP to be formulated. In some companies, the culture seemed to be an impact driver or inhibitor, while in others, the influence of culture seemed insignificant. However, one conclusion this research lead to is that when a very formal process is in place with clear instructions, responsibilities, and structure, the impact of culture becomes negligible.

4 IMPROVEMENT TOOL

Description

The S&OP Improvement Tool, shown in Exhibit B, is a two-page A3 table containing a scorecard system to assess the maturity and success of seventeen S&OP activities. Corresponding to each group of activities is a visual representation showing the impact of fourteen influential factors grouped in three categories: behavioural, technological and organisational.

Purpose

The purpose of the tool is to facilitate the performance improvement of an S&OP process. This is done through firstly benchmarking the current level of performance. Highlighted strengths and weakness can then be attributed to influential factors. This provides a basis for focusing improvements. The tool can also be used a reference when designing and implementing a new S&OP process.

Instructions

Running down the centre of the document are the four phases of an S&OP initiative and their corresponding activities, as described in Section 2. To the left of each activity a simple 1-5 scoring system can be used to audit each activity's level of maturity or success. To the right of each phase, the impact level of influential factors is shown based on the findings from literature and surveying 25 companies. Once the levels of success and maturity have been scored for each of the relevant activities the influential factors can be cross-referenced to understand which factors will help facilitate the improvement of an activity.

EXHIBIT A: Details of the activities of each phase

Analysis / Design

- Planning Horizon: define the length of time needed to establish plans, taking into account the market and availability of resource (material, equipment, people, facilities, tooling, suppliers, money). "How long does it take to see the need to make changes in sales and production plans?"
- Product Families: segment products into logical groupings or families based upon function (or value, lead time, customer location, complexity, process). Use conversion factors where necessary.
- Time fences: for each product family define guidelines that define when changes are feasible. Balancing customer service (order priorities, output rates) with cost and effort (overtime, premium shipping charges, premium raw material charges).
- Participants: define mandatory participants as the top executives within the company's departments who are the decision makers. Potential participants should be defined also, and be prepared to be called upon, if a greater level of detail is required. The main departments involved in S&OP meetings are: Production, Sales, Finance, and sometimes Purchasing and Logistics. The participants must be empowered to make the final decisions; therefore managers usually represent the involved departments.
- Schedule: schedule recurring appointments for meetings well in advance of the commencement and allocate
- Measures:
    - Define a set of key performance indicators (KPIs) to monitor the contribution of the process to the business: customer service levels, supply costs, inventory levels and uncertainty.
    - Allocate roles, responsibilities and individual objectives for each participant, relating to S&OP success, as part of each participant's Personal Development Review (PDR).
- Report design: define the format of the departmental reports.

- Company policy: create belief in the process through incorporating S&OP into company policy.
- Feedback system design: ensure a feedback and review system is designed and planned which would ensure the process always remains state-of-the-art.

Implementation

- Structural change: recruitment of persons with the competences expected or change of the organisation structure to allow the process to run at its full potential.
- Planning: planning of implementation milestones (software running, participants trained, first meeting date).
- Education: participants given understanding of the S&OP process to know what others expect of them, how to make the maximum contribution and how S&OP impacts on the company.
- Communication: promote clearly the essence and objectives of S&OP. Promotes short and long-term benefits for the company and individuals. Link to corporate strategy.
- Manage Change: executive management to promote feelings of trust and honesty amongst participants. Ensure buy-in to the S&OP process. Communicate progress and achievements throughout implementation stage and recognise success.
- Involvement: executive management to have a noticeably high presence to demonstrate commitment to, and the importance of, S&OP.

Operation / Running

- Preparation
    - Data gathering: collect data, prepare and distribute.
    - Demand planning: develop a statement of detail and aggregate demand through understanding whether planned demand is actual demand.
    - Supply planning: understand the impact of changes on resources and the associated cost and timeliness of possible responses.
    - Finance planning: understand the financial impacts of the different decisions.

- Pre-S&OP meeting (without managing director)
    - Performance review: evaluate KPIs in order to uncover the underlying causes of any difficulties and find appropriate remedies.
    - Assumptions and vulnerabilities: review and understand previous assumptions made including markets, economies, competition and internal factors.
- Executive-S&OP meeting (with managing director)
    - Family-by-family review: through departmental presentations of past and future performance, implications of change and alternatives. Approve plans and reach consensus.
- Alignment with Finance.

Maintenance / Momentum

- Critique: periodically, quality should be assessed with respect to preparation, attendance, detail, time and possible improvements.
- Review of the process designed:
    - Data: ensure the data is both accurate and used, as soon as possible after it was generated, to make decisions. Also ensure data is of the correct format.
    - Review the validity of Planning Horizon, Product Families, Time fences, Participants involved, Schedule for meetings, Measures, Report design, Integration to Company policy and Feedback system design
- Review of the execution of the process
    - Measurement / Recognition: recognise participants' efforts and congratulate them where appropriate. Take the opportunity to assess and develop management potential in order to grow the company and motivate participants.
    - Participation: ensure participants feel they can contribute and do so willingly. Take those to task who do not prepare sufficiently.
    - Discipline: ensure participants adhere to and respect the meeting schedule and agenda. Also that processes and procedures (analysis, collection, timing) are adhered to.

- Environment: ensure the atmosphere in which the meeting takes place is one that facilitates honesty (informal, relaxed, comfortable, listening, disagreement, consensus, criticism, few hidden agendas, no power struggles).
- Honesty: ensure an honest and truthful picture of each department's performance is delivered. Pressure should not be felt or given in meetings due to a department's poor performance to plan.

EXHIBIT B: S&OP Improvement Tool

(As shown in Appendix I.)

EXHIBIT C: Recommended Reading

Brechbühl, H. (2004) Making the Link Between Sales and Operations Planning. Executive roundtable series co-founded by the Center for Digital Strategies at the Tuck School of Business and Cisco Systems, Inc., Dartmouth.

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