From lean supply and relationships to SME assessment

Portfolio:

1. Literature review of Lean Supply:

   Additional Factors presented;

2. Comparative SME assessment tool (SOAT)

   using business processes: innovation through

   development, application, analysis;

3. Memorandum of Understanding and Intent

   created for new business relationships

Executive Summary, Engineering Doctorate

September 2000

Robin McKenzie

Abstract

This Executive Summary is a summary of the author's Engineering Doctorate research and the application of that research. The Executive Summary has sufficient detail and description to be read independently from the other pieces of research, called submissions, to which this refers.

In outline, the three areas of research arose from the three research programmes with which the author was closely involved.

The first area of research involved the identification of critical success factors within customer-supplier relationships in the automotive industry. An extensive literature review was performed using Lamming's Lean Supply Model (1993) as a starting point. A number of gaps in the body of knowledge were identified and were grouped into five areas for the purpose of further research. One area was subsequently addressed as part of the second area of research.

The second area of research was aimed at assisting small and medium sized enterprises (SMEs) in their use of the internet to improve their performance. A means of assessing the effectiveness of the operations of the SMEs was a critical part of this programme. A new tool called the *S*ME (*O*perations) *A*ssessment *T*ool, (SOAT) was developed because it focused on key business processes as the basis for assessment instead of the more traditional financial analysis. Having developed SOAT within the specific research programme, it was applied to three SMEs as a test of the methodology as a more general tool. Feedback from the three SMEs and those within the research programme showed that SOAT was straightforward to apply.

The third area of research allowed the author to develop his interest in customer supplier relationships, as this was seen to be the main focus of concern within companies within the programme. A Memorandum of Understanding and Intent (MUI) was developed and justified, but was in the process of being applied by other researchers.

Robin McKenzie

Table of Contents

Appendices

Statement of Original Authorship

This section outlines the author's own work and where work was collaboratively undertaken.

Own work

The author wrote all the submissions except for Submissions 2-1 and 2-2, which were co-authored and acknowledged.

Submission 1, Submission 2-3, Submission 3-3, Submissions 4-1 and 4-2 were wholly the author's own work.

Submission 3-2, except for the initial development of the Questionnaire, was the author's own work.

Collaborative work

Submissions 2-1 and 2-2 as acknowledged.

Submission 3-1: the choice of business processes was Paul Chapman's (Chapman, undated). Paul Chapman was a Research Engineer within the Engineering Doctorate Programme, WMG, University of Warwick.

Submission 3-2: the understanding that the methodology within AutoLean II could be used as an assessment tool, was developed in discussions with the author's co-interviewer, Mike Szczygiel, EIAG, and is acknowledged. EAIG, the European Automotive Initiative Group, was a specialist consultancy within the automotive sector.

It was the author's own initiative which sought to assess SOAT in the ways described, both in terms of its innovation and of its content, and to apply SOAT.

Acknowledgements

I would like to thank my mentors, Dr. Tim Goodhead and Nigel Brennan.

Also thanks to my WMG colleagues with whom I have worked, especially Paul Chapman, now at Cranfield University, and Penny-Anne Cullen.

Also thanks to Mike Szczygiel from EAIG, without whom the ideas which developed in SOAT would not have been possible, and who also taught me to be a consultant.

In particular, I would like to thank my wife, Amanda, and my young children, Annabel and Caroline, without whose patience and tolerance over my many hours spent in the study, would not have enabled this to come to fruition.

And to those who prayed that this doctorate may be complete.

Robin McKenzie

26 September 2000

1 Introduction

1.1 Summary of Engineering Doctorate

This Engineering Doctorate was based on three research programmes to which the author contributed, all based within WMG, University of Warwick.

1.1.1 The first research programme, literature review and papers

The first research programme sought to discover critical success factors for supply into vehicle assemblers, which also provided the start point for the author's research. Lamming's Lean Supply Model (1993) was chosen as this model was also chosen because it was based on the automotive industry and reflected the author's interest in customer-supplier relationships with which this model was concerned.

This research programme provided the basis for a literature review, which became Submission 1. A number of gaps in the body of knowledge were identified, and five grouped areas for possible further research were put forward.

Out of this literature review and the accompanying primary research, was developed a further set of factors to be used in customer-supplier relationships. These were presented at various conferences and were published, Submissions 2-1, 2-2 and 2-3.

1.1.2 Second research programme, including application of innovation: SOAT

The second research programme was again within the automotive supply chain, but this time focused on SMEs within the West Midlands area of the UK. The purpose of this programme, called AutoLean, was to assist these SMEs in successfully utilising internet access. WMG, together with an outside consultant assisted these SMEs to see how the internet might be used specifically in their company.

It was during the course of these visits to assist the SMEs, that it became clear to both the author and to the outside consultant, that the tools and methodologies for assisting the SME with their internet access, actually provided a simple and quick assessment, but in sufficient detail for significant issues within the SME to emerge. This methodology was termed by the author as SOAT, *S*ME (*O*perations) *A*ssessment *T*ool, and it was SOAT which was considered to be innovative, rather than the provision of internet access.

SOAT was applied in three SMEs primarily as an assessment tool. Feedback on its success within these three SMEs, together with an appraisal of the SMEs assisted within the AutoLean programme visited by the author. A set of questions were developed to judge whether SOAT had been applied successfully. These questions were used as a basis for feedback sometime after the SOAT visit and subsequent report generated, to assess the application of SOAT with both the AutoLean II SMEs and with the three additional SMEs. From this feedback, both individually and taken together, the author considered that SOAT had been applied successfully.

As part of the justification for SOAT's innovative nature, a literature review was conducted to find equivalent assessment tools or methodologies, but none were found. This review also confirmed that SOAT was consistent with main business research philosophies.

Initially, there appeared to be no clear relationship between the first research programme, and the second research programme with which the author was involved. However, the way that this second research programme developed through the development of SOAT meant that one of the five areas identified from original literature review had been, at least in part, addressed. This was the need to enable the philosophy behind the Lean Supply Model, called Lean Thinking (Womack and Jones, 1996), to be managed into the supply chain.

1.1.3 Third research programme: innovation, Memorandum of Understanding and Intent

The third research programme with which the author was involved, called ECLOS, Effective Contractual and other Legal Obligations in Strategic Alliances in the Aerospace Sector, was one which related contractual process, together with Product Development processes, in order to supply. At first glance, this research programme did not relate to the author's original literature review.

However, what emerged from interviews with companies and organisations involved, was the need for what might be termed "good relationships" with the other party in the customer-supplier relationship to be undertaken. This being the case, the importance and characteristics of customer-supplier relationships was one of the further proposed areas of research identified in the original literature review.

A literature review of models of customer-supplier relationships was performed, and a document developed to assist in the establishment and continuation of customer-supplier relationships. This document was called the Memorandum of Understanding and Intent (MUI), and was its content was also justified.

This Memorandum of Understanding and Intent was claimed to be another area of innovation developed within the author's Engineering Doctorate, but was not able to be applied as it was at the end of the author's research time.

1.2 Objectives of Executive Summary

This Executive Summary is required as a summary of the Submissions included within the author's Engineering Doctorate. In this regard, there are frequent references to these Submissions within the text. Submissions are either documents written specifically for the Doctorate, or are papers published for the purpose of sharing the work with interested parties.

The Executive Summary has been written with the intention that it can be read as a free standing document, without necessarily having sight of these supporting Submissions. Enough of the data and detail has been included for the reader to follow the argument.

1.3 Engineering Doctorate Submissions: placement within Executive Summary

Section 1.7 gives a full listing of the Submissions within the Engineering Doctorate.

This section describes the Submissions submitted as part of the Engineering Doctorate, and summarises the relationship of these Submissions to this Executive Summary. An additional recap chapter within the Executive Summary is included. Table 1-1 summarises the Chapter numbers with the equivalent main submission.

Executive Summary	*Equivalent main submission*
Chapter 1	Not applicable
Chapter 2	Submission 1
Chapter 3	Submissions 2-1, 2-2, 2-3
Chapter 4	Submission 3-1
Chapter 5	Submission 3-2
Chapter 6	Submission 3-2
Chapter 7	Submission 3-2
Chapter 8	Submission 3-3
Chapter 9	Submissions 4-1, 4-2
Chapter 10	Not applicable

Table 1-1 Identification of the main content of each Chapter in the Executive Summary

Submission 1 was a literature review on areas surrounding Lean Supply, starting with Lamming's Lean Supply Model (1993). Gaps within the body of knowledge were identified together with proposed actions to fill these gaps. Five grouped areas for further research were identified.

Chapter 2 summarises the first part of Submission 1, and summarises the gaps in the body of knowledge. Section 2.10.2 reviews how the five grouped areas for further research have been addressed within the Engineering Doctorate.

Submission 2-1, 2-2 and 2-3 were papers published as a result of theory developed during the literature review. Chapter 3 outlines these papers and why they were written.

Submissions 3-1, 3-2 and 3-3 describe the AutoLean research and consultancy programme from which arose the SME (Operations) Assessment Tool, SOAT, which was seen to be innovative, and which was then subsequently applied. Submission 3-1 described the AutoLean programme. Submission 3-2 reviewed appropriate literature

to claim innovation, and also analyses the data from the SMEs interviewed. Submission 3-3 reviewed the application of SOAT in three SMEs, and also in retrospect to the SMEs originally interviewed.

Chapter 4 provides an introduction to AutoLean and SOAT. Chapter 5 defines business processes required for any tool focusing on these activities, and also defines operations, the part of the SME where the assessment tool SOAT, is used.

Within Chapter 5 is a summary of the literature review which sought to identify other similar assessment methodologies, finding none equivalent, which led the author to believe that SOAT was innovative.

Chapter 6 is a review of the analyses of the SMEs interviewed within the AutoLean programme. An analysis of this data was required for a number of reasons, but demonstrated that any assessment of an SME could be placed within the understanding of a group of SMEs It also revealed particular characteristics for the SME which could be used as key assessment indicators.

Chapter 7 summarises the place of the tool developed, SOAT, as part of continuing existing research philosophies.

Chapter 8 summarises the application SOAT within three specifically interviewed SMEs outside the original research programme. Also within Chapter 8 are references to the role of other providers of services to SMEs, and an overview of the benefits of SOAT for SMEs and SME Service Providers. Characteristics of the SME identified as appropriate for a successful application of SOAT are also summarised in Chapter 8, together with areas seen for SOAT's improvement.

Submission 4-1 and 4-2 were adapted reports for the research programme, ECLOS, into which they were submitted. Submission 4-1 reviewed the literature of customer

supplier relationships models, whilst Submission 4-2 justified a proposed Memorandum of Understanding and Intent, MUI, developed as a framework for any proposed customer supplier relationship. Chapter 9 outlines the MUI and summarised its justification. The models of customer-supplier relationship are not summarised.

Chapter 10 briefly suggests how SOAT and MUI could be seen together, and also restates what has been developed within the Engineering Doctorate.

1.4 How and in what order should the Executive Summary and Submissions within the Engineering Doctorate be read

The author has suggested two ways the Executive Summary and the accompanying Submissions could be read, depending on the purpose of reading. The first purpose is for the reader to clearly see the application of innovation as required within the Engineering Doctorate programme. The second purpose is for the reader who wishes to have an overview of the author's research submitted, or review a particular part of the research submitted.

1.4.1 Identification of Application of Innovation in Executive Summary and Submissions

The development of SOAT and its application are believed to satisfy the requirements of Application of Innovation. For a speedy identification of Application of Innovation of SOAT, the Executive Summary and the Submissions could be read as follows:

1. Read Section 2.10.2 which identifies how SOAT came from an identifiable gap in the body of knowledge,
2. Read Chapter 5 which identifies no equivalent to SOAT within the literature. For a fuller understanding read Chapter 2, Submission 3-2, as Chapter 5 is a summary of this chapter,
3. Read Chapter 8 which summarises the application of SOAT. For a fuller understanding read Submission 3-3, at this stage omitting Chapter 4. Here SOAT can be seen to have been successfully applied.

Reading these areas should be sufficient to justify the claim that SOAT is innovative and has been successfully applied.

For a fuller understanding of SOAT, now read as follows:

4. Read Chapters 4, 6 and 7 to be read alongside Submission 3-1 which describes the research programme, AutoLean, and read alongside the rest of Submission 3-2, which analyses the data from the primary research, the SME interviews of the SMEs within the research programme, AutoLean II.

Read now the rest of the Executive Summary:

5. Read Chapter 2 for a summary of the original literature review of the area of Lean Supply, Submission 1,
6. Read Chapter 9 below, which is a summary of a second area of innovation, although not applied. This innovation was a document to assist companies in setting up appropriate relationships. The document, the Memorandum of Innovation and Intent is in Submission 4-2, together with a commentary and justification for such a document. Submission 4-1 is a review of the literature which was used within the research programme, ECLOS on models of customer supplier relationship,
7. Read Chapter 3 below which introduced the papers the author has presented and published, Submissions 2-1, 2-2 and 2-3.

1.4.2 Understanding of the author's progression of research

A second way that the reader can read the author's Executive Summary and Submissions is as the author progressed through the doctorate.

The order of the Chapters in the Executive Summary mirror progression of research done by the author. Table 1-1 outlines, in general, which Submission has been summarised into which Chapter.

For an overview of the author's research, the Executive Summary should be read through first. For a fuller overview, each Submission could be read after, or alongside, each appropriate chapter.

1.5 Abbreviations

Abbreviation	*Description in full*
£ K	£, thousand
CAD	Computer Aided Design
EAIG	European Automotive Initiative Group
ECLOS	Effective Contractual and other Legal Obligations in Strategic Alliances in the Aerospace Sector
EPSRC	Engineering and Physical Sciences Research Council
EU	European Union
IPT	Integrated Project Teams
MoD	Ministry of Defence
MUI	Memorandum of Understanding and Intent
N/A	Not applicable
NPD	New Product Development
pa	Per annum
PC	Personal computer
pcm	Per calendar month
PDP	Product Development Process
PIP	Product Introduction Process
R&D	Research and Development
RM	Relationship Marketing
SBAC	Society of British Aerospace Companies
SCRIA.RET	Supply Chain Relationships in Action Relationship Evaluation Tool
SIBET	Soft Issue Bid Evaluation Tool
SME	Small and Medium sized Enterprise
SOAT	SME (Operations) Assessment Tool
WMG	Warwick Manufacturing Group

1.6 Definitions

Phrase	*Description*
Application SMEs	The SMEs within the application stage of SOAT, where SOAT was used primarily as an SME assessment tool.
AutoLean	The programme of research and consultancy, which assisted SMEs within the West Midlands area of the UK with internet access, in part through mapping the business processes.
AutoLean 1	The first tranche SMEs assisted of AutoLean.
AutoLean II	The second tranche of SMEs assisted where SOAT was developed.
ECLOS	The programme within which Memorandum of Understanding and Intent was developed
Lean Supply	The research area around which the literature review was conducted, Submission 1.
SME	An SME is defined as such by the EU if it employs less than 250 employees.

1.7 Submission references within the Engineering Doctorate

For the sake of readability and flow of the text in this submission, the author's submissions for the Engineering Doctorate have been shortened to just the submission number. The full listing of submissions here is also given in the list of references, both under the authors' names and the Submission number.

Submission 1: McKenzie, R. (1999), "A critical evaluation of the Lean Supply Model (Lamming, 1993), the Lean Aircraft Initiative Model, and the Lean Thinking Model (Womack and Jones, 1996)", Submission for Engineering Doctorate, 18 February 1999; Submission 1, Engineering Doctorate, WMG, University of Warwick

Submission 2-1: McKenzie, R. and Goodhead, T. (1999), "Supply chain development - What comes after lean supply?", 3rd Annual Airline Purchasing & Aviation Suppliers Conference, Brussels, Belgium, 14-15 April 1999; Submission 2-1, Engineering Doctorate, WMG, University of Warwick

Submission 2-2: McKenzie, R. and Brennan, N. (1999), "Lean Supply in the Automotive Industry – Factors identified for successful customer-supplier relationships", Logistics Research Network Annual Conference, University of Northumbria, September 1999; Submission 2-2, Engineering Doctorate, WMG, University of Warwick

Submission 2-3: McKenzie, R. (1999), "Doing more with less", *Aircraft Technology Engineering & Maintenance*, Issue 42, pp. 56-60; Submission 2-3, Engineering Doctorate, WMG, University of Warwick

Submission 3-1: McKenzie, R. (2000), "AutoLean II: Description of the Project", 1Submission 3-1, Engineering Doctorate, WMG, University of Warwick, September 2000

Submission 3-2: McKenzie, R. (2000), "The SOAT tool: an Innovative Approach to SME assessment", Submission 3-2, Engineering Doctorate, WMG, University of Warwick, September 2000

Submission 3-3: McKenzie, R. (2000), "Application of SOAT tool", Submission 3-3, Engineering Doctorate, WMG, University of Warwick, September 2000

Submission 4-1: McKenzie, R. (2000), "ECLOS The role of relationships between customer and supplier: description of relationship models", Submission 4-1, Engineering Doctorate, WMG, University of Warwick, June 2000

Submission 4-2: McKenzie, R. (2000), "Commentary on and Justification of ECLOS Memorandum of Understanding and Intent", Submission 4-2, Engineering Doctorate, WMG, University of Warwick, June 2000

2 Literature Review

2.1 Introduction

The literature review, Submission 1, explored issues in customer-supplier relationships. The starting point within the literature review was Womack, Jones and Roos' (1990) seminal work on the analysis of the Japanese production techniques within the automotive industry. This was then followed, in order, by a review of Lamming's (1993) much quoted Lean Supply Model, important as this model had come out of the research conducted for Womack *et al.*'s research; the Lean Enterprise Model, which arose from a programme called the Lean Aircraft Initiative; and the Lean Thinking Model, developed by Womack and Jones, (1996). Each of these three methodologies: Lamming's Lean Supply Model, Lean Enterprise Model, and the Lean Thinking Model were critically assessed in terms of their strengths and weaknesses. Submission 1 revealed 26 gaps in the body of knowledge, and these were gathered together into five general selected areas for consideration of further research by the author.

2.2 Structure of Chapter

This chapter summarises Submission 1, the literature review around Lean Supply. The review of Lamming's Lean Supply Model is summarised in detail as this was the starting point for the author's research, and a significant part of the research, and only briefly summarises the other parts of Submission 1.

2.3 Objectives of Literature Review

The literature review aimed to meet five related objectives.

1. To provide a starting point for research into customer–supplier relationships using an appropriate and well grounded academic model.
2. To provide a literature review to complement the programme into which the work on customer-supplier relationship was going. This was on critical success factors for supply into the automotive industry.
3. To develop an expert knowledge of an engineering area, or in other words, to begin to actually do the research.
4. To write an extended academically based piece of written work.
5. To identify areas for academic investigation which could be researched within the timescales of the Doctorate.

2.4 The Research Programme

The research programme into which the literature review contributed was the "capacity building of delivery organisations through evaluation of O.E.M. and first tier business strategy", under the Regional Challenge Accelerate Programme. In effect, this was a European Union Initiative to help SMEs in the automotive supply chain within the West Midlands, UK, to enable them to understand the requirements for supply into vehicle assemblers and the vehicle assemblers' first tier suppliers. In addition to the author, the research team included Nigel Brennan as a Project Leader and Penny-Ann Cullen, both of WMG.

The methodology within this research programme incorporated a literature review which was drawn from the author's literature review which became Submission 1, and also included interviews with senior managers of vehicle assemblers in the UK, USA, Japan and Korea, as well as trade associations and commentators within each of these geographical areas.

The aim of this programme was to discover critical success factors which any SME would require when supplying either into the vehicle assembler or the first tier supplier.

2.5 Fit into Engineering Doctorate

The Engineering Doctorate can be a set of disparate research programmes, but showing Application of Innovation and fulfilment of a set of personal competences by the author. The author was interested through his previous experience in customer-supplier relationships, and this continued throughout the Doctorate.

In terms of the competencies required within the Engineering Doctorate, the literature review covered the following; first, the ability to search relevant information sources and seek optimal solutions to complex engineering problems; secondly, the development of written communications skills; thirdly, the development of an expert knowledge of an engineering area; and fourthly, team working skills.

The literature review provided to some extent the basis from which the other major areas of work arose, these being the SME (Operations) Assessment Tool (SOAT), Submissions 3-1, 3-2, 3-3, and secondly the Memorandum of Understanding and Intent (MUI), Submissions 4-1 and 4-2.

The author was able to bring the work in the literature review together in the form of ten Additional Factors. These were initially presented at a practitioner conference within the aerospace industry (McKenzie and Goodhead, 1999, listed as Submission 2-1). These factors were then presented at an academic conference together with data from the research programme described above (McKenzie and Brennan, 1999, listed as Submission 2-2), and then redrafted for a practitioner journal (McKenzie, 1999, listed as Submission 2-3). These Additional Factors were to be used in conjunction with the factors within Lamming's Lean Supply Model (1993).

2.6 Academic start point for research: Lean Supply Model, (Lamming, 1993)

A suitable and appropriate choice for a start point was needed for both the Regional Challenge programme within WMG Accelerate Programme and also for the author's own studies. This seemed to be best done by using Lamming's (1993) Lean Supply Model of customer-supplier relationships, reviewed briefly in Section 2.7. below. This was appropriate because Lamming was part of the team that also contributed to Womack, Jones and Roos' (1990) work *The Machine that Changed the World,* looking at automotive practices in Japan. In Womack *et al.*'s book, Lean Production was introduced, and the benefits of matching production and customer demand were demonstrated. Also researched were issues to do with supplier. As Lamming had been a contributor to Womack *et al.*'s programme, and as the automotive industry was often seen as a lead industry, as demonstrated by Womack *et al.*, it was appropriate to take Lamming's Lean Supply Model as a basis for both the author's initial study and research, and also a model with which to compare customer-supplier relationships in interviews with vehicle assemblers and first tier suppliers. These interviews were conducted by the Project Leader Nigel Brennan supported by Penny-Ann Cullen and the author. The actual suggestion and choice of Lamming's Lean Supply Model was the author's.

2.7 Lamming's Lean Supply Model (1993)

The Lean Supply Model consisted of nine factors. These are listed in Table 2-1 together with characteristics for each factor. These factors were developed by Lamming during the research which resulted in Womack, Jones and Roos' (1990) book, *The Machine that Changed the World.*

Factor	Lean supply characteristic
Nature of competition	Global operation; local presence Based upon contribution to product technology Organic growth and merger and acquisition Dependent upon alliances/collaboration
Basis of sourcing decisions	Early involvement of established supplier in new vehicle Joint efforts in target costing value analysis Single and dual sourcing Supplier provides global benefits Re-sourcing as a last resort after attempts to improve
Role/mode of data/information exchange	True transparency: costs, etc. Two-way: discussion of costs and volumes Technical and commercial information Electronic data interchange Kanban system for production deliveries
Management of capacity	Regionally strategic investments discussed Synchronised capacity Flexibility to operate with fluctuations
Delivery practice	True Just-in-Time with kanban Local, long-distance and international JIT
Dealing with price changes	Price reductions based upon cost reductions from order onwards: from joint efforts
Attitude to quality	Supplier vetting schemes become redundant Mutual agreement on quality targets Continual interaction and kaizen Perfect quality as goal
Role of R & D	Integrated: assembler and supplier Long term development of component systems Supplier expertise/assembler system integration
Level of pressure	Very high for both customer and supplier Self-imposed Not culturally specific

Table 2-1 The Lean Supply Model of customer-supplier relationships; *Source:* Lamming (1993, p. 194)

2.8 Structure of Literature Review, Submission 1

The Literature Review was structured in seven parts as follows:

First, an initial scene setting which was a discussion of Womack, Jones and Roos' (1990) understanding of mass production and supply.

Secondly, a description of Lamming's Lean Supply Model and how it fitted in to recent historical analysis of customer -supplier relationships.

Thirdly, factors within the Lean Supply Model were looked at in detail. Support for each factor was researched within the literature and those areas not supported by other areas were identified.

Fourthly, it reviewed part of the Lean Enterprise Model which arose from the Lean Aircraft Initiative. The factors in the Lean Enterprise Model which were seen to be relevant for supply were then analysed. The Lean Enterprise Model arose from work in the Lean Aircraft Initiative Model, a programme initially devised for the American Department of Defence which followed on from the research by Womack, Jones and Roos' research in the car industry. It was then taken up by the American Civil Aerospace sector and became known as the Lean Aircraft Initiative, and a model mapping the characteristic measures and requirements for a typical Lean Enterprise were actually listed. The Lean Enterprise Model is given in Table 2-2. The Lean Enterprise Model was not reviewed in Submission 1.

Meta-Principles
- Responsiveness to change
- Waste minimisation

Enterprise principles
- Right Thing at Right Place, Right Time and in the Right Quantity,
- Effective relationships within the value stream
- Continuous improvement
- Optimal First Delivered Unit Quantity

Enterprise Level Metrics
- Flow time: order to delivery time in months, product development cycle time (industry comparative, % reduction)
- Stakeholder satisfaction: on time deliveries, continuous cost / price improvement
- Resource utilisation: output/employee, inventory turns
- Quality yield: scrap and rework rates, design changes/initial release/project phase

Factors
1. Identify and optimise enterprise flow
2. Assure seamless information flow
3. Optimise capability and utilisation of people
4. Make decisions at lowest possible level
5. Implement integrated product and process development
6. Develop relationships based on mutual trust and commitment
7. Continuously focus on the customer
8. Promote lean leadership at all levels
9. Maintain challenge of existing processes
10. Nurture a learning environment
11. Ensure process capability and maturation
12. Maximise stability in a changing environment

Table 2-2 Lean Enterprise Model; source LAI Web page [1]

Fifthly, the Lean Thinking Model by Womack and Jones (1996) was analysed, Figure 2-1. This model included five factors and the analysis of each factor was included. A significant analysis within this section in Submission 1 was the relationship between traditional marketing and Lean Thinking (Piercy and Morgan, 1997). Essentially Piercy and Morgan equated Lean Thinking with an operations focus of a business.

[1] Web page at "http://web.mit.edu/ctpid/www/lai/" July 19 ,1996

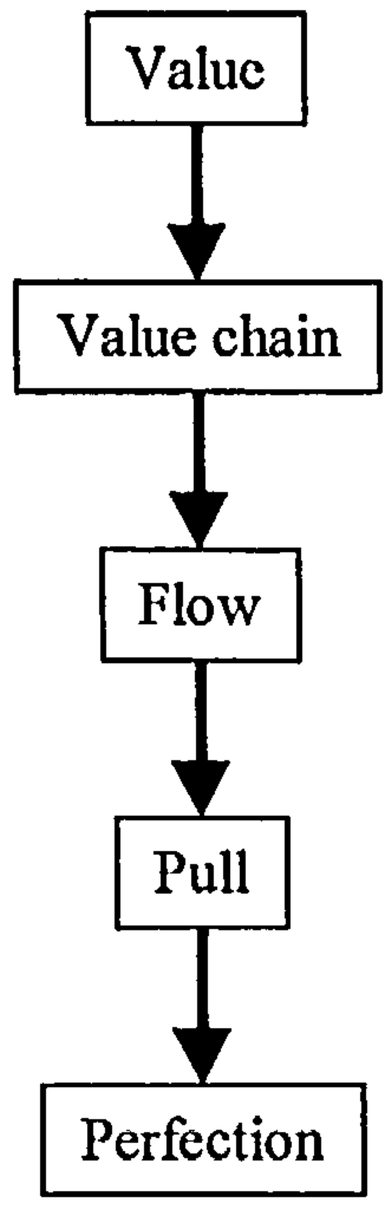


Figure 2-1 The Lean Thinking Model *Source:* Womack and Jones (1996)

Sixthly, gaps in the body of knowledge were identified. In total twentry-six gaps in the academic literature were identified (Submission 1, Section 8-2), together with ways of addressing each of these gaps in the body of knowledge being presented in Submission 1, Section 8-3. These gaps in the body of knowledge are listed in Table 2-3.

Gaps in the body of knowledge, Submission 1, Section 8.2

1. The types of relationships within customer-supplier interaction needs to defined, including leadership and grouping. Research on the measurement of the relationship, both at the strategic and operational levels.
2. Research on the role of the individual within the supply chain context.
3. Supply chain theory should be developed to take account of more complicated sets of relationships which occur in practice, both in terms of networks and regional clusters.
4. Outside environmental factors need to be included in customer-supplier issues.
5. Research into the how Lamming's Lean Supply Factors can be tested and how they are interrelated.
6. Research into the requirements for survival of tier 1 suppliers.
7. Research on the integrity and approach across a supply chain, especially within a single organisation.
8. Research on the need to address the issue of intellectual property rights.
9. Research on the influence the contract has, and a contractual mindset has on customer-supplier relations.
10. Research on what happens with technological change within the automotive industry.
11. Research on how Sako's (1992) model of trust and types of relationship are applicable in the supply chain.
12. Research on the use of EDI and information flow within the automotive supply chain.
13. Research on whether successful change starts with internal people and resources or with acquisition and capital.
14. Research on the use of supplier associations as a mechanism to ameliorate the two-way relationship between customer and supplier, especially in a situation where one party is taken over.
15. Research on the instability of supply chains and its consequences.
16. Research on where intervention or cascade is appropriate for successful supply chain management (Lamming, 1996).
17. Research on the benefits of subcontracting, and situations when subcontracting is most appropriate.
18. Research on seeing whether there is an end point to the current rationalisation of the automotive component supplier base.
19. Research on the issues surrounding partnerships to do with production process and partnerships to do with the delivery of components.
20. Research regarding the role of internal financial systems with regard to changing business practices.

21. Research on how organisational slack measured within supply chains and what is appropriate for different supply chains.
22. Research to examine to what extent product is "pulled" through the supply chain, and to examine the structural factors which may influence the strength of this pull.
23. Research on what may be called perfection in supply chain thinking.
24. Research on how valid are the Lean Organisation Principles and Objectives within the Lean Thinking Model.
25. Research on modelling conflict resolution within the supply chain.
26. Research on the support or otherwise of the assertion that where there is no sales promotion there is stable demand.

Table 2-3 Gaps in the Body of Knowledge as stated in Literature Review, *Source:* Section 8.2, Submission 1

Finally, five different areas of research were outlined comprising some of the gaps in the body of knowledge. These areas were summarised as follows:

1. There was a need to further research on the nature of customer-supplier relationships, including the measurement the strength of the relationship, including definitions of different types of relationship and of the individual, together with an understanding of requirements for leadership for change within the Lean Approach.
2. Research was required on the complicated and complex way in which relationships were formed between different groups. The approach outlined in the Literature Review was the network approach.
3. There was a need to map outside environmental factors, in terms of environmental legislation and consumer information within the supply chain.
4. There was a need to understand and see how Lean Thinking paradigms could be managed into the supply chain culture, by relating how people and organisations learn.
5. There was a need to verify whether or not the Lean Supply Model as suggested within the literature review just restates the role of a traditional buyer.

2.9 Summary critique of Lean Supply

2.9.1 Introduction

Part 1, Submission 1, introduced and reviewed the Lean Supply Model (Lamming, 1993) and is summarised below.

2.9.2 History of customer-supplier relationships

Lamming identified four distinct phases of customer-supplier relationships in recent commercial history and these were also discussed briefly in Section 3.1, Submission 1. The first phase up to 1975 was characterised as a period of relative calm within domestic demand supply, which was well balanced for mass producers with little international competition in the automotive industry. The second period came after the oil shock in 1975 and subsequent recession, where demand fell and became unstable. The third phase began after about 1980 where there was a noticeably better attitude towards relationships, but the relationships themselves were difficult and unstable.

In time, this led to an understanding of Japanese relationships, the so called Japanese Model or rather Post Japanese Model or Partnership Model. Lamming though, believed that there was a further stage, which he entitled Lean Supply which was a more generic understanding of customer-supplier relationships, not automotive industry dependant. However, within the automotive industry this was seen as automotive companies becoming not just global in their outlook but also regional with there being three major regions, North America, Europe and the Far East. Suppliers would have had to set up in these regions to match their requirements. In addition, the sourcing of components would be the responsibility of first tier suppliers, often from low labour costs economies. Lamming was not alone in understanding the need for collaboration and partnership. This was also seen in other models, in the Relationship Marketing paradigm (Cranfield School of Management, 2000), in other aspects of Lean Supply, for example in Hines *et al.*

(2000) and also seen in the understanding of relationships within networks (Ford *et al.*, 1998). Other models similar to Lamming's Lean Supply Model can be seen in, for example, Sinclair *et al.* (1996).

2.9.3 Benefits of Lean Supply,

Lamming gave a number of benefits for Lean Supply as an example of collaboration; these arise from his analysis of the characteristics of the Lean Supply Model. These were reviewed in Section 3.3.1, Submission 1.

First, through risk reduction, by relying on the supplier's technology often in unknown areas, where the assembler would share some of the risk in what might be termed micro-niche markets. This also meant that this would reduce risk as technology could be spread over a number of assemblers and in different industries. This collaboration was enabled because of the continuing further and deeper relationships between assemblers and first tier suppliers.

Secondly, through sourcing certain parts the supplier had an opportunity to gain economies of scale in selling to other assemblers and to other industries through shared R&D, where supplier and customer share complementary technology and patents. The example Lamming gave was the anti-lock braking systems.

What appeared to be singularly missing from Lamming's work was, what might be called, the "down side" of partnerships and these were discussed in some length within the Submission.

2.9.4 Summary of review of factors within the Lean Supply Model

Chapter 4, Submission 1, outlined each of Lammings Lean Supply factors in detail, with support for each factor together with areas not supported by the factor. These are summarised below.

2.9.4.1 Factor 1: The Nature of Competition

This was reviewed in Section 4.1, Submission 1.

The nature of competition was seen to be a summary factor outlining the changes in the supply chain of both vehicle assemblers and their first tier suppliers arising from changes in purchasing strategy by the vehicle assemblers and also the globalisation of the automotive market.

The Lean Supply Model stated that assemblers would have to have a global operation but have to have a local presence in one of the three major regions as stated earlier. The supplier would not only manufacture in each region but would also contribute to the product technology and indeed might become the technological leader or innovator. In Lean Supply, competition would centre on out-sourcing and re-configuration of supply to assemblers. In this case quality, price and delivery would be order qualifying criteria, as opposed to order winning criteria.

Lamming did see the difficulty in the assembler and the supplier being able to align their human and capacity resources, but the suppliers would need to grow to be able to provide the resources needed for this change. Lamming saw this change to have arisen from acquisitions, mergers and joint ventures and partnerships. This had been clearly seen in

the rash of many acquisitions and joint ventures over the previous years, for example TRW and Lucas.

2.9.4.1.1 Factor1: Support given in the literature review

A summary of support for this factor was given in Section 4.1.1, Submission 1.

The Literature Review identified four areas for support for this Nature of Competition factor. First, the re-structuring of assemblers' purchasing function. The Lean Supply Model could have predicted the re-structuring of assemblers purchasing activity on a worldwide basis, for example within General Electric (Smith, 1995), and within Ford (*Purchasing*, 1996).

Secondly, the reduction in the number of assemblers at the time of the literature review and also subsequently could have been predicted.

Thirdly, a reduction in the number of component suppliers was correctly predicted. However, what was not predicted was the way in which this differed in different cultures. For example in Japan, such reduction was done through mutual consent using the cross holding mechanisms and the use of the supplier association (Hines, 1994). In Western Europe and North America, it was through acquisitions rather than through partnerships or collaboration.

Fourthly, the requirements for innovation and financial strength was seen. The Lean Supply Model emphasised the need for innovation and the need for necessary financial resources in order to survive.

2.9.4.1.2 Factor 1:Areas in the literature review which did not support the factor

Section 4.1.2, Submission 1 outlined five areas which did not support the factor.

First, the inter-relationship of the factors within the Lean Supply Model was not seen or acknowledged.

Secondly, the issue of regional plants for the manufacturer and supply of vehicles appeared to be not supportable in all cases, because of the over capacity in the vehicle market (Gardner, 1997).

Thirdly, a key factor mitigating against the theory of Lean Supply as described by Lamming was predicted over-capacity which meant that it was unlikely that assemblers would set up a presence in each region. Womack and Jones (1996) put their faith in the creation of smaller production units for manufacturing. But this went against the understanding and best practise in production, where economies of scale and high utilisation were still required for high performance manufacturing (Lowe *et al.*, 1997).

Fourthly, the Lean Supply Model did not address issues relating to external changes in a competitive environment. Vehicles were becoming more expensive to design and market, and customers were requiring more features with enhanced quality and reliability.

Fifthly, although the model could have predicted the restructuring of the component suppliers' industry, other consequences were not foreseen. For example, there might have been only perhaps one or two suppliers of any one component type, which meant that small assemblers would have had less influence than their larger assembler competitors. Such lack of influence would be compounded by the predicted trend towards sub-contracted design. Such a change could also have been explained through Stakeholder Theory (Mitchell *et al.*, 1997; Rowley, 1997).

2.9.4.2 Factor 2: The basis of sourcing decisions

This factor was reviewed in Section 4.2, Submission 1.

Although Lamming showed that the traditional bid and lowest price system for selecting supply had been discredited, he also stated that there was a requirement to not purely mirror the Japanese practice of a close tie between the supplier and customer. Lamming called this the Partnership Model. This was required because there might be many potential suppliers, so there had to be a mechanism for bringing in new suppliers.

Lamming suggested that this could be done first, by seeing to it that an existing supplier could deliver the new technology, or secondly, by switching to a new supplier, providing all appropriate evaluation had been done, or thirdly, by getting existing potential new suppliers to work together. Lamming called this "dynamic" ability in sourcing decisions. Each of these arrangements were seen within the research. For example, Nissan would take the first option in that it would work with existing suppliers. Ford would take the second option by using new suppliers, and the Japanese factories established in the United States were to take the third option (MacDuffie and Helper, 1997).

2.9.4.2.1 Factor 2: Support given in the literature review

Section 4.2.1, Submission 1, gave one area of support for the Basis of Sourcing Decisions factor. The factor could be supported by observing the tiering of supply chain, and this was also shown in other texts, for example Slack *et al.* (1995).

2.9.4.2.2 Factor 2: Areas in the literature review which did not support the factor

Section 4.2.2, Submission 1, though, provided seven areas which did not support the factor.

First, the issue of intellectual property rights was not addressed by the model nor was the handling of new technologies as discussed by Sako (1992), Hunt (1997), and Hall (1994).

Secondly, the numbers involved in close partnership arrangements between Japanese supplier and customer were considerably less than those believed to be involved by the industry in Western economies, (Khare, 1997).

Thirdly, there were no references to the sociological or the cultural context. Again Khare (1997) pointed to the feudal structures in Japan which led to the establishment of the supplier associations, the *kyoryoku kai,* that existed in Japan and gave rise to the way that that assemblers managed suppliers. Relationships did not exist in isolation but were socially constructed (Augoustinos and Walker, 1995; Porac and Ventresca, 1996; Searle, 1996). Whittington (1993) also highlighted the country specific sociological context in which a company might do business.

Lamming proposed that technological prowess would be seen as the means for tier two suppliers to continue to supply into tier one supplier but there appeared to be little academic evidence for this assertion. However, research with SMEs in the automotive supply chain in the West Midlands, UK (Submissions 3-1, 3-2 and 3-3) suggested that there was a continuing requirement for existing supply arrangements within the automotive supply chain. First, that it was difficult to reconfigure the complete supply chain at any one time. Secondly, any change of supplier might be initially resisted

because of the risks involved because the competency of the new prospective supplier might not be known.

Fifthly, the Lean Supply Model appeared to treat all suppliers and all relationships the same. Ford *et al.* in their assessment of business-to-business relationships grouped relationships into four types depending on the maturity of the relationship. Other scholars looked to classify different types of relationships in different ways. For example, Sinclair *et al* (1996), classified, Table 2-4, a range of dependencies within the relationship of the importance of the supplier and customer to each other.

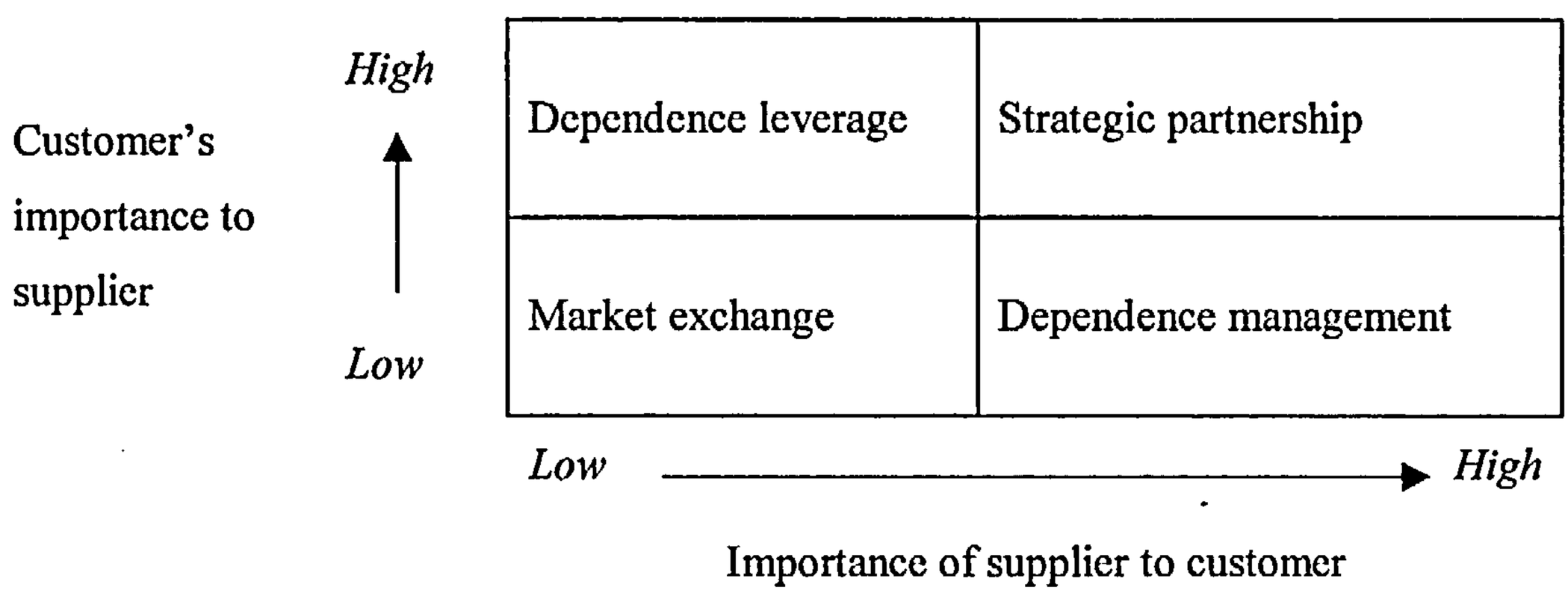


Table 2-4 Relationship dependence S*ource:* Sinclair *et al.* (1996)

Sixthly, the issue of single and sole supplier as described by Larson *et al.* (1998) was not addressed. Larson *et al.* distinguished between suppliers which had a monopoly over technology and this they called *sole* supplier and where there was a choice of customer to be supplied from a so-called *single* supplier. This was an issue of relative power.

Seventh, Lamming assumed relationships were to be conducted both ethically and within the appropriate legal framework. The cases over recent years of the European Union

taking various assemblers to court over their pricing policies indicated that this was a simplistic assumption.

2.9.4.3 Factor 3: The Role and Mode of Data/ Information Transfer

The third factor in the Lean Supply Model was the need for effective data or information exchange. This was discussed within Section 4.3, Submission 1.

Lamming saw the positive use of information by customer and supplier to gain joint competitive strength. First, Lamming pointed out that suppliers had to know more about these essential markets for their products, and to take the initiative to do so. Secondly, the assembler must have confidence in knowing that the supplier could retain any confidential information provided, and then, either knowingly or by accident, should not disclose this confidential information to a competitor.

Thirdly, Lamming stated that suppliers should have orientated their production to match any fluctuating demand on volume to the final market. He took this stance because of the *heijunka* set of practises in the Japanese domestic market (Womack *et al.*, 1990), whereby sales activity and production planning were closely linked.

2.9.4.3.1 Factor 3: Support given in the literature review

This was discussed in Section 4.3.1, Submission 1.

The Literature Review put forward a number of points for the support of this factor. First, the rise in the use of the internet. The base technology at that time appeared to be the internet, having taken over from EDI (Electronic Data Interchange). This was seen

particularly in the research with SMEs in the automotive supply chain, discussed in Submission 3-1.

Secondly, all the big US vehicle manufactures were committed to the internet, both for internal and external communications (Frook, 1997). This was proposed to be taken a stage further with a creation of possibly the world's largest internet based virtual purchasing and supply market, with General Motors, Ford and Daimler-Chrysler together with Toyota, Renault and Nissan forming the Automotive Network Exchange. This would be a $230billion worth market, purchasing parts from tens of thousands of suppliers (*The Economist*, 4 March 2000).

Thirdly, the technology allowed a low cost, low risk approach to sales and marketing (Honeycutt Jr. *et al.*, 1998).

Fourthly, there was considerable understanding for the requirements of an electronic market, for example, Bocus (1998), Keen *et al.* (1999) and Newell (2000). The American Defence Logistics Agency bought through the internet from manufacturers so avoiding the need to hold stock (Peters, 1998).

In addition, the internet should be seen as part of the marketing mix, (Honeycutt Jr. *et al.*, 1998).

2.9.4.3.2 Factor 3:Areas in the literature review which did not support the factor

This lack of support for this factor was reviewed in Section 4.3.2, Submission 1.

There were five areas outlined which did not support the factor. First, the behaviour of individuals or groups of individuals to pervert positive aspects of relationship was not recognised, seen for example by Gummesson (1997).

Secondly, the confidentiality of information provided was not addressed. Thirdly, there was no mechanism or understanding how the *heijunka* type of activities to smooth demand may be applicable to non-Japanese cultures.

Fourthly, there was no understanding of whether information through the internet or other types of technologies may be misused.

Fifthly, the risk associated with new technologies in changing traditional markets was not recognised. For example, the changes in sales channels in the US automotive market were not recognised in the Lean Supply Model.

2.9.4.4 Factors 4 and 5: The Management of Capacity and Delivery Practice

These factors were reviewed in Section 4.4, Submission 1.

These two factors were considered together as they were the only practical manifestations of supply at an operational level.

While stating that capacity considerations were long-term investments, Lamming saw such decisions as being made solely on a "normal business basis". The Lean Supply Model also implied that such decisions were based on trust. However, the only major issue addressed in terms of delivery practices was Just-in-Time requirements. None related to capacity considerations. Here, Lamming pointed out, perhaps rightly, that it

was travel time which was the major constraint of Just-in-Time, as shown by Hines (1994) in the case of Toyota. There were problems identified with crossing international boundaries in terms of supply (Levy, 1997).

2.9.4.4.1 Factors 4 and 5: Support given in the literature review

Three following areas of support were given in the literature review, Section 4.4.1, Submission 1.

The Lean Supply Model was followed on from the Lean Production Model as specified in Womack *et al.*, 1990. In the Lean Production Model, there was a need for suppliers and assemblers to tailor, or integrate processes together for greater efficiencies and effectiveness.

Next, there was a requirement that tier one suppliers situate their manufacturing next to the assembler's factory in order to shorten production and time scales. An example of this was with the production of the Ford Ka, (Burt, 1997).

Also given was an example of Lean Supply in another industry, in this case Bradley's (1996) description of the logistical arrangements to do with Kodak film, where Kodak reduced the number of carriers from sixteen to just one. It also showed that the initial cost saving was 20% of the freight line and that the systems, reporting structure and goodwill ensured that Kodak continued to receive favourable pricing.

2.9.4.4.2 Factors 4 and 5: Areas in the literature review which did not support the factor

In terms of areas not supported by the factors, Section 4.4.2, Submission 1 gave nine areas.

First, issues which dealt with Just-in-Time internationally. Lamming did not provide any reason for overcoming Just-in-Time's supply difficulties over international boundaries.

Secondly, the detail of the capacity modelling with suppliers was not addressed. No definition of what 'normal business' was given and there was no support for the assertion that the supplier should locate near to every assembler's plant. There was no understanding of how the existing and predicted capacity should be assessed. There was no model given for addressing local or national influences.

Thirdly, there appeared to be no understanding of how cultural issues may have affected capacity decisions.

Fourthly, there was no consideration within the Lean Supply Model of any market downturn. This was important because the Lean Supply Model considered that assemblers and tier one suppliers should locate together, but the problem would be that if there was a market downturn then both would be affected.

Fifthly, there was no consideration of how different types of product may be considered logistically. For example, Lamming gave an example of seating but this maybe a special case because of its bulk and fragility.

Sixthly, and this was a major consideration, the Lean Supply Model gave no consideration of over-capacity issues and this was extensively considered in the literature review. Gardner (1997), quoted a DRI/McGraw-Hill study which looked at the problems of over capacity. First, there was gross over capacity in the supply of cars and trucks. For example, in 1997 the capacity was potential production of 64.8 million units of which 49.6 million units were actually made, a global capacity usage rate of 77%. This

utilisation capacity was the equivalent to the productive capacity of 60 assembly plants turning out 250,000 vehicles a year, which would be enough to satisfy the predicted sales demand for the Unites States for the whole of 1997. In addition, this capacity gap was predicted to grow fast. Global capacity was expected to be 75.6 million units in 1997 whilst demand was expected to rise to 57.4 million units. The Global capacity usage rate would drop slightly to 76% but the absolute gap would rise from 15.2 million vehicles to 18 million vehicles, equivalent to an additional 12 idle assembly plants. Gardner stated that there might be a number of possible consequences. For example pricing and profitability would be effected with a great temptation to import vehicles back to Western Europe from low wage rate economies of Eastern Europe, such as Poland, Hungary and Czech Republic. In these countries, the wage rate was approximately $250 per month compared to $2700 per month in Western Germany.

Seventhly, there was an issue in terms of export. Japanese vehicle manufacturers had exported their way to dominance but the rules had changed. Emerging markets now required local production and investment. This could leave Japan by 2000 with 4 million units of spare capacity or the combined output at Honda, Mitsubishi and Nissan in 1995. In fact, the problems at Nissan drove it into placing itself into take-over by Renault in all but name recently. Korea wanted to add 3 million capacity nearly doubling the 1996 potential output but the problem was where these vehicles were to be sold. This would mean that some other assembler would suffer because of the mature markets in Europe and United States. Although the DRI/McGraw-Hill report was written before the South East Asian crisis, there might still be a desire by the Korean manufacturers to export cheap vehicles, even if the predicted capacity did not materialise. Also, the Lean Supply Model did not address the political issues, as mentioned with respect to Korea, where the car industry was seen as a national industry.

The Lean Supply model did not take into account increasing urban congestion. Cusumano (1994) pointed out some of the difficulties in the continuation of Lean Production in Japan. When Toyota started production after the war, the prefecture, equivalent to the

local "county", was mostly rural, but as many industries had relocated to the area and adopted the Toyota Just-in-Time system at the time of his writing, there was intense traffic congestion. In addition when Toyota started, most of the suppliers were local to Toyoda city in the Aichi prefecture. However, assemblers and their suppliers had started to relocate to less costly and less congested areas elsewhere in Japan, it was more difficult to have the type of small delivery Just-in-Time that Toyota had grown used to.

Eighthly, the Lean Supply Model did not give a clear picture of what might be included in the criteria for delivery product of what might be deemed to be over bearing requirements of the supplier. An example of this was that the small lot delivery was seen to be an ideology, so larger assemblers would use their economic muscle to obtain smaller and smaller deliveries, irrespective of the costs to the supplier.

Ninthly, it was seen that the automotive supply chain was considered to be in two parts. The author formed a view when writing the literature review that the considerations for supply into the assembler seemed to be at odds with the public statements and the image of the assembler out into the market. Supply into the assembler was characterised by the collaboration and co-operation between companies, as opposed to supply into the consumer market where assemblers fiercely defended the perhaps archaic franchising system, a system which was continually under investigation by the European Union authorities. There seemed to be a contradiction to this which did not seem to be consistent or right.

2.9.4.5 Factor 6: Dealing with Price Changes

This was reviewed in Section 4.5, Submission 1.

The Lean Supply Model took as its role model the Japanese method of supplier and assembler working together to reduce costs, looking at return on assets, value analysis and target costing. This was then to be done successfully over a number of years to obtain much lower prices and costs. This was also seen in the primary research interviews. Jaguar with its major suppliers did not discuss price until the product development process was significantly advanced, taking on trust that the appropriate pricing would be achieved. Instead they used the time it would have taken for negotiation in actually developing the new products together[2].

It was true that the issue of "cost down" had then become a regular feature in customer supply relations in the automotive industry. For example, *The Economist*, 14 August 1995, reported that Ford wanted to reduce the price of its parts purchased by 20% over the following four years as well as making the suppliers do the engineering work, and to be able to reclaim any windfall profits due to any currency movements.

2.9.4.5.1 Factor 6: Areas in the literature review which did not support the factor

Section 4.5.1, Submission 1 outlined four areas where this pricing factor was not supported.

First, the author believed that Lamming's thoughts on the issue of price reduction had shifted albeit subtly. In a paper by Lamming (1990), he outlined supplier strategies in an area that became known as Lean Supply. In this paper, price reduction was seen to be obtained by the supplier reducing costs through incorporating best practices and through the implementation of new technology as a means of gaining competitive advantage. Here, it appeared that the supplier should use price reductions at his own discretion but

[2] Interview with Margaret Beaver, Senior Buyer, Jaguar cars.

though in time prices would fall. However, within the Lean Supply Model, price reduction was seen to become a directive that was then assembler driven, an ideology irrespective of other considerations.

Secondly, the Lean Supply Model did not consider issues of changes in prices of commodity for example, wiring looms, whose main content, copper, was a spot-marketed commodity.

Thirdly, the Lean Supply Model did not consider the believability of costing figures. Even where there was a considerable amount of understanding in collaboration, for example, in the case between Rover and its supplier, TRW (Burnes and New, 1997), the issue of allocation of overhead costs relating to management and culture could be seen to be difficult to address.

Fourthly, the Lean Supply Model assumed that customer suppliers wished to work together to reduce costs and to remove waste. The issue of the relationship where this did not occur was not considered in the Lean Supply Model, but this was a consideration within the SME (Operations) Assessment Tool (SOAT), Submission 3-3, and also within the research which led to the proposal of the Memorandum of Understanding and Intent (MUI), Submission 4-2.

2.9.4.6 Factor 7: Attitude to Quality

This was reviewed in Section 4.6, Submission 1.

The Lean Supply Model rightly pointed out the poor legacy of quality in Western Europe, characterised by an aggressive and dogmatic approach to suppliers. One solution had

been the use of vetting systems by customers of suppliers, but Lamming stated that in a partnership approach such a way of handling quality and the relationship was counterproductive. Quality should become an issue with which both customers and supplier should share an equal part. Quality was seen to be an order-qualifier for being able to supply, rather than as order-winning criteria.

2.9.4.6.1 Factor7: Support given in the literature review

This was reviewed in Section 4.6.1, Submission 1.

Levy *et al.*'s (1995) research in the telecommunications industry revealed that customer organisations found it very difficult to give up their buyer power. Secondly, Levy *et al.* found that there was scope to extend the processes developed for internal total quality into the supply chain. Thirdly, they found that there was little measurement of this state of the relationship itself. This need to measure the state of the relationship was identified as a gap in the body of knowledge, and included as the first point in developing the research of the author, Point 1, Section 8.4, Submission 1.

2.9.4.6.2 Factor 7: Area in the literature review which did not support the factor

This was reviewed in Section 4.6.2, Submission 1.

The Lean Supply Model did not give any indication of how any such partnership relationships could be improved so that quality may become a joint issue.

2.9.4.7 Factor 8: Role of Research and Development (R&D)

This was reviewed in section 4.7, Submission 1.

The Lean Supply Model saw collaboration through mutual R&D, and that R&D should not be exploitative of the assembler or the supplier but should done through trust. Trust was defined as mutual agreement on principles, transparency of information and correct behaviour.

2.9.4.7.1 Factor 8: Support given in the literature review

This was reviewed in Section 6.4.5, Submission 1.

The main element of collaboration seen was that by subcontracting work, including R&D, flexibility, faster turnaround times and lower inventory would be the result. Ellram (1991) outlined the potential benefits of Japanese style subcontracting in terms of management, technology and finances.

2.9.4.7.2 Factor 8: Areas in the literature review which did not support the factor

This was reviewed in Section 4.7.2, Submission 1.

There were a number of areas which did not support the collaborative nature of Research and Development.

First, there might be a loss of technological competencies. As the assembler continued to subcontract work, there was a risk that they might lose competency in design and technology, so providing a commercial threat to their competitiveness.

Secondly, the Lean Supply Model assumed stable incremental change in new technologies in the current supply chain, and that there would be few new entrants to upset the supply chain.

Thirdly, a considerable change in the supply chain was not considered by the Lean Supply Model. Where there was considerable change often caused by the fast adoption of new technologies usually pioneered by new entrants to the supply chain, this led to redundancy of technology, factories and ways of working. This was called technological discontinuity (Foster, 1986).

2.9.4.8 Factor 9: Level of Pressure

This was reviewed in Section 4.8, Submission 1.

In Lean Supply the attitudes between individuals within the customer and supplier should have had a so-called high level of pressure. This area was relevant as it was the only factor which directly included people and their behaviour.

2.9.4.8.1 Factor 9: Areas in the literature review which did not support the factor

This was reviewed in Section 4.8.1, Submission 1.

The factor, Level of Pressure, however, was not described and was seen to be a weak area within the Lean Supply Model. There were two areas which do not seem to support the factor.

First, the issue of individual's motivation was not considered, as seen for example in the work by Gummasson (1995).

Secondly, there appears to be little academic support for the way which Lamming treated the individuals' pressure and the relationships in which individuals attempted to operate. This can be compared to the considerable quantity of literature which discussed the demands which relationships created, and in making them work, for example, Hines (1994), Priess *et al.* (1996), Gummesson (1997), Brodie *et al* (1997), and Sinclair *et al.* (1996).

2.10 Gaps in the body of knowledge identified, and suggested areas of research

The Lean Supply Model was chosen as it was the start point for both the author's research and for the research programme to which it contributed. The Lean Supply Model was used as a basis for the generation of a further theory (Submissions 2-1, 2-2 and 2-3).

The literature review demonstrated gaps seen in the body of knowledge. Although the gaps in the body of knowledge seen by the author were listed in Section 2.8 above, an example of the information behind the assertion of such a gap is given.

2.10.1 Example of a Gap in the body of knowledge identified

The example chosen is Gap 1, and is quoted from Section 8.2.1, Submission 1, see Box 2-1.

It can be seen that the gap related to the definitions of customer-supplier relationships, and that there was a need to provide some measurement of the relationship.

8.2.1 The types of relationships within customer-supplier interaction needs to defined, including leadership and grouping. Research on the measurement of the relationship, both at the strategic and operational levels.

The issue of customer-supplier relationships is a central concern in this review. Relationships are referenced in many of the introductory Sections 1.2, 1.3, 2.1 and 2.2.2. Relationships are also central to the Lean Supply Model so are raised in Sections 3, 3.1, 3.2, 3.3 and 3.4, which review the Post-Japanese Model, the Lean Supply Model and the factors within the Lean Supply Model. It is interesting to note that it is only at this stage that the term 'relationship' has been used loosely. 'Relationship' refers to a set of related concepts. Not one of the sources reviewed attempted to define relationship, except

perhaps Sinclair *et al.* (1996) Section 4.2.2.5, and Sinclair *et al.* appears to have a restricted view of relationship.

Relationships were raised in the following sections:

- Section 4.1.1.3, the relationship of the component suppliers to the culture in which they reside,
- Section 4.1.2.1, the interrelationship between the factors in the Lean Supply Model,
- Section 4.2.2.1, time as an indication of the strength of the relationship,
- Section 4.2.2.3, the social construction of relationships is raised,
- Section 4.2.2.6, the issue of single of sole supplier status is dependent on the relationship between supplier and customer,
- Section 4.2.2.7, the need for relationships to be ethically based,
- Section 4.2.2.9, styles of organisational relationship to other organisations may differ within a single company,
- Section 4.5.1.4, the issue of how a relationship can be continued or taken forward if the objectives of that relationship differ, for example despite product acceptability and operations work together,
- Section 4.6, the relationship itself should be measured as a quality standard, and section 4.6.1.1 suggests that there could be many potential measures which could be used for customer-supplier relationship. Joint relationship initiatives require joint quality standards on the relationship,
- Section 4.7.2.4, technological discontinuities need to be considered in customer-supplier relationships,
- Section 4.8.1.1, measurements in the factors for the Lean Supply Model are needed,
- Section 4.8.1.2, the issue of the individual's motivation in the relationship is considered,
- Section 4.8.2 reviews a case between TRW and Rover. Section 4.8.2.2 considers factors which influence how two companies may work closely together; the difference between senior and operational levels in the strength of the relationship; the rhetoric of partnership in any relationship needs to be treated with caution,
- Section 5.2.4 discusses non-cooperation within the supply chain,
- Section 5.2.9 discusses the issue of trust,
- Section 5.2.18 discusses that in the Lean Supply Model, the 'level of pressure' is the only directly people factor, and no academic support has been shown for its inclusion,
- Section 5.2.19 deals with the relationship of individuals,
- Section 5.2.24 discusses the applicability of the Lean Supply Model to different groups,

- Section 6.3 discusses the factor 'Optimisation and use of people' within the LAI model refers only to any one company under review,
- Section 6.3.1 suggests that relationships have validity in themselves,
- Section 6.3.4 also discuss the importance of time in developing relationships and the possible use of the relationships within supplier associations to change the dynamic of the customer-supplier relationship,
- Section 6.4.2 reviews a study which suggests that the strengths of relationship with the customer is a better predictor of factory performance than typical human resources issues like work systems or human resources management policies,
- Section 6.4.5 suggests that a close relationship with a single supplier may blind the customer to technology changes not being pursued by the supplier,
- Section 6.4.6, the relationship between the supplier and the customer may become diffuse where for example part of the production process is contracted out,
- Section 6.6.5, management accounting systems between companies need to reflect the reality of close cooperation,
- Section 6.9.1, the relationship needs to include considerations on catastrophic change,
- Section 7.1.4.1, the concept of organisational slack suggests that there may be an end point to closer cooperation,
- Section 7.4.1, all organisation relationships have a competitive and a co-operative element. What is unclear is how the involved individuals' motives and behaviours contribute to this. In addition it is not clear how internal relationships may differ from external ones.

Box 2-1 First gap in the body of knowledge identified with supporting evidence *Source:* Section 8.2.1, Submission 1

Section 8.3, Submission 1 then outlined possible actions in order to address or fill each gap. Section 8.3.1, Submission 1, outlined the possible actions with respect to the need to define customer-supplier relationships, and to measure aspects of the relationship, see Box 2-2.

8.3.1 The types of relationships within customer-supplier interaction needs to be defined, including leadership and grouping. Research on the measurement of the relationship, both at the strategic and operational levels.

Actions to meet research gap:

- A set of definitions for "relationship",
- A set of predictions as to how cultural background influences customer-supplier relationships,
- The interrelationship between the factors in the Lean Supply Model can be determined and quantified,
- A definition of how time influences customer-supplier relationships,
- A definition of when it is appropriate to single or sole source,
- A statement on what constitutes ethical considerations in customer-supplier relationships,
- A system of predicting and influencing an organisational relationships' style,
- A way of reconciling differing organisational objectives between customer and supplier,
- Determine what in the relationship can be measured and how these measures can be used as a quality standard. A system for determining whose responsibility it is to monitor and enforce such standards,
- Determine a system for individuals within the customer-supplier interaction of how fast the technology is changing, and what effects this will have,
- Provide an appropriate set of measures for the factors within the Lean Supply Model,
- Measure and predict how an individual's motivation will influence the relationship,
- Define, measure and predict the influence and roles of senior and operational people,
- Define trust and predict how it changes and influences the relationship,
- Provide a justification for the factor "level of pressure" in the Lean Supply Model as appropriate,
- Define and show how different groups influence the customer-supplier relationship,
- Determine the role of individuals to enable successful relationships between customer and supplier to be established,
- Determine to what extent the relationship has an identity separate from the organisations from which the participants are drawn,
- Establish how other sets of relationships, such as supplier associations influence the customer-supplier relationship,

- Establish a comparative measure of the relationships between customer and supplier and relationships internally to determine where managerial time and effort is best apportioned,
- Establish mechanisms for ensuring the customer maintains an understanding of the latest developments in technology even when it is closely linked to a particular supplier,
- Determine and specify the boundary characteristics of the company in a situation where the boundary is diffuse, for example when part of the production process is contracted out,
- Determine and establish a financial system to reflect the close cooperation between customer and supplier,
- Determine issues which may have a catastrophic impact on the customer-supplier relationship, and establish systems to cope with the consequences of such catastrophies,
- To be able to determine whether there is an end point to close integration between organisations which remain separate, for example by using organisational slack, and if there is an end point, to determine what effects closer integration will have,
- To determine the relationship between individual's motives and behaviours and the organisation's competitive and co-operational characteristics.

Box 2-2 Addressing knowledge gap 1 *Source:* Section 8.3.1, Submission 1

The author chose five main areas of research, as listed in Section 2.8.

As the main interest was customer-supplier relationships, these five areas were based around understanding customer-supplier relationships, Section 8.4, Submission 1. Submission 1 closed with a review of integration and collaboration, with the assertion that with a better understanding of customer-supplier relationships, it would be possible to manage better and predict other areas within the relationship. Submission 1 showed that there is no one model which fitted the diversity of factors that influenced such relationships.

Therefore the author proposed that further research aims should be stated to address some of the gaps in the body of knowledge as outlined in Sections 8.2, Submission 1, and actions to address these in Section 8.3, Submission 1.

The further research aim quoted is Point 1, see Box 2-3. It can be seen that factors from the quoted Section 8.2.1, Submission 1 and reproduced in Box 2-1, and Section 8.3.1, Submission 1 and reproduced in Box 2-2, were included in Point 1.

1	To further research on the nature of customer-supplier relationships, including the measurement of the strength of the relationship, as discussed in Sections 8.2.1 and 8.3.1. Included in this would be a definition of the different types of relationship, of the individual (Sections 8.2.2 and 8.3.2) and with the environment (Sections 8.2.4 and 8.3.4). There needs to be an understanding of the requirements in leadership for change within the lean approach (Sections 8.2.1 and 8.3.1). This may also include customer grouping (Sections 8.2.1 and 8.3.1).

Box 2-3 Point 1 of further research aims *Source:* Section 8.4, Submission 1

2.10.2 Addressing further research aims within the Engineering Doctorate

The areas for further research aims are reviewed to assess how they have been addressed within the Engineering Doctorate. It can be seen that the work done for the Engineering Doctorate addressed Points 1 and 4.

2.10.2.1 Point 1 Customer-supplier relationships

See Box 2-3 for Point 1.

The nature of customer-supplier relationships was addressed in the Engineering Doctorate, directly through the ECLOS project. The nature of customer-supplier relationships was the main concern within the companies and organisations of the ECLOS project, Section 1, Submission 4-1, although this had not been the main focus of ECLOS originally. In support of the need to further understanding of customer-supplier relationships within ECLOS, the author reviewed models within the literature of customer-supplier relationships, mostly in the area of Relationship Marketing, and these were brought together in Section 5, Submission 4-1. This led to the development of a Memorandum of Understanding and Intent which could be a guide for the way new relationships between customer and supplier could proceed and continue, Submission 4-2. These are summarised in Chapter 5 below.

The measurement of customer-supplier relationships started to be addressed through two tools reviewed in Section 3.2, Submission 4-1. SCRIA.RET (Supply Chain Relationships in Action Relationship Evaluation Tool) was developed by a team from Bath University under Lamming for the UK Aerospace Industry, and SIBET (Soft Issue Bid Evaluation Tool) developed by the MoD in order to place the relationship, rather than the price, as a means of determining who should win any particular contract. As these were ongoing, the author did not believe he could significantly add to them.

One aspect of the different types of relationship is discussed in Chapter 10 below, which brings together the two main areas of research within the Engineering Doctorate.

The nature of the customer-supplier relationship was reviewed indirectly within the primary area of research presented, the SME (Operations) Assessment Tool (SOAT),

Submissions 3-1, 3-2 and 3-3. SOAT mapped the flow of information and product not only within the SME itself, but also between itself, its suppliers and customer. It was seen that good relationships with customer and suppliers contributed towards effective flow of product and information in the minimum of time. An example of this was seen in one of the SMEs where SOAT was applied, an Application SME, called Brandenburg (UK), where the SOAT analysis had clearly mapped the link between standard, though long, supplier delivery times, and wasted time within the production processes, Section 6.1.2, Submission 3-3. Brandenburg (UK) acknowledged that they had to improve the relationship with their suppliers in order to reduce supply lead times.

SOAT also highlighted some of the leadership requirements for implementing the issues raised within SOAT, for example being ideally younger and open to change, Section 8.6.7, Submission 3-3.

The issue of customer grouping was not further researched.

2.10.2.2 Point 2 Formation of complex relationships; use of network theory

2	To further explore the complicated and complex way relationships are formed between different groups. This is a network approach to supply chain management, Sections 8.2.3 and 8.3.3. Within this, an understanding is required of how particular firms, often locally situated, can successfully work together yet also compete against each other. This is the subject of regional clusters, section. Hines (1998) has drawn attention to the lack of research in these areas. Such research would include what factors in Small and Medium Sized Enterprises lead to regional clusters.

Box 2-4 Point 2 of further research aims *Source:* Section 8.4, Submission 1

See Box 2-4 for Point 2.

The issue of addressing the complex way relationships were formed, and using the network approach was only referred to in the various literature reviewed, for example, Ford *et al.* (1998) in Submission 4-1 and also below in Chapter 6. The issue of regional clusters of SMEs was raised on a number of occasions, Submissions 1 and 4-1.

Otherwise, this research aim has not been addressed in the Engineering Doctorate.

2.10.2.3 Point 3: Environment factors

3	The affect of external, environmental factors, in particular environmental legislation and consumer influences on supply chains could be mapped (Sections 8.2.4 and 8.3.4).

Box 2-5 Point 3 of further research aims *Source:* Section 8.4, Submission 1

See Box 2-5 for Point 3. This area of research was not addressed.

2.10.2.4 Point 4: Managing lean thinking paradigms into the supply chain

4	The managing of Lean Thinking paradigms into the supply chain culture, by relating how people and organisations learn could be investigated, Section 8.3.13 and also Sections 8.3.7 and 8.3.9.

Box 2-6 Point 4 of further research aims *Source:* Section 8.4, Submission 1

See Box 2-6 for Point 4.

This research aim was addressed within the Engineering Doctorate, and was done so through the AutoLean II programme and through the development and use of SOAT. The AutoLean programme, Submission 3-1, was aimed at assisting SMEs in a particular industry in a particular geographical area (SMEs within the West Midlands), within the automotive supply chain, to obtain and use the internet. It's use was not just directed to the technology itself, but also to the way it could be applied to the SME's business. This was done through an analysis of three business processes within the SME, Quotation Process, Product Development Process, and Order to Delivery Process, and these were mapped using process flow and time compression methodologies. These processes mapped flow of information and product between customer, SME and supplier. The methodologies used, which were process flow and time compression, were *lean* methodologies. In addition, through the addition of a detailed questionnaire ran through with the SME, a significant understanding of the SME was obtained. SOAT was seen to raise issues which could then be addressed, Sections 6.2 and 6.3, Submission 3-3. In addition, because it was possible to suggest which SMEs might benefit from using SOAT, Section 8.6, Submission 3-3, together with the attributes of effective leaders within an SME, SOAT can be said to manage lean thinking paradigms into the supply chain.

Point 4 addresses the idea that managing these lean thinking paradigms should be by the way people and organisations learn, and this is only indirectly addressed through the application of SOAT.

The points raised in the sections within Submission 1, mentioned within Point 4 were not addressed.

2.10.2.5 Point 5: Lean Supply Model and role of buyer

5	It is proposed to verify or not the conclusion suggested in Section 8.1.2. where we suggested that the Lean Supply Model gives a good understanding of the role of the traditional buyer, and to investigate where the ideologies stated in Section 8.1.3 are true, and whether they support the conclusion suggested. These ideologies perhaps arise, from the conclusion just drawn on the operational nature of the lean approach and secondly, as mentioned in Sections 8.3.3, 8.3.15, 8.3.18 and 8.3.21, from the questioning if there is an end point to supply chain integration.

Box 2-7 Point 5 of further research aims *Source:* Section 8.4, Submission 1

See Box 2-7 for Point 5. The point was not addressed.

3 Papers published

Submissions 2-1, 2-2 and 2-3 were the papers presented and published.

Submission 2-1 introduced new theory developed by the author, which arose out of the literature review, Submission 1. This theory was a set of factors to be addressed in any customer-supplier relationship, and these factors were to be used in addition to those listed in the Lean Supply Model, (Lamming, 1993), addressed from Submission 2-2 onwards as the Additional Factors. This paper accompanied a presentation on these factors to a conference of practitioners within the aerospace sector. It was co-written with the author's academic mentor.

Submission 2-2 used the Lean Supply Model and the Additional Factors to analyse the primary research from the programme to which Submission 1 contributed. This paper was presented to the Logistics Research Network Annual Conference, and was published in the conference proceedings. This paper and presentation was co-authored by the author's research colleague on that research programme.

Submission 2-3 took the paper which was Submission 2-1 and redrafted it in a form for publication within a practitioner aerospace journal. It was the author who was approached directly by the journal to produce a paper specifically for inclusion in the journal.

4 AutoLean II Programme and SOAT, Introductory Chapter

4.1 Objectives and Structure of the Chapters 4, 5, 6, 7 and 8

4.1.1 Objectives of Chapters 4, 5, 6, 7 and 8

Chapters 4, 5, 6, 7 and 8 have one principle objective which is to demonstrate Application of Innovation within the Engineering Doctorate programme. It does so through the use of the SME (Operations) Assessment Tool (SOAT).

These chapters are based around three submissions. Submission 3-1 entitled AutoLean II: "Description of the Project" showed how the programme and SOAT tool arose. Secondly, Submission 3-2 "SOAT tool: innovative approach to SME assessment" and thirdly, Submission 3-3 "Application of the SOAT tool".

4.1.2 Structure of Chapters 4, 5, 6, 7 and 8

This chapter is an introductory chapter which summarises the application of innovation.

Chapter 5 reviews the literature review, showing how SOAT can be seen to be innovative when compared to the literature.

Chapter 6 reviews the data collected from the AutoLean II SMEs, the programme from which SOAT arose.

Chapter 7 reviews the philosophical research background in which SOAT sits. SOAT can be seen to be part of a continuum of such research philosophies.

Chapter 8 reviews the application of SOAT, and the claim that SOAT provides application of innovation as required by the Engineering Doctorate.

4.2 Fit into Engineering Doctorate

SOAT fitted into the Engineering Doctorate by demonstrating Application of Innovation. This it did by taking a methodology developed for one purpose, assistance with internet access, and making it more widely applicable as a general purpose tool for assessing the performance of SMEs.

The author was appointed lead person within the AutoLean II project within WMG, and this meant that he was responsible for ensuring that the interviews were done and liasing with other parts of the university to ensure that the financial side of the programme was addressed. This led to development of leadership skills in a public organisation, namely the university. Teamwork skills were demonstrated in that the author had to work closely with his predecessor Paul Chapman of WMG, and Mike Szczygiel of the European Automotive Initiative group (EAIG) with whom the author had to bid for and to win the AutoLean II programme. This meant the team had to work to justify the budget put in for the AutoLean II programme and the author's skills were developed in terms of what was required for bidding within the public sector for money. The author also had to work closely with Mike Szczygiel during the AutoLean programme, as both were co-interviewees in the SME's interview. This meant that the author had to understand and develop consultancy skills and to develop a rapport with Mike Szczygiel the co-interviewer. This certainly developed the author's oral communication skills in an area which had not been required before.

The programme also developed an understanding of the technical organisational skills required in SMEs. The author had come from a background of industrial marketing, so the understanding of organisations was reasonably well developed, but this then had to be applied and understood using SOAT. For example, in two of the SMEs where SOAT was applied the author was able to suggest that the organisation currently used within the SME was not meeting its needs. The author suggested that each of these two SMEs required a "middle person" to take responsibility for the Product Development and

Introduction Process and Procedures, and this person was to be organisationally between the technical people and the commercial people.

The author had to seek out relevant information sources to justify the innovative nature of the tool and also to justify the philosophy behind the tool in terms of research methodology.

5 SOAT: Innovation from the literature

5.1 Introduction

This chapter summarises definitions of operations and business processes, from Section 2.2.2, Submission 3-2, and summarises the literature reviewed in Chapter 2, Submission 3-2. The purpose of this literature review was to justify the reason for researching SMEs, and also to discover if any assessment tool of SMEs, based on business processes was in the literature.

No such assessment tool was found in the literature, so helping to justify the assertion that the SOAT tool developed was innovative.

5.2 Business Processes and Operations

5.2.1 Overview

These processes were Quotation Process, Product Development Process and Order to Delivery Process. SOAT mapped the three processes using flow chart and time based process maps. Gregory and Rawling (1997) stated for a similar time based process map analysis that it provides a "rigorous approach...to identify key issues and help challenge belief held in the business" (p.231). This section reviewed the literature starting from Chapman (undated) in his analysis of AutoLean I and included a definition of business processes, the importance of operations to an SME and the justification of core business processes. It also the looked at the data gathered from the AutoLean II SMEs.

Section 6.2 below described the history of the AutoLean project and also describes why business processes were seen to be important.

5.2.2 Business processes as arising from AutoLean 1

Paul Chapman bought the AutoLean project into existence with his understanding of business processes, information technologies and of Lean Thinking, So the Lean part of AutoLean was a reference to the need to understand process flow to meet customer value and also to understand value chains in order to remove waste from such value chains, (Womack and Jones, 1996). Mike Szczygiel and the author extended the methodology used, to provide a fuller and broader understanding and assessment of SMEs and of the SME's issues. This methodology called SOAT, was used with the AutoLean II SMEs and with the Application SMEs.

5.2.3 Definitions of Operations and Business Process

The definition of operations and business processes were discussed in Chapter 2.2, Submission 3-2. "Operations" is discussed and defined first here, after which "business process" is discussed and defined.

Scholars used the words "operations" and "manufacturing" interchangeably (Hill, 1991; Hill, 1993; Saunders, 1997). It was Slack *et al.* (1995) who seemed to come up with an appropriate definition and where they stated:

> "Operations management is about the way organisations produce goods and services," (p.4).

Within the AutoLean II interviews, business processes were mapped irrespective of whether or not the SME used this terminology. The interviewers looked for a set of procedures in place, or intended to be in place, that would meet the requirements of the business processes. Every effort was made to identify any such behaviour and procedures or set of procedures, which could be classified as business processes.

A definition of a business process is also given. A process within operations was defined (Slack *et al.*, 1995) as transforming inputs to outputs, see Figure 5-1. Within each transformation was one or more activities, and as a business required a combination of functions, sales literature, marketing technical performance, purchasing and manufacturing, then the process was a set of linked activities, the output of one activity becoming the input for the next activity.

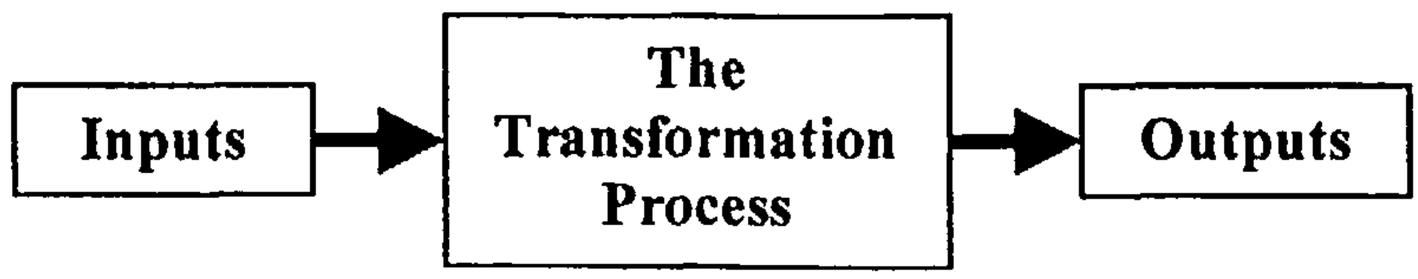


Figure 5-1 The input-transformation-output process model *Source:* Slack *et al.*, (1995, p. 11), and quoted as Figure 2-1, Submission 3-2

Building on this definition a *business process* was one where the transformation adds value (Ryals, 2000), Figure 5-2.

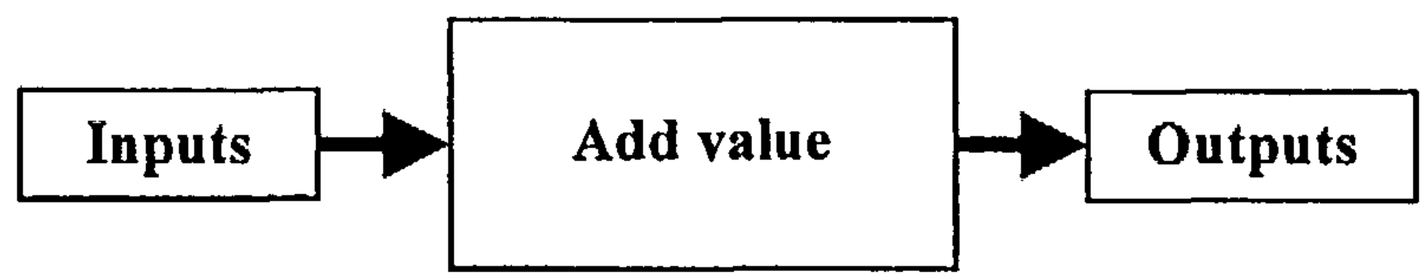


Figure 5-2 Definition of business process *Source:* Ryals, (2000, p. 253), and quoted as Figure 2-2, Submission 3-2

So, a defined business process would be a set of "value adding activities", where the outputs of one set of activities became the inputs of the subsequent set of activities. In addition, there was required a definable start input or set of inputs, and a definable end output or set of outputs.

Ryals continued with a discussion on *core* business processes:

> "core business processes are likely to be those processes which a company has a *relative strength*, which add *significant value* and are regarded as *fundamental* to the business", (p. 254, italics in original text).

These core business processes were the ones which provide customer value. Ryal believed that relatively few processes generally contributed to core value. One of the ones listed included new product development which was one of the core businesses identified and used in SOAT.

5.2.4 Importance of operations to an SME

Chapter 2.4, Submission 3-2 provided a justification for the importance of operations in SME. In this, Hill (1987) estimated that operations were about 80% of the costs of the business. In addition, by using the cost structure figures for a manufacturing business by Lanigan (1992), and using the findings on those parts of an SME from the AutoLean II research, a similar figure to Hill's was suggested. In this case, the cost of sales of product, as an approximation for the cost of operations within an SME, was estimated to be 78% of the total price of the product. Chapter 2.4, Submission 3-2 argued that even if the assumptions made were overgenerous, it was certainly the case that the operations part of an SME made up a proportionally large part of the business.

5.2.5 Justification of core processes

The choice of Quotation Process, Product Development Process and Order to Delivery Process as appropriate core business processes was justified by the participating AutoLean 1 SMEs (Section 2.1, Submission 3-1), and from a review of the literature (Sections 2.6 and 2.7, Submission 3-2).

First, justification for the choice of the three business processes from AutoLean 1, (Chapman *et al.*, undated). Chapman argued that these three processes covered the span of activities within an SME, and the business process mapping methodology was trialled in two SMEs initially. The validity of the three business processes was reviewed with the 21 AutoLean 1 SMEs some time after the initial interview, in terms of data accuracy, of business process understanding, and of the direction on application of internet capability, (Chapman *et al.*, undated). On all these three counts the methodology and the choice of business processes could be justified.

Secondly, the choice of core business processes was given in Sections 2.6 and 2.7, Submission 3-2. This could be seen in the fact that internal business processes were seen by reference to the Balanced Scorecard Model (Kaplan and Norton, 1996), see Figure 5-3.

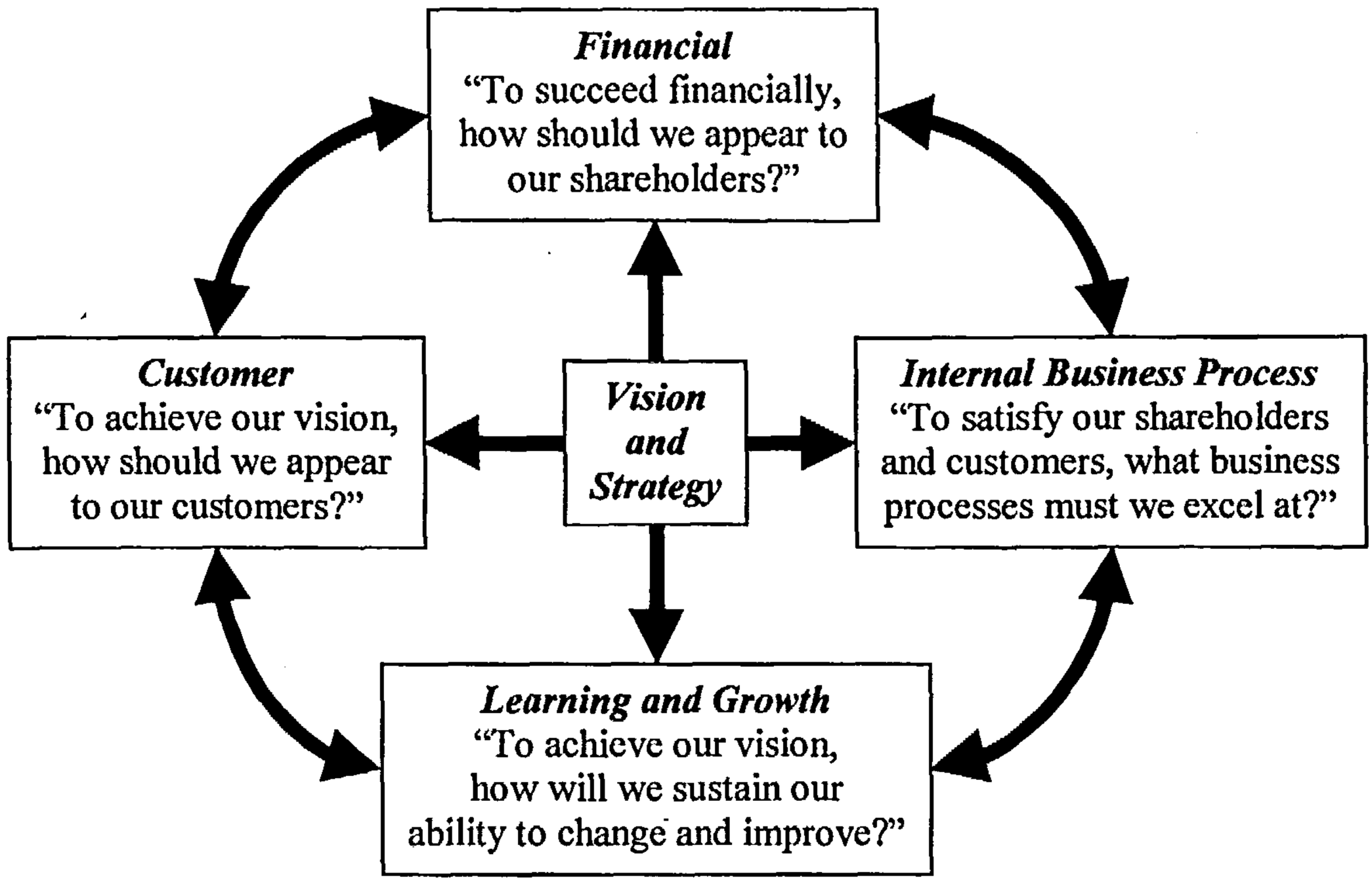


Figure 5-3 The Balanced Scorecard *Source:* Kaplan and Norton (1996, p.9, adapted), and quoted in Figure 2-5, Submission 3-2

The three SOAT business processes were essentially Internal Business Processes as described in one of the four main elements of management and control within the company. The three SOAT business processes also related to the Customer, another element within the Balanced Scorecard. During the development of SOAT, the other two Balanced Scorecard elements were discussed.

In the Kaplan and Norton model, within the internal business perspective were several further business processes, Figure 5-4.

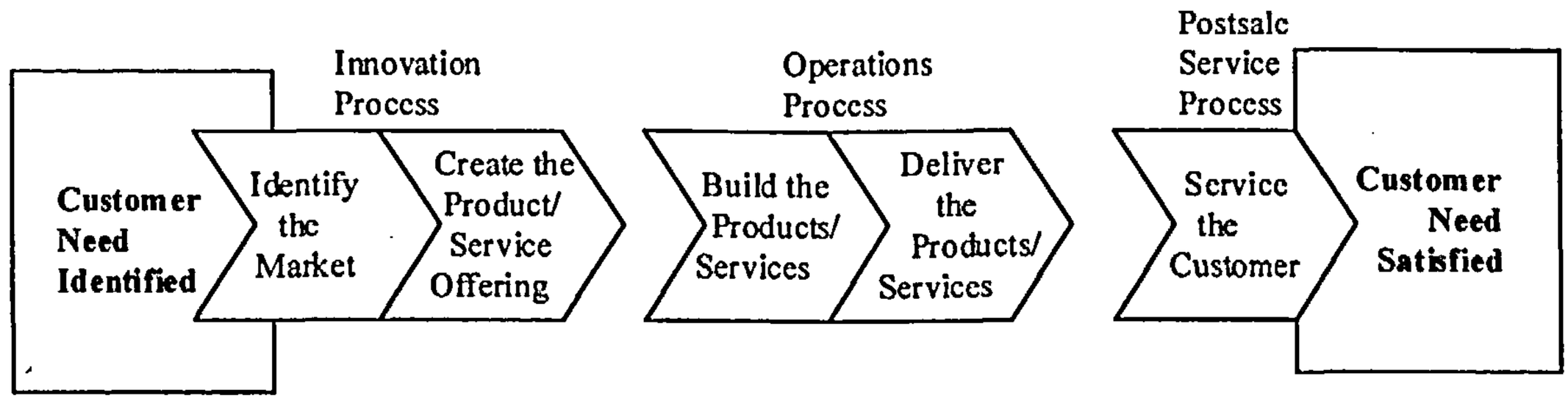


Figure 5-4 The internal-business-process perspective, the generic value-chain model, *Source:* Kaplan and Norton (1996, p. 96), and quoted in Figure 2-6, Submission 3-2

From Figure 5-4, "Create the Product/Service Offering" corresponded with SOAT processes, Quotation Process and Product Development Process. The third SOAT process, Order to Delivery Process was Kaplan and Norton's "Operations Process" which covered both the "Build of the Product/Services", and "Deliver the Products/Services". In only one case in AutoLean 1 was there a "Post-Sale Service Process".

Thirdly, Ryals (2000) included New Product Development, Consumer Development, Customer Management, Supplier Development, Supply Chain Development within he core businesses processes. New Product Development was directly identified and was equivalent to SOAT's Product Development Process. The other processes Ryal listed could be seen to be part of the Quotation Process and Order to Delivery Process within SOAT.

Fourthly, and more generally, Hammer (1996) pointed out that in the Information Age just beginning, competitive advantage would come to firms with the most effective processes. In addition, Mroz (1998) saw core processes as being the dominant management paradigm in this Information Age.

Fourthly, and again more generally, processes were used successfully at an operational level (Gregory and Rawling, 1997) and also at a strategic level, (Womack and Jones,

1996; Hines, 1994). These seem to identify the process of flow from customer back through the company and supply chain.

5.3 Review of SME literature

5.3.1 Justification for research into SMEs

The justification for researching SMEs was answered in two ways in Section 2-3, Submission 3-2. In essence, SMEs were seen to be important politically so attracted support, and secondly, that the literature pointed to SMEs being seen to be different to larger companies.

There was a considerable "industry" researching and supporting SMEs. For example in academia, Business Links, Chambers of Commerce, UK Government through Department of Trade and Industry and the Research Councils, and from the European Union. The research programme through which SOAT was developed was the AutoLean programme, a European Union funded programme under the Accelerate Initiative, aimed at increasing the abilities of SMEs in the automotive sector within the West Midland area. So there was a phenomenological justification ("it is there, so let's get on board") for researching SMEs, and the value driven justification in that support for SMEs was seen as an integral part of governmental support for business both at local, national and at EU levels.

The literature suggested that SMEs were not just a name given to "cut-down versions of large companies". Large companies were characterised by sophisticated management structures through the use of business units or international structures (Womack and Jones, 1996), and also by the numerous stakeholders required to make any supposedly simple decision, (Blythe, 1998). This meant that flows of information, product or decision making within the process were more likely to be impeded.

Ahmed *et al.* (1996) stated that large firms were more likely to be adopters of strategy than small firms. Wiele and Browne (1998) quoting Lee and Oakes (1995), suggested that for the SME it was easier for managers to inspire and motivate others in the organisation,

because organisational structures and systems in the SME were generally simple. They listed several factors which created difficulty for SMEs and these included the inclusion of initiatives, such as total quality management into strategy, together with investment and training. However, the limited knowledge base within the SME and the limited financial resources constrained the SME.

Carrier (1994) identified problems with intrepeneurs (an internal "entrepreneur") in both large and small firms. In large firms, intrepeneurs suffered through the inertia of the large organisational structure, which in turn stifled personal autonomy and individual creativity. SMEs provided for a friendlier environment, where structures and processes remained simple, flexible and adaptable. However, SMEs had limited resources.

Ghobadian and Gallear (1997) listed differences between large and small firms. They listed a number of advantages for SMEs including a flat management structure, short decision making process allowing for shorter and faster information flow so improving communications; a low degree of specialisation and a broader perspective on issues and problems. Alchemie was one of the SMEs used for application of SOAT. Alchemie was able to deliver from stock the same day, which provided feedback in case of problems, and made it easier to make changes. The unified culture within Alchemie provided a foundation for change.

Ghobadian and Gallear also stated that SMEs provided an environment where innovation and continuous improvement existed; AutoLean II SMEs, by contrast, were seen to be variable in their approach to innovation and improvement. Disadvantages of SMEs included lack of financial resources which could affect investment in new product development processes; *ad hoc* systems for example in training; and the unwillingness of the owner to delegate.

5.3.2 SME Literature Review: Operations and Business Processes

Section 2.5 of Submission 3-2 identified four broad areas of the literature review regarding SMEs.

5.3.2.1 Analysis of the SME sector as a whole or part

The analysis of the SME sector as a whole or part seen for example in work by Storey (1994)) and Boter and Holmquist (1998). However, both Storey, and Boter and Holmquist did not discuss the internal operations nor the impact of internal operations on other characteristics and functions of the business. Boter and Holmquist recognised that processes existed but only in a narrow sense of seeking to understand the innovation characteristics of SMEs and their ability to innovate from internal sources.

5.3.2.2 Consideration of particular traits of the SME

Here, for example Keasey and Watson (1993) considered the inner financial environment of SMEs looking at economics, ownership, profitability, financing and remuneration. Such an approach did not consider business processes.

5.3.2.3 "How to do it" type of manuals

Examples of the "how to do it" type of manuals were Morris (1988), *J.K.Lasser Institute* (1994) and Kuriloff *et al.* (1993).

It was interesting to note that although these books were sometimes quite extensive, for example Kuriloff *et al.* ran to almost seven hundred large pages, the internal operations were almost completely missing, and business processes were not mentioned at all in their descriptions and analyses.

In summary, these types of book appeared to "miss the wood for the trees" by concentrating on the detail, rather than keeping sight of what the SME was trying to do which was to (sometimes) design, and deliver product to customers who wanted the product, and to do so profitably

These books appeared to treated SMEs the same irrespective of size. However it was knowing that SMEs had different characteristics depending on size (Storey, 1995) that provided a justification for grouping the SMEs researched.

5.3.2.4 A limited amount of operations and business process information

Lastly, the SME literature revealed a limited amount of operations and business process information. Hill (1987) was typical in trying to use such techniques and tools in a book on operations of SMEs, where network analysis was outlined for project type control, selling a large scale project or service, but not seen to be appropriate for AutoLean II SMEs. Hill did though, highlight the need for key processes to be designed for, but only in a narrow production sense in order to overcome production bottlenecks.

There was though a gradual rise in understanding that there was a need for business processes and accompanying tools to implement such processes. Vorstman (1983) was perhaps an early example of business process implementation with primary supporting processes. In the primary process, Vorstman outlined a set of activities to be conducted sequentially, which were similar to those stated by Womack and Jones (1996).

It was only comparatively recently, and only in journal articles, that scholars started to point to the introduction of process of flow as a requirement, despite the emphasis given by Womack and Jones in their book, *Lean Thinking* (1996). For example, Lewis *et al.* (1997) concluded that three flows were necessary; information, product flow, and integrate internally and integrate externally.

Fawcett and Fawcett (1995) outlined the firm as a value-added system where logistics, operations and purchasing should be all seen to flow within customer value added transformation processes. But this did not address the relationship between requirements at an operational, implemented level, and the overall integration of logistics, operations and purchasing activities.

Similarly, Halley and Guilhion (1997) stated that it was important for small firms to integrate logistics strategies into the firms overall framework, but again how this should be done in practice was not described.

Armistead *et al.* (1995) linked operations management and business process re-engineering, with operations viewed as an example of a business process.

6 Innovation: SOAT as a usable business tool

6.1 Introduction

SOAT is a tool for assessing small businesses using business processes as a base methodology. SOAT is described in this chapter, illustrated with some of the data from the AutoLean II SME interviews in which SOAT was developed.

No such similar tool was found to exist in practical examples seen in the literature, in more general literature reviewed over the course of the Engineering Doctorate, or through discussions with colleagues or business people.

6.2 Practical Examples

6.2.1 Practical Examples seen in the Literature

As will be seen within the rest of this chapter, SOAT provided a way of assessing SMEs through using business processes as a base methodology. No practical examples of assessing SMEs through the use of business processes, formally specified or used in any other way was seen in the literature.

6.2.2 Coventry and Warwickshire Business Link

One of the providers of assistance to SMEs contacted when the author was applying SOAT to SMEs more widely, was Coventry and Warwickshire Business Link. Business Links were locally based providers of a range of business services, originally part of local government, but increasingly having to become self funding.

Chapter 7.2, Submission 3-3 described the Coventry and Warwickshire Business Link approach to assessing small businesses. They had four characteristics, but the one that was related to SOAT was the fourth one called "Practice and Performance". Through experience this Business Link had seen that practices which the business was forced to adopt or chose to adopt through customer requirements, environmental or legal requirements or through their own choice, affected the performance of the business. In addition, this worked in reverse. Where an SME had a certain level of performance, this was often associated with the culture of the SME and its business practices, then it was very difficult to change these practices. SOAT was seen to fit this fourth area as it did indeed seek to examine both the practices within the SME and also its performance.

6.2.3 AutoLean II – Action Research

The AutoLean II programme, through a consultancy approach, was aimed at generating actions which the SME would then follow through, and as the programme was also to produce academic research findings, then the methodology followed was one of Action Research. In addition, from such findings it was possible to review the information of the consultancy exercise in a retrospective manner. This allowed the author to compare the circumstances of individual SMEs with the group of SMEs as a whole, or part of the group of SMEs and this was done in the feedback stage of the project, as described in Chapter 5 and 6, Submission 3-3 in general discussions with the SME.

Action Research is summarised in Section 7.3, from a discussion in Section 3.3, Submission 3-2.

6.3 Background to SOAT

6.3.1 Introduction

The SME (Operations) Assessment Tool was developed within a programme called AutoLean II.

6.3.2 The AutoLean Programme

The AutoLean programme was a European Union funded programme under an Initiative called Accelerate. Accelerate was to assist SMEs within the automotive supply chain in the West Midlands area of the UK, designated for EU purposes as "Objective 2". AutoLean was to assist such SMEs with internet access, and as part of the "package" of assistance, the SMEs business processes were mapped in order for the SME to perceive internet opportunities.

Later, a second tranche of money was won to expand the assistance originally provided. This tranche of money was called Accelerate II, and AutoLean was part of this continued Initiative, called AutoLean II. It was at this later stage that the author became involved. The original programme became known as Accelerate 1 and AutoLean 1, respectively.

It was at the start of AutoLean II that the questionnaire part of the business mapping interview was significantly expanded. During the course of the 23 SMEs interviewed, it became clear that the questionnaire and business process mapping structure provided a quick and accurate way of assessing the SME, irrespective of the original purpose of the interview.

It was as a consequence of these beliefs that the questionnaire and business process mapping was used as primarily an SME (Operations) Assessment Tool, SOAT with SMEs not within the designated characteristics for AutoLean assistance. The results of the application of SOAT are given in Chapter 8 below.

This chapter describes the content of SOAT, analysing data gathered from the AutoLean II interviews.

6.3.2.1 Innovation: SOAT

SOAT used business processes as a base methodology for assessing SMEs. Chapter 5 demonstrated that no such approach had been seen in the literature, and Section 6.2 suggested that no such approach was seen to be used by companies themselves, or those assisting companies.

The author claimed that SOAT was a tool which had been shown to assess SMEs successfully, because in feedback from the AutoLean II SMEs, SOAT did accurately map the business processes and it did reveal further issues which were to be then acted upon. These are discussed in detail in Chapter 8.

What was not claimed to be innovative is the constituent parts of SOAT itself. The business processes used were developed within AutoLean 1 and seen to be appropriate (Chapman, undated; Chapman *et al.*, undated). A semi-structured questionnaire was seen to be a standard research tool, though the particular content of the Questionnaire may be original, but the content of the questions might be called standard business characteristics of the SME.

However, it was by putting the questionnaire together with the mapping of the business processes that a usable business tool was born. This was the claim for innovation.

To ensure that the content of the questionnaire was appropriate, the data from the AutoLean II SME interviews was analysed, Chapter 5, Submission 3-2 and summarised in this chapter. The data gathered from the business processes from the AutoLean II SMEs was also analysed, Chapters 6, 7, 8 and 9, Submission 3-2 and is summarised in this chapter.

There were a number of purposes in doing such analyses. The first was to discover if any of the questions used were inappropriate or poorly drafted. This did not appear to be the case. Secondly, it was to be able to understand the characteristics across the AutoLean II SMEs, but to be able to do this each characteristic had to be reviewed in turn, against other characteristics as seemed appropriate. In doing so, it was discovered which questions were to be seen as the ones which provided significantly more value for the assessment, and these were outlined in Chapter 10, Submission 3-2.

6.3.3 AutoLean I

AutoLean 1 programme was used as background to the research presented and was given in Section 2.1, Submission 3-1 and is repeated here.

The AutoLean 1 programme was a European Union Initiative, called Accelerate. In the original AutoLean programme, henceforward called AutoLean 1 which ran until the end of 1998, 21 SMEs were assisted, and they were assisted in two distinct ways. First, they were assisted through the provision and installation of a low cost personal computer (PC), together with internet training. This part of the AutoLean programme was provided by the University of Wolverhampton, School of Computing and Information Technology.

Secondly, the SME was assisted by a consultation exercise which saw Paul Chapman, a researcher from WMG, together with Mike Szczygiel from the European Automotive Initiative Group (EAIG), a specialist automotive consultancy, spending half a day at the SME understanding how the business operates in terms of the SME's three business processes: Quotation Process, Product Development Process and Order to Delivery Process. The justification of choice for these three processes was through research by Chapman *et al.*, (undated) and in Chapman, (undated), but essentially these three processes covered the span of activities within an SME, and was trialled in two SMEs initially. This was summarised in Section 5.2.4 above.

The Accelerate Initiative was a European Development Fund supported project aimed at assisting Small and Medium sized Enterprises (SMEs) within the automotive supply chain within the West Midlands areas of the UK, a defined "Objective 2" area. This area included what might be called "Greater Birmingham", including the built up areas to the west of Birmingham of Dudley and Walsall, the "Black Country", and the city of Coventry. Its aim was to build SME "capacity", which was a way of building up the competencies of SMEs, people, technology, understanding and systems.

6.3.4 Use of Internet

The rise of the use of internet was discussed by Chapman (undated) and Chapman *et al.* (undated) and reviewed in Section 2.2, Submission 3-1, and is summarised here.

The rise of internet has been widely reported for business-to-business use, for example Cranfield School of Management (2000), Keen *et al.* (1999), Newell (2000) as well as specifically in the automotive industry supply chain (*The Economist*, March 4th, 2000). Justification for its usage as a basis for the AutoLean programme was given by Chapman (undated). For these reasons, further justification for the use of business processes to aid internet usage was not given in the author's submissions.

6.3.5 AutoLean II and the birth of SOAT

Chapter 2.3, Submission 3-1 outlined the background to AutoLean II, and this is summarised here.

Given the received success of the original Accelerate Initiative, a further expanded tranche of money was won to continue support for Objective 2 SMEs in the automotive sector. This became known as Accelerate II and the AutoLean programme was also carried forward, this time to include 100 SMEs, of which 75 would have the business process consultation. 23 of these 75 SMEs were interviewed within AutoLean II by the author and Mike Szczygiel. It was in within these AutoLean II SMEs that the methodology, originally used for internet capability and application, was believed to be suitable for a fuller and broader assessment of the SME. It was on the basis of these 23 SMEs that the SME (Operations) Assessment Tool (SOAT) was born.

6.3.6 "Package" provided to the SME within AutoLean II

The "package" of assistance for the SME through AutoLean II was outlined in Chapter 2.4, Submission 3-1 and is summarised here.

Each SME within the programme received a PC with internet access hardware and software, its installation on its site, and training for its staff on internet usage. This was provided by the University of Wolverhampton.

After such training, the SME was visited by one person from WMG and one from EAIG who spent half a day with the SME's Managing Director or other senior director, to discuss the business and to "walk" through the SME's business processes. The business processes were outlined in Section 2.6, Submission 3-1 and are summarised below in Section 6.5.2. A reason for working with the SME in some detail was to put the usage of the internet into perspective, and to suggest ways in which the internet could benefit the SMEs. Such a view was supported by Liz Amos from the Institute of Manufacturing Director, who stated that:

> "It is important that companies look at e-commerce [using internet technologies] in a more holistic way, incorporating it into their management processes through the supply chain and so on," (*Overseas Trade,* 1999, p. 21).

The argument was not just to have internet access, but to relate the new technologies to possible applications within the business.

6.4 Overview of the AutoLean II methodology

Section 2.6, Submission 3-1 provided an overview of the AutoLean II consultancy part of the programme, and is summarised here.

In AutoLean I the purpose was to map the three business processes, and very little other information was recorded. This is seen for example in a typical report in AutoLean 1 generated for the SME and is given in Appendix A, taken from Appendix A, Submission 3-1. For AutoLean II, Mike Szczygiel, EAIG put together a questionnaire to be used in a semi-structured way before the mapping of the business processes. Appendix B, Submission 3-1 showed the first questionnaire developed within the context of an example report, and is placed here in Appendix B. The business processes were mapped in a flow of activities, and timings for each activity were given in terms of Activity Time and Waste Time. Activity time was time actually spent in performing the activity, and was used as a proxy for value added time, and the waste time was the remaining time not accounted for, Gregory and Rawling (1997). Appendix B, Submission 3-1 also showed that the analysis given for the company interviewed in terms of strengths, weaknesses and challenges.

6.4.1 Level of detail appropriate for the AutoLean analysis

The research showed that it was possible to provide an appropriate overview in a two person visit lasting about two hours as shown from AutoLean (Chapman, undated) and this was corroborated in AutoLean II. This was seen through the reported accuracy of the data captured and detail within the business processes (Section 6, Submission 3-3).

6.4.2 Process of assessing an AutoLean II SME using SOAT

The assessment of SOAT was done in two parts.

The first part was an interview on site and consisted of two stages, a semi-structured interview and the mapping of the business processes.

The second part was the evaluation of the SME by the interviewers and a preparation of a report detailing the information given in the questionnaire stage and the business processes mapped.

The report was then emailed to the SME, and the process concluded with a follow-up telephone call to ensure that the SME was satisfied with the report.

At any stage after the interview, the interviewers were open to discussions with the SME, and the interviewers might ask for clarification on points raised.

6.4.2.1 Consultancy session on the SME's site

The first part was a consultation session with the SME. A description of the consultation section was given in Section 2.5, Submission 3-1 and is summarised here.

Each consultation session was a half-day, arranged in an advance with the Managing Director or another senior director of the business. Within AutoLean 1, the focus of the consultation had been on the core business processes, Quotation Process, Product

Development Process, and Order to Delivery Process, with only a simple and sketchy overview of the SME visited, see Appendix A for a typical report resulting.

With the AutoLean II SMEs, this overview of the SME was expanded to fill half the consultation time, and more importantly provided a basis, together with the business processes, of a tool to assess the SME, namely the SOAT tool. Thus SOAT had two parts, a semi-structured questionnaire and the business process mapping.

This methodology, an extensive questionnaire, together with detailed mapping of the business processes, was the basis for the SME (Operations) Assessment Tool, SOAT. A report generated using SOAT is shown in Appendix B. Later, when SOAT was applied in non-AutoLean SMEs, the questionnaire was restructured by the author, and an example of the resulting report is given in Appendix C.

In the two to three hour visit of the SME, both the questionnaire and the process mapping were done. This appeared to an optimum time spent at the SME in order to acquire the information needed. An overview of the SME was obtained, and the data collected was used to produce a report which was sent later to the SME. See Section 3.5, Submission 3-1.

The questionnaire part was led by Mike Szczygiel whilst the business process mapping part was led by the author.

6.4.2.2 Preparation and sending off the SOAT report

The second part of SOAT was the preparation of a report. Immediately after the visit, the interviewers recorded their impressions from the visit, in particular adding to the

strengths, weakness and challenges already specified within the interview on the SME's site. Back in the office, the questionnaire was completed with the information given by the SME, and also the business process maps and time base process maps were prepared. This was all put into a report with an explanation of the purposes of mapping the business processes and following a check by both interviewers, the report was emailed to the SME. The report generation was budgeted for two man days. Sometime later, a follow-up telephone call was made to a contact of the SME to ensure that he had received the report, and to elicit any feedback.

6.5 Description of SOAT

SOAT consisted of a semi-structured questionnaire and the mapping of the business processes. A description of SOAT was given in Section 2.6, Submission 3-1 and is summarised here.

6.5.1 Semi-structured questionnaire

Section 2.6.2.1, Submission 3-1, outlined the questionnaire and this is detailed below. The questionnaire covered the following areas:

- A general introduction,
- A marketing and competitor overview,
- Questions looking at turnover, number of employees, customers and their supply chains and other similar information
- The number of requests for quotation,
- The number of product introductions,
- Details about the order to delivery process,
- A review of key standards,
- Inventory and shipments,
- How any regular orders were placed: forecasts, schedules and call-offs,
- A section on technology for commerce, looking at the information technology in terms of interface with customers or suppliers,
- Other communications issues relating to how individuals or the technology were used, and
- Finally, overall strengths, weaknesses and opportunities that affected the whole business.

Appendix B shows a questionnaire in its original form as recorded in a typical AutoLean II interview. This form was subsequently restructured by the author for the application of SOAT, Submission 3-3, and a report from this stage is given in Appendix C.

6.5.1.1 Benefits of the questionnaire

The benefits of asking the questions in the questionnaire was given in Section 3.1, Submission 3-2. The questionnaire was introduced in to AutoLean II, whereas only a few general questions were asked in AutoLean 1. The benefits provided were on a number of different levels. The answers were used to save time later in the process mapping as it was often clear what should be included and what should not. They also provided a high level assessment of the company, and this was the basis of the SOAT analysis as outlined in Submissions 3-2 and 3-3. On reflection, it may have been intimidating for the owner to be asked such questions about his business, and their probing nature meant that they were unlikely to have been often asked of him.

The detailed questioning did provide some disadvantage.

First, some of the SMEs appeared to be uncertain of the status of the interviewers, thinking they may be 'tax' people, as some of the turnover figures given would have meant that each employee would have been on a "slave" wage. By dividing turnover by the number of employees, the interviewers were able to see which companies were doing well, and which needed to improve. For example, under £30000 turnover per employee was considered to be an indication that either the right turnover figure had not been given, or that there was a danger that the company would have difficulty in generating profit.

Secondly, those SMEs which had used the AutoLean II programme to simply acquire a low cost PC, did not welcome or see the need for such questions.

6.5.2 Business Process Mapping

Once the questionnaire was completed within the interview, the business processes were mapped for the Quotation Process, Product Development Process and the Order to Delivery Process.

The questionnaire provided a basis for determining which of the processes might be present. All AutoLean II companies had a quotation process, whilst all except two SMEs were volume producers so had an Order to Delivery Process. The two SMEs which did not have an Order to Delivery Process were the ones whose business was design. These were Heron Design in the design of jigs, and Springfield Tools, in the supply of one- off tools. A number of SMEs did not have any process or procedure to develop new products, for example JBI Engineering and Electroheat Treatments.

6.5.2.1 Quotation Process

The Quotation Process started when a customer sent the SME a specification, or Request for Quotation (RFQ). The Process Mapping exercise then followed the set of activities through the SME, until a quotation was sent off. Activities were combined where they appeared to be adjacent in terms of time or in terms of a series of transformations, for example a set of machines linked together. See Figure 6-1 for a typical example.

The purpose was to understand the flow of information and/or material through the SME using time as a measure of success. Activity Time was used as an approximation for value added time and Waste Time was all the other time expended, for example where there was inactivity, queues, or waiting for a decision. Time was considered to be truly adding value where all three of the following rules were true (Chapman, undated; Womack and Jones, 1996):

- The product/document/information was physically changed,
- The customer cared about the change, and
- The change was done right first time.

Activity Time took into account the first of these rules, i.e. that the thing in the process was physically worked on. Whether this activity was value added depended upon the end customer caring about the change and that it was done right first time. However, the approximation of Activity Time to Value Added Time within the SOAT tool, still provided an accurate representation of the business processes within the SME, so could be seen as valid (Section 6, Submission 3-3).

Non-value adding time was everything else and included time where the thing going through the process stood idle, was being reworked or underwent a step that the customer did not care about. See the typical example of the analysis of a Quotations Process, Figure 6-1, with the corresponding time base process map in Figure 6-2 and Table 6-1.

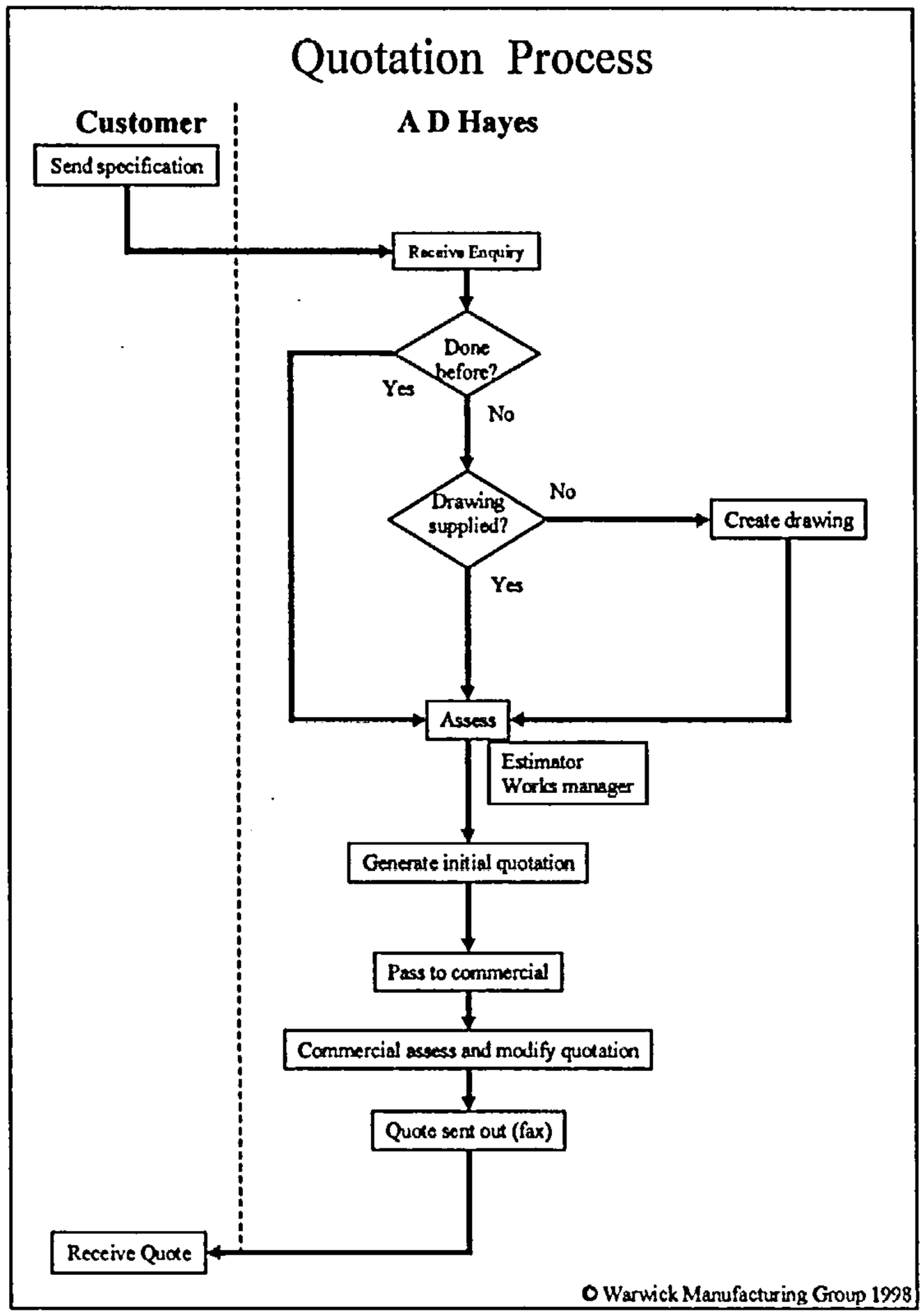
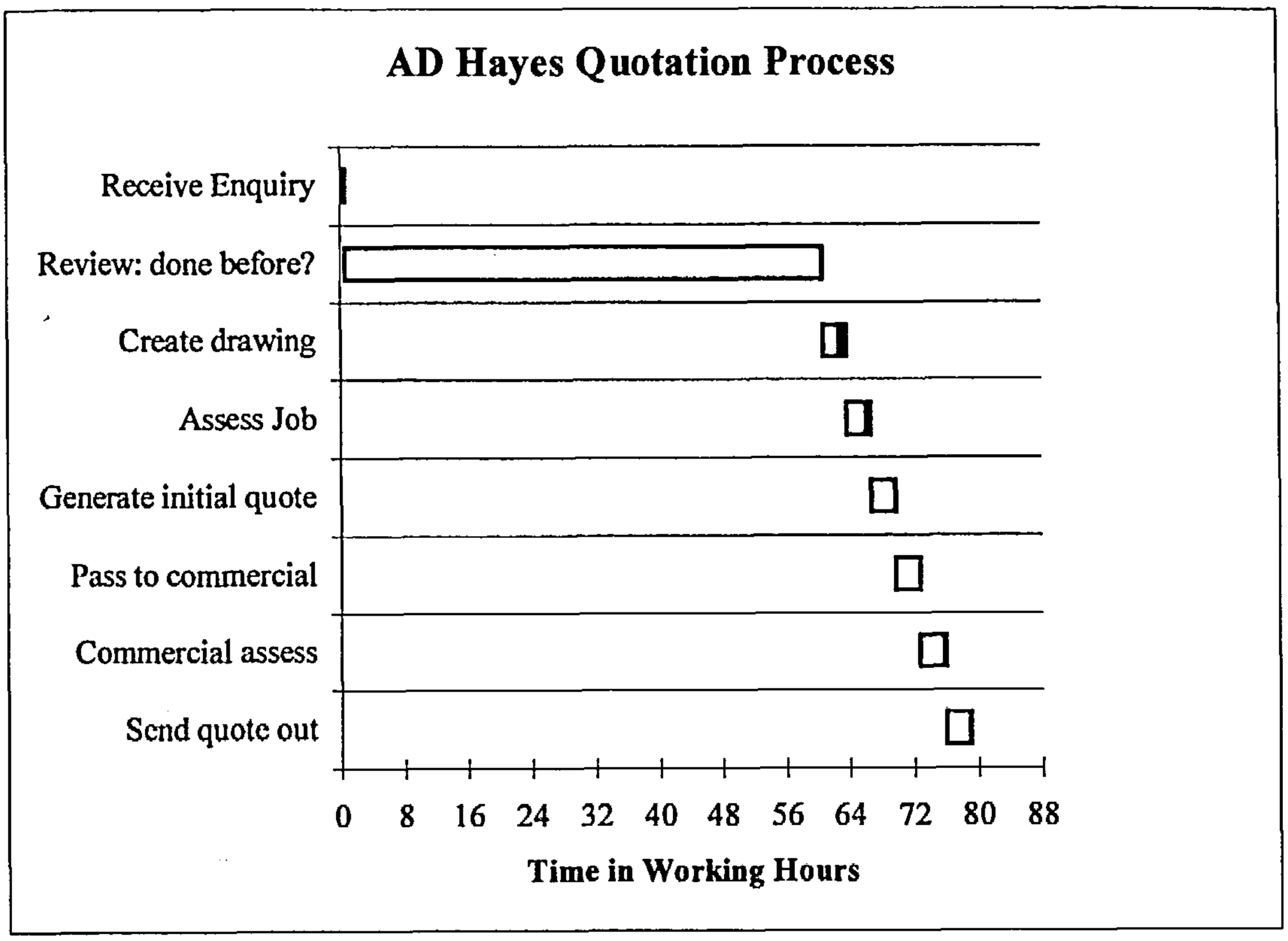


Figure 6-1 Typical AutoLean II Quotation Process (A.D. Hayes) *Source:* Figure 1, Submission 3-1, from AutoLean II interview



Grey Bars = Waste Time
Black Bars = Activity Time

Figure 6-2 Time based process map for A.D. Hayes Quotation's Process *Source:* AutoLean II interview

	Quote Process Steps	Cum	W T	AT
ID	AD Hayes	Hrs	Hrs	Hrs
1	Receive Enquiry	0	0.5	
2	Done before?	0.5	60	0.1
3	Create Drawing	60.6	2	1
4	Assess	63.6	2.5	0.5
5	Generate Initial Quotation	66.6	3	0.1
6	Pass to Commercial	69.7	3	0
7	Commercial Assessment	72.7	3	0.2
8	Quote sent out (fax)	75.8	3	0.1
	Total	78.9	77	1.9

Table 6-1 Data for A.D. Hayes Quotation Process, time-based process map *Source:* Table 1, Submission 3-1, from AutoLean II interview

Analysis of the A.D. Hayes Quotation Process.

1. Time base process map

The quotation process begins when a customer sends A.D. Hayes an enquiry. This process can be considered complete when the person generating that request receives A.D. Hayes' quote in reply.

Examining the process in Figure 1 which creates this quote, it is clear that an extensive process exists. From the point of view of the quote passing the process, there are 8 steps it needs to go through before reaching the customer.

The performance of this process is revealed in Figure 2, the Time Based Process Map. It can be seen that much of the time the quote spends during this process is idle. In fact, the amount of time the quote was worked on was only 2 % of the time that elapsed.

Given the importance most customers stress upon timely responses to their needs, it is clear that this process contains opportunities to improve.

2. Internet Opportunities within the Quotation Process

2.1 Short Term

- E-mail with customers to resolve routine questions,
- Receive drawings in digital form.

2.2 Long Term

- Accessing Request for Quotations (RFQ) at the customer Web site obtaining all relevant documentation in digital form. Quote is submitted as one or more on-line forms provided by customer. This will be provided by customers to speed up the quotation process,
- The Internet will facilitate the establishment of brokerage facilities making it easier for buyer and seller to find each other. This will evolve from simple one to one matching where a complete supply chain will be able to offer its services on an integrated basis to prospective customers. The Internet will be used to not only advertise such services but offer the means for a complete brokerage service to be established between buyers and sellers (integrated supply chain groupings).

Box 6-1 Analysis of A.D. Hayes' Quotation Process and for internet usage *Source:* Box 1, Submission 3-1 and from AutoLean II interview

The SME, as part of the AutoLean II programme, received a report detailing the business processes and an analysis of each process together with potential internet usage, in both long and short term. The analysis for A.D. Hayes' Quotation Process is given in Box 6-1.

6.5.2.2 Product Development Process

Once a customer accepted a quotation for a new product from the SME, the customer created an order for it. The New Product Development Process was then followed until the customer accepted a first off production sample. The Process flow diagram, time based activity map and process analysis was similar to the Quotation process. An example was given in Section 2.6.2.2.2, Submission 3-1, and is given below, Figures 6-3 and 6-4.

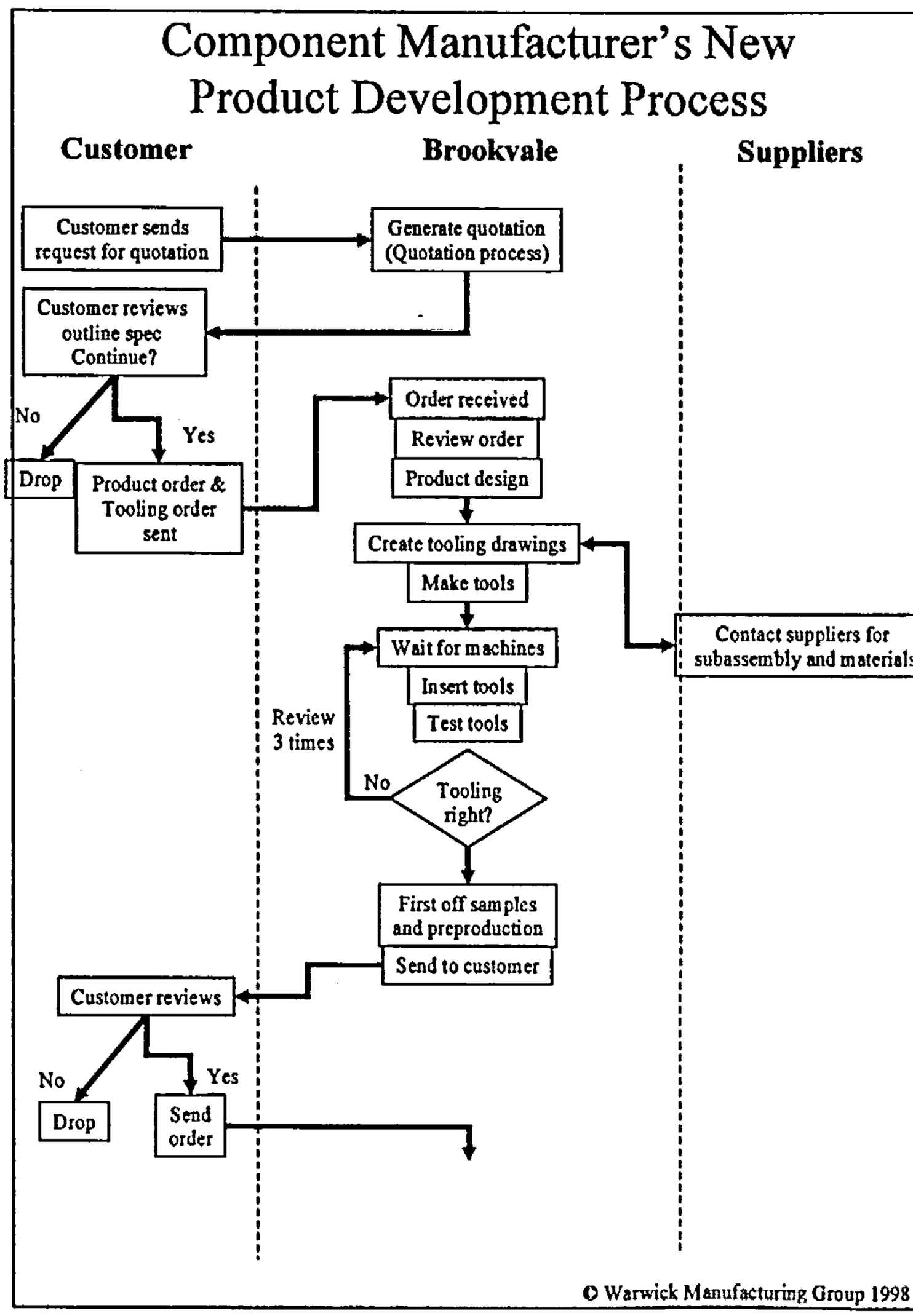


Figure 6-3 Product Development Process for Brookvale Manufacturing (part a) *Source:* Figure 3, Submission 3-1, from AutoLean II interview

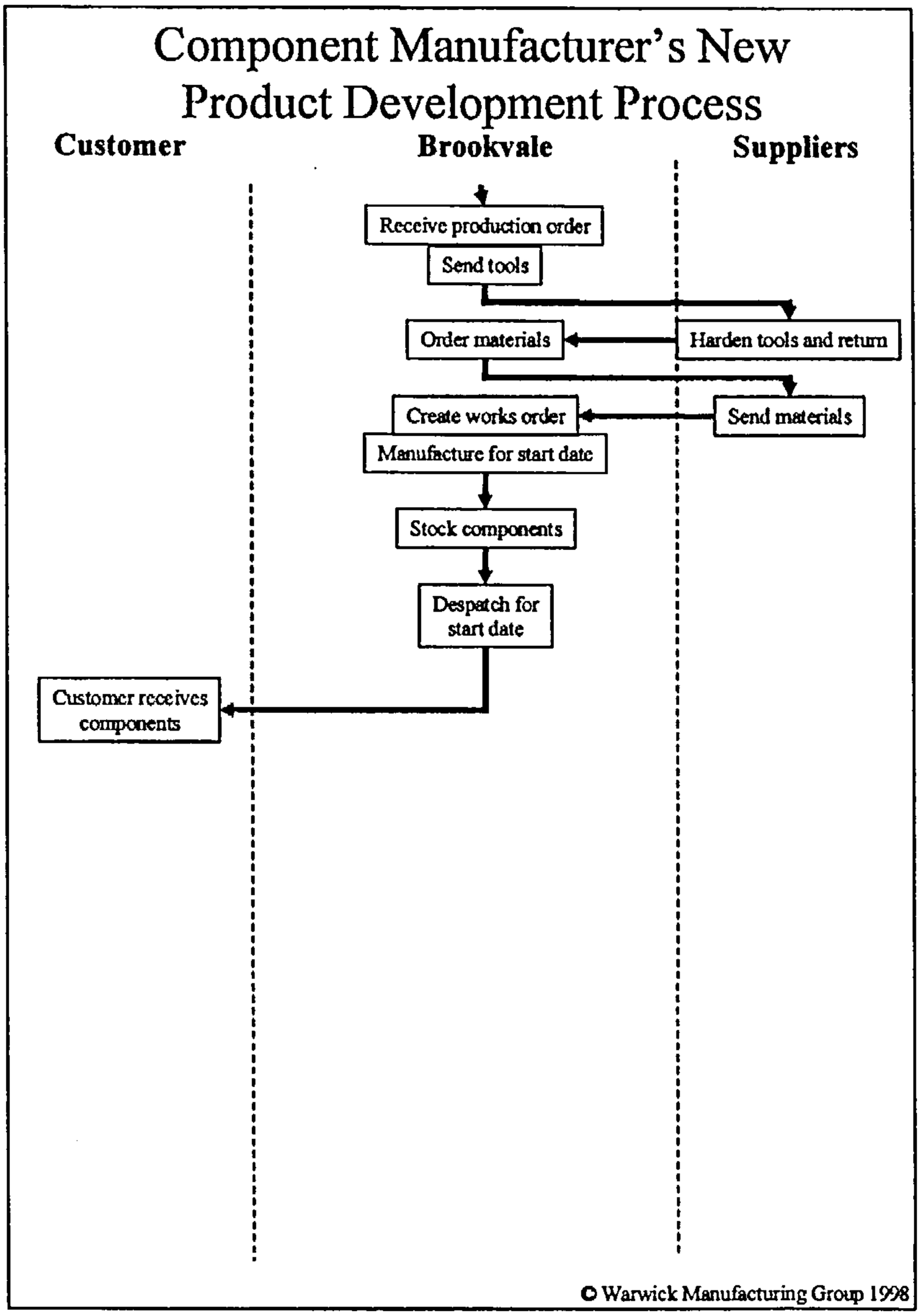


Figure 6-4 Product Development Process for Brookvale Manufacturing (part b) *Source:* Figure 4, Submission 3-1, from AutoLean II interview

As the other parts of the analysis were similar to the Quotation Process example given in Section 6.5.2.1 above, they have not been included here.

Executive Summary

What was clear about the Product Development Process was that it was considerably more involved than either of the other two processes. This was further discussed in Submission 3-2.

6.5.2.3 Order to Delivery Process

The final order management process at the SME was the ongoing supply of goods. This may be triggered from an order, or from a forecast, schedule or call-off. The process finished with the receipt of goods by the customer. A typical example was given in Section 2.6.2.2.3, Submission 3-1 and is shown in Figure 6-5.

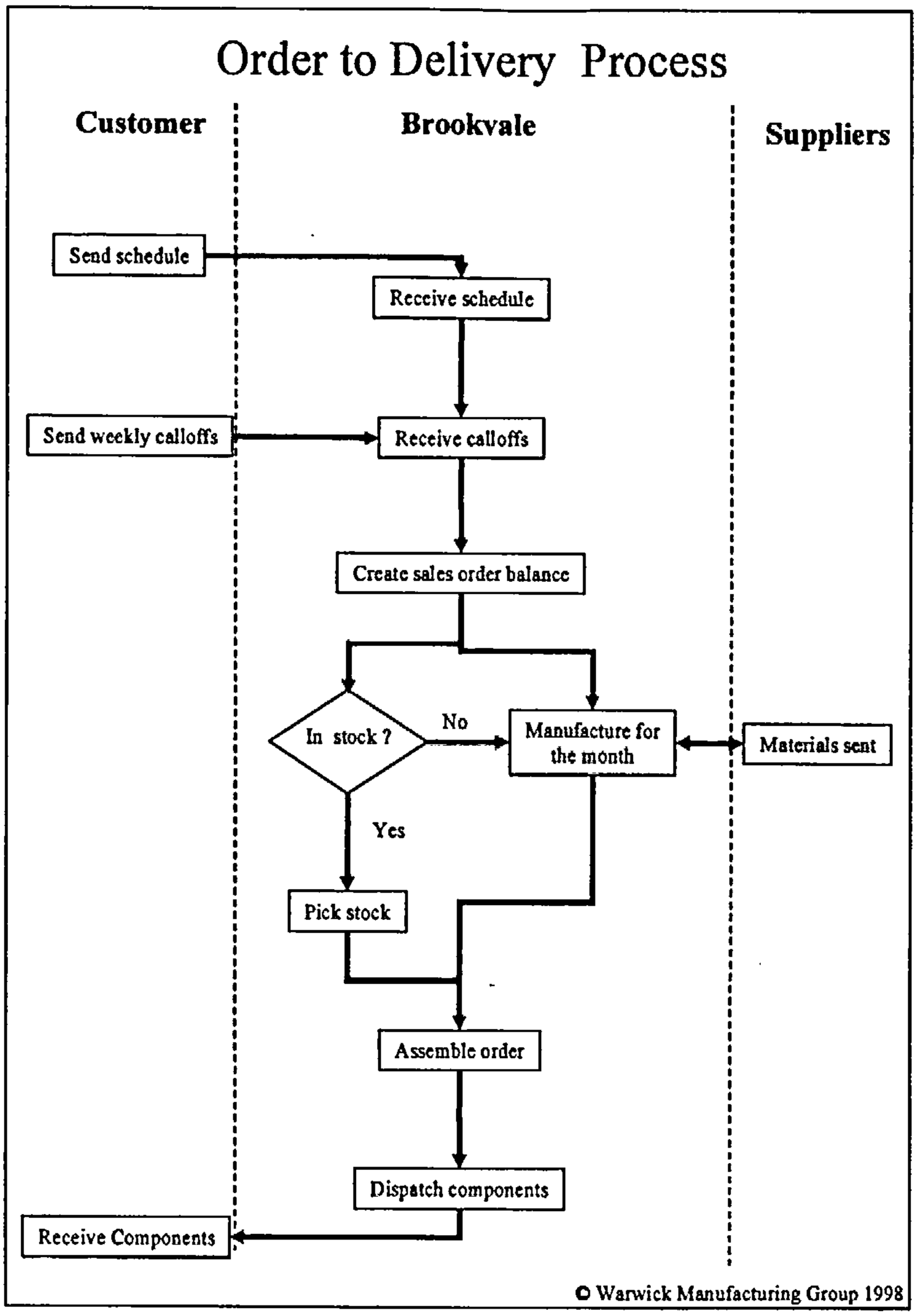


Figure 6-5 Typical Order to Delivery Process, Brookvale Manufacturing *Source:* Figure 6, Submission 3-1, from AutoLean II interview

Again the flow chart, the time based activity map and the analysis was similar to both the Quotation Process and the Product Development Process, so the results from the other parts of the methodologies have not been included here.

6.5.3 Identification of key activities within the business processes

The interviewers were concerned that key activities should be identified and included in the business process mapping, as such mapping was done through interpreting what was seen. Business processes analysed the way information flowed through the business.

The identification of key activities within the business processes was given in Section 3.3, Submission 3-1 and is detailed here.

Doing both the questionnaire and process mapping provided a corroboration on data obtained from both methods, as much of the data gathered in the process mapping was the same or similar to the questionnaire. In fact the process mapping data was considerably more detailed. Thus, the data from questionnaire and process mapping could be triangulated (Hussey and Hussey, 1997). A methodological justification for research into SMEs was given in Section 5.3.1 above, and Chapter 2.3, Submission 3-2.

In addition, by moving out of the interview room within the SME and into the factory in order to 'walk' the business processes, and by asking for similar information as in the questionnaire stage, the interviewee was made to feel relaxed, and often opened up in terms of actual concerns and issues within the business. This "walking" the business processes meant physically following the flow of information and product through the processes as far as was practicable.

This information started with quotations and was a combination of financial information and technical information related to a particular enquiry. This was called the Quotation Process.

With the Product Development Process, the information was both conceptual, in terms of the design itself, and also physical, in terms of the product being designed.

With the Order to Delivery Process, the information was both the paperwork associated with the order and the physical product flowing through the factory.

Information was also tracked from and to customers, and to and from suppliers.

Thus, a complete high level picture of the business, its interactions and its attitudes to both internal processes and external relationships was covered. In many cases, the company had to work closely with either a customer or a supplier. For example, the plastic moulders and metal formers had to work closely with toolmakers in particular. This high level approach was combined with a level of detail which meant that a real understanding of the business was obtained.

It was thus a judgement in the eyes of the interviewer as to what activities should be grouped, either where activities or tasks naturally could be grouped together, or where there was no identifiable or waste time between discreet tasks or sets of tasks. Despite these apparent arbitrary definitions, the SMEs generally thought that the process mapping had been accurately done (Chapman, undated; Section 6, Submission 3-3).

Another benefit in this analysis was that it was not necessary to understand the complete manufacturing process, but only the overall process. The SMEs it appeared were most competent within their production or manufacturing parts of the business and were very keen to reduce actual production times. What was measured in the SOAT analysis was the overall times in particular production areas, and the times between different operations. But often it was difficult to follow the flow of information from order input to actual material placed into production. For example in Cromwell Plastics, orders were left in a certain area for the works supervisor to pick them up at some convenient time later, albeit later on in the day.

It was sometimes difficult to assess in the Order to Delivery Process how to measure the process.

This was overcome in two ways. First, this was done by asking the customer to consider a typical order. Even in cases where the SME protested that it was not possible at all to outline a process, it was possible to identify a typical process. For example, at surface treatment company K&S Plating where the product "just turned up", on pressing the interviewee, it was found that over 50% of the work was regular work, even if the details of actual qualities and timings were only known about at the last moment. The solution generally was to focus on the commonality of orders, rather than their differences.

Secondly, it was important to map the process in terms of the actual quantity or volume supplied to the customer in any one delivery. For example, because of production efficiencies in Qualplast, it was better to flock all the actual order for a particular vehicle part at the same time, in the same batch. However, this production quantity was actually broken down into several consignments to meet the Just-in-Time requirements of the customer. It was only towards the end of the AutoLean II exercise that it was realised that the mapping process should be done in this way. It should be this actual *delivered* quantity that should be process mapped. This was a practical outworking of both Hines' (1994) and Womack and Jones's (1996) analysis that the customer should pull the product through the supply chain.

6.6 Content – SOAT Tool

6.6.1 Introduction

As was described in Section 6.3.2.1 above, the application and usage of SOAT was innovative in a specified area. Submission 3-1 provided an overview of SOAT. The constituent parts, the questionnaire or the business process mapping were not themselves innovative, but used together demonstrated innovation. This is reviewed in Chapter 8 below, summarised from Submission 3-3.

However, what was needed to be justified was that the content of the SOAT was appropriate and that the SOAT's usage was also appropriate: this is the purpose of this section.

6.6.2 Semi-structured questionnaire

The area of details asked for in the questionnaire were described in Section 2.6.2.1 of Submission 3-1. However although this part of the SOAT Tool was called Questionnaire, it was data on the company which was asked for in a semi-structured manner.

The data required from the questions was very broad and this included general details about the company including, for example turnover and number of employees; a marketing and competitor overview which was added for the application stage of SOAT; and data about customers, suppliers and other similar information. This was then followed by details on the business processes which would then be mapped, namely Quotation, Product Development, and Order to Delivery Processes. A considerable amount of information was requested on the Order to Delivery, and this included inventory and shipment and whether any regular schedules or call-offs had been placed on the SME. Key standards were also reviewed. Information on the technologies used for electronic data exchange and other communications issues were asked for. Finally, the SME's strengths, weaknesses and challenges affecting the business were asked for, strengths and weaknesses were seen as being current issues, and challenges were issues that needed to be addressed sometime in either the near or distant future.

In general therefore, the questions asked ranged, in general, from the strategic to operational, and from being objective to being subjective.

The interviewers discussed the strengths, weaknesses and challenges given by the SME. As a result, these were then added to and interpreted to provide an overall set of strengths, weaknesses and challenges which were included in the final report given back to the SME. The report covered a description of business processes and mapping, a table filled out with all the data gathered from the questionnaire part of SOAT, an assessment of the company in terms of the whole company and also in terms of the technology used

for communications. The business processes which had been mapped on the interview day were presented, together with an analysis of each business process.

6.6.3 Assessment of AutoLean II data

6.6.3.1 Introduction

The Questionnaire part of the SOAT asked the SME for approximately 100 separate pieces of data, in seven areas. The first was to do with general information about the company, the second was to do with markets and competitors, the third dealt with supply chain issues, the fourth, on quotations, the fifth, on product introduction, the sixth, on the delivery process, and the seventh was to do with people communications and information technology.

The second stage of SOAT was the process mapping of the core business processes, these being the Quotations Process, the Product Development Process and the Order to Delivery Process. Justification for these to be seen as core processes was given in Sections 2.6 and 2.7, Submission 3-2 and also summarised here in Section 5.6.6.

The interview was semi-structured which ensured that the person leading the consultancy or research was able to focus on areas which were seen to be important both in terms of the relationship to other SMEs and for the SME itself.

In addition, the SOAT process provided a vehicle or mechanism for managing change within the SME. This was important in providing the SME with the vehicle for learning and adapting, the fourth area on Kaplan and Norton's Balance Scorecard.

Chapter 8, Submission 3-3 discussed the possible need to include a more wide ranging financial assessment of the SME within the SOAT framework. SOAT met the requirements for assessing customers and internal processes as its primary function. If a more rigorous financial overview of the SME was added, and using the report and results provided by SOAT for the SME to learn and adapt, then the requirements for Kaplan and

Norton's Balanced Scorecard Approach could be said to be satisfied. Thus, it could be said that SOAT provided a tight and cohesive structure to assess an SME.

An assessment and analysis of the data collected for the AutoLean II SMEs was given Chapter 5, Submission 3-2. A summary of this data follows.

6.6.3.2 SME Overview data

6.6.3.2.1 General SME Data

The general SME company data collected within the AutoLean II interviews was as follows, (Section 5–1, Submission 3-2):

- Company name,
- Contact Name,
- Position,
- Company address,
- Company telephone number,
- Personal direct telephone number,
- Company fax number,
- Personal mobile number,
- Email address,
- Ownership of the company,
- A summary of product line/service,
- Base technology.

Executive Summary

The basic financial related information was as follows, (Section 5.2, Submission 3-2):

- SME turnover,
- Percentage of non-UK business,
- Number of employees.

Whether the SMEs had QS9000 or other types of approvals, or whether other standards were important were asked (Section 5.7, Submission 3-2). QS9000 was an enhanced and extended ISO9000, drafted specifically for the automotive industry.

6.6.3.2.2 Geographical Location

The AutoLean II SMEs were all in the Objective 2 area within the West Midlands area of the United Kingdom. Objective 2 was a classification of geographical area in order for it to receive support funding from the European Union.

6.6.3.2.3 Interviewee's position in the SME

A high proportion of interviewees within the AutoLean II SME were Managing Directors and senior managers, Figure 6-6, which meant that the interviewers were confident in the information given. Section 5.1.3, Submission 3-2 suggested that this maybe why SOAT provided both SMEs' strategy and operational detail. Given that most of the organisational forms within the AutoLean II programme were simple hierarchical, where there were the owner or partners together with workers, usually with no middle managers, then it was possible for the managing director to understand both strategy and operational detail.

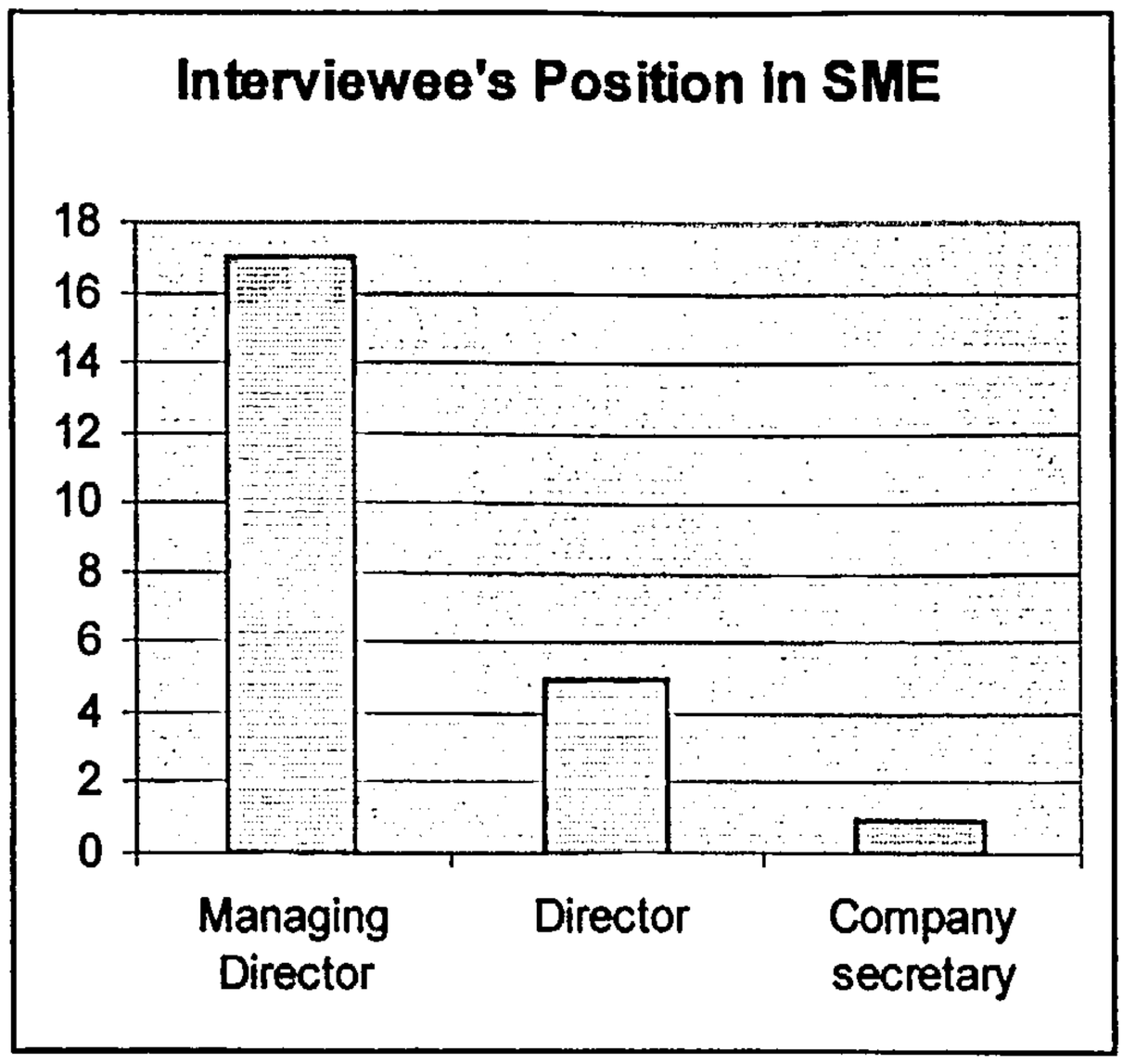


Figure 6-6 Interviewee's position in SME (23 companies in total) *Source*: Figure 5-1, Submission 3-2, from AutoLean II interviews

6.6.3.2.3.1 Ownership of SME

All but two of the SMEs, who stated their ownership, described themselves as either privately owned or family owned (see Figure 6-7).

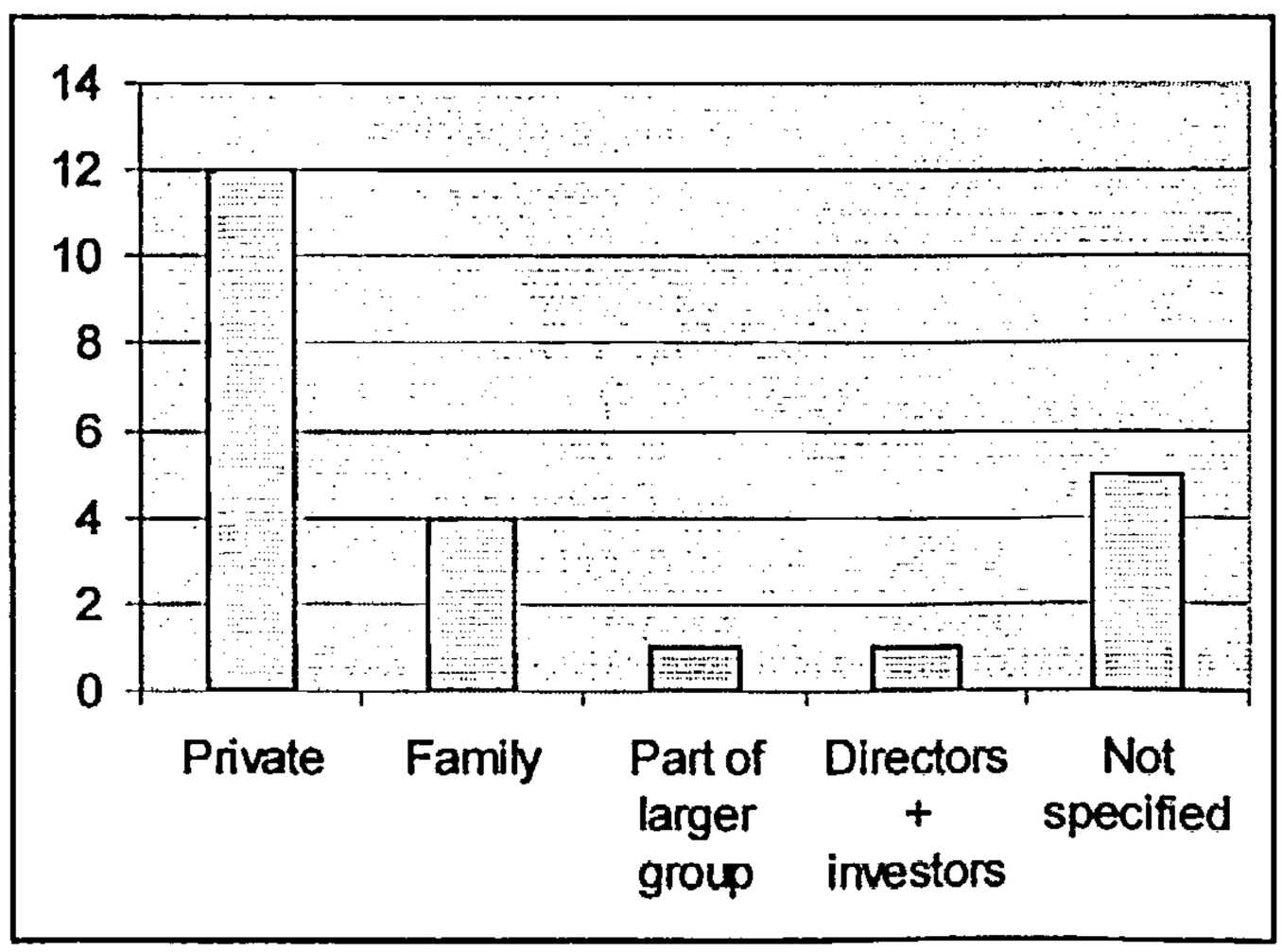


Figure 6-7 Ownership of SME (23 companies in total) *Source*: Figure 5-2, Submission 3-2, and AutoLean II interviews

Section 5.1.4 outlined a number of possible implications from these findings. First, it allowed the SME greater freedom and flexibility to manage their company as they saw fit without the intrusion of large corporate bodies, such as a parent group or set of investors. Secondly, the AutoLean II SMEs were heavily dependent on their customers for revenue generation to fund the business. This could possibly be why the SMEs were interested in the business process mapping, as it combined into an easy to understand graphical representation of a part of the relationship with their customer.

6.6.3.2.4 Type of Technology/Service and Turnover

The AutoLean II SMEs could be grouped together into different types of technology and these were metal turning, metal stamping, metal finishing and for plastics, injection moulding, other moulding and plastic finishing. There was also an electrical assemblies and design company, and testing equipment company, a toolmaker and a jig design company. These companies were also characterised by a wide range of turnovers from £150,000 per annum (pa) turnover up to £6.5Million pa (Table 6-2)

SME	*Type of technology*	*Turnover (£,000 pa)*
Halesowen CNC	Metal turning	400
JBI Engineering	Metal turning	670
Marquin Engineering	Metal turning	700
Hayfield Engineering	Metal turning	840
Chadwick Engineering	Metal turning	1500
AD Hayes	Metal turning	1600
James Hutton Pressings	Metal stampings	300
Brookvale Manufacturing	Metal stampings	1000
C & H Howe	Metal stampings	2000
Cooke Bros	Metal stampings	4800
Ash Heat Treatments	Metal finishing	300
K & S Plating	Metal finishing	1200
Advanced Finishing	Metal finishing	1500
Electroheat Treatments	Metal finishing	3000
PJS Mouldings	Injection moulding	1000
Aldridge Plastics	Injection moulding	6500
Concept Mouldings	Other moulding	2500
Cromwell Plastics	Other moulding	
Qualplast	Plastic finishing	400
RDM	Electrical assemblies	1500
Rotech	Testing equipment	700
Springfield Tools	Toolmaker	400
Heron Design	Design	150

Table 6-2 SME grouped by technology type and ranked by turnover *Source*: Table 5.1 Submission 3-2, from AutoLean II interviews

This can be seen diagrammatically in Figure 6-8.

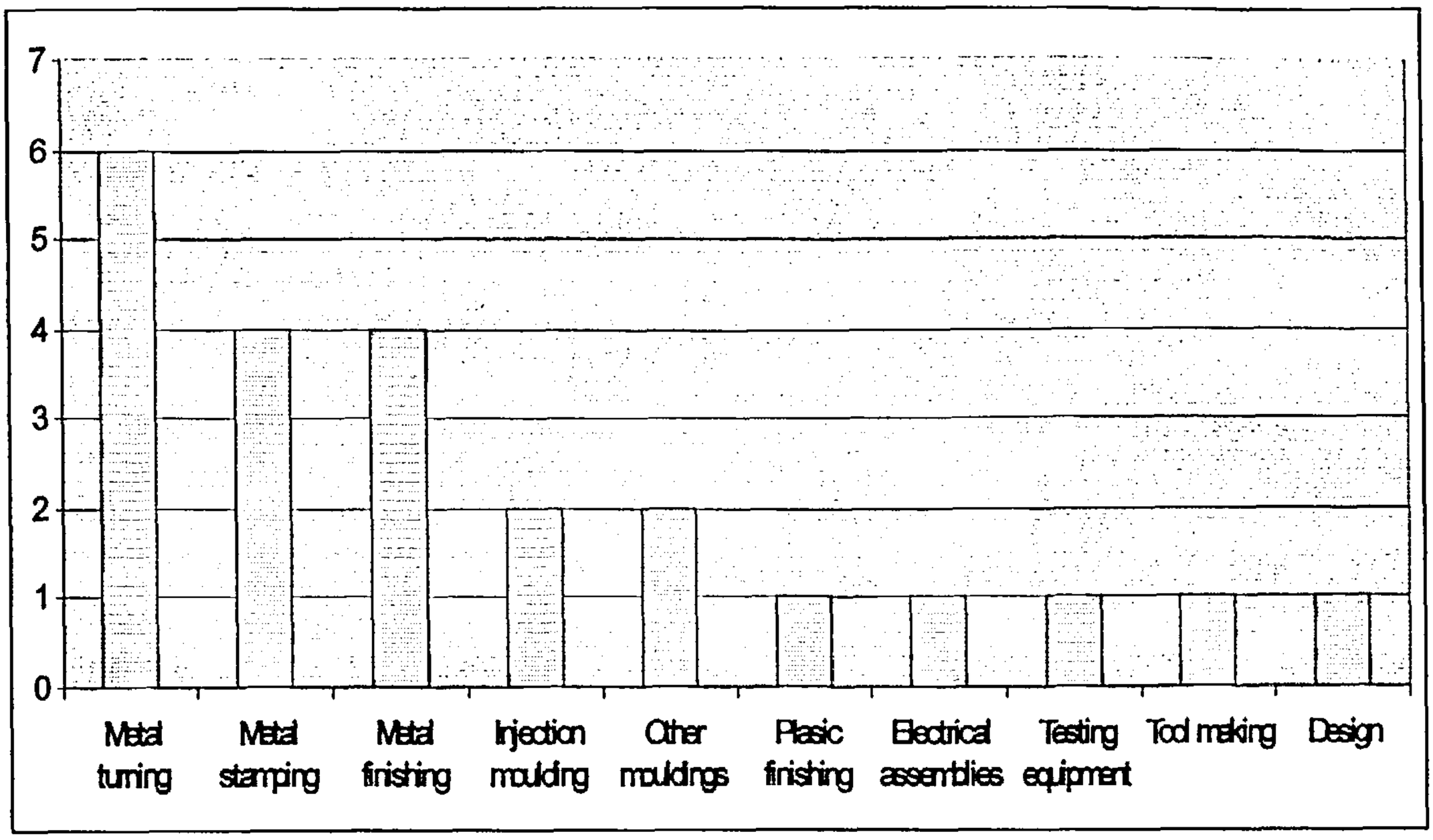


Figure 6-8 Classification of SME by technology base technology type, (23 companies in total) *Source*: Figure 5-3, Submission 3-2, and AutoLean II interviews

A number of the AutoLean II SMEs had other areas of technology which were a substantial part of the business and these are shown in Table 6-3.

SME	*Main technology area*	*Other technology areas*
Concept Mouldings	Other mouldings	Design
Cooke Bros	Metal stamping	Design, assembly, toolmaker
Cromwell Plastics	Other mouldings	Assembly
Halesowen CNC	Metal turning	Assembly
James Hutton Pressings	Metal stamping	Design, assembly
Marquin Engineering	Metal stamping	Assembly
Rotech	Electrical assemblies	Design

Table 6-3 SMEs with a significant other technology area *Source*: Table 5-4, Submission 3-2, from AutoLean II interviews

6.6.3.2.5 Number of Employees

The number of employees was a critical measurement of the size of the company, and was one of the criteria within the EU's assessment of whether a company was an SME. To qualify as an SMEs, the SME has to be below 250 employees, (Commission of the European Community, 1992; Storey, 1994). The definition for an SME was further divided, Storey, (1994), p.13: a micro enterprise if it was below 10 employees, a small enterprise from 10 to a 100 employees and a medium size enterprise was between a 100 and 250 employees.

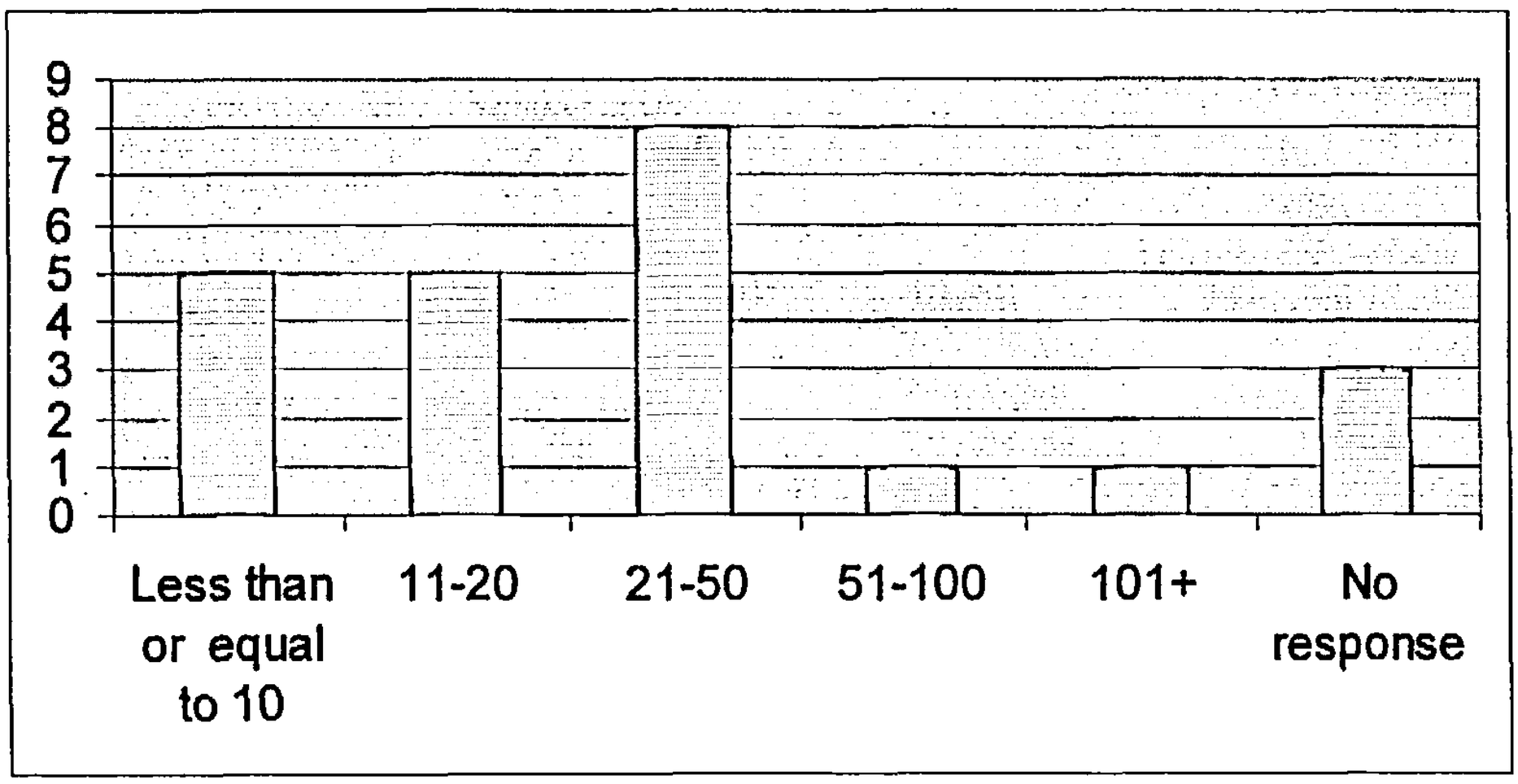


Figure 6-9 Numbers of employees, (23 companies in total) *Source*: Figure 5-4, Submission 3-2, from AutoLean II interviews

Turning now to the research data, Figure 6-9, all but two of the SME were companies with 50 employees or less. The two larger companies Aldridge Plastics and Cooke Brothers were by contrast significantly larger. The classification by Storey was seen to be appropriate in practice, as these two larger companies SMEs had a different "feel" to the other SMEs. This was seen in that they had a more sophisticated management structure, and that one was owned by an investment group.

There were a number of micro SMEs in the AutoLean II group and these exhibited unstructured processes and management styles. As processes, these were loose and haphazard. The micro-SMEs were Ash Heat Treatments, Heron Design, James Hutton Pressings, PJS Mouldings and Springfield Tools.

6.6.3.2.6 Turnover per employee

Figure 6-10 shows that there was a wide variation of turnovers of the SME. The lowest was in fact £150,000 and the highest was £6.5Million per annum.

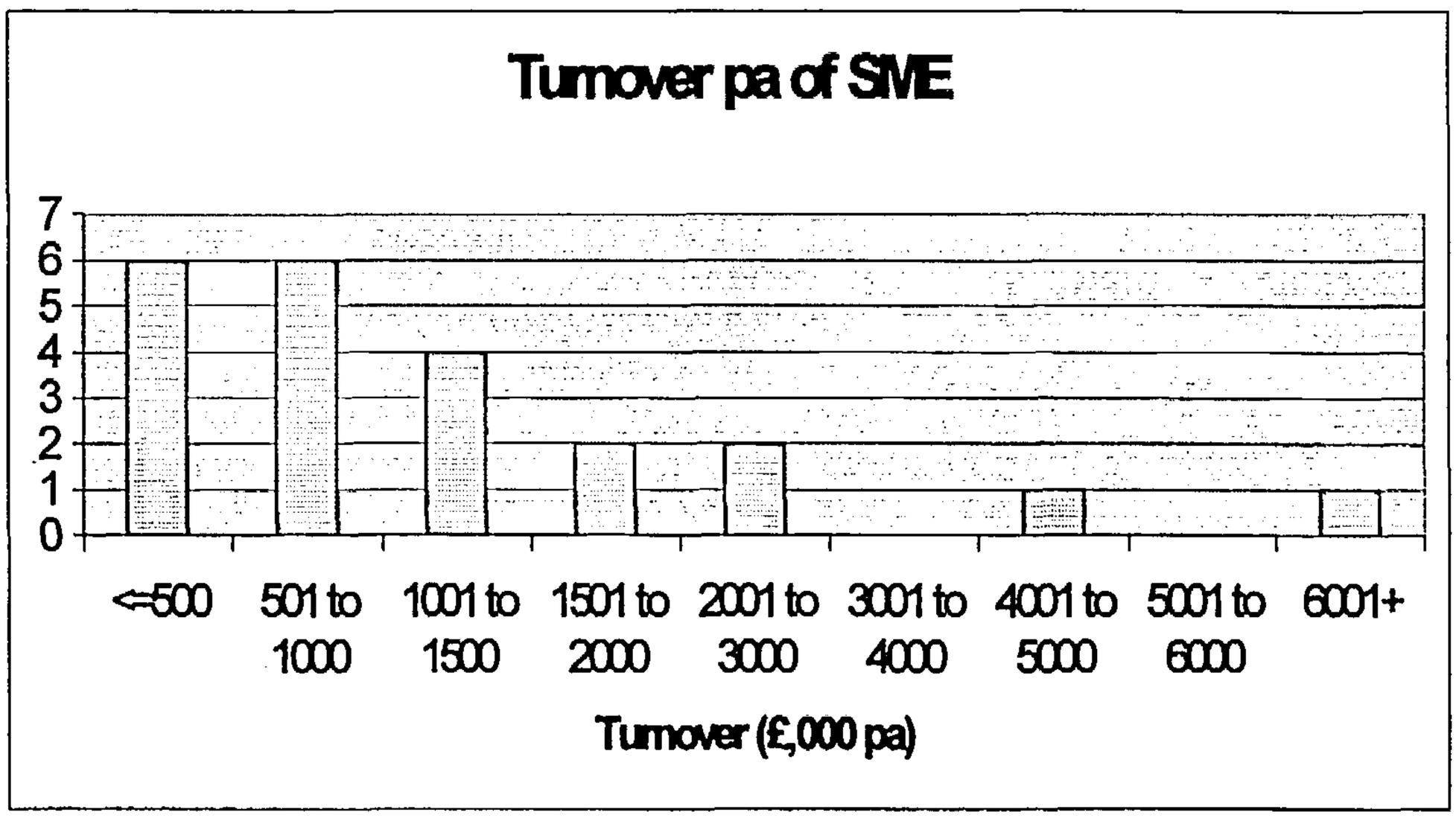


Figure 6-10 SME turnover per annum, (22 companies in total, one did not reveal turnover) *Source:* Figure 5-5, Submission 3-2, AutoLean II interviews

Turnover per employee was seen to be a key measure of the success or other wise of the SME. The turnover per employee figure plotted against SME turnover provided an insight into the success of the SME, see Figure 6-11.

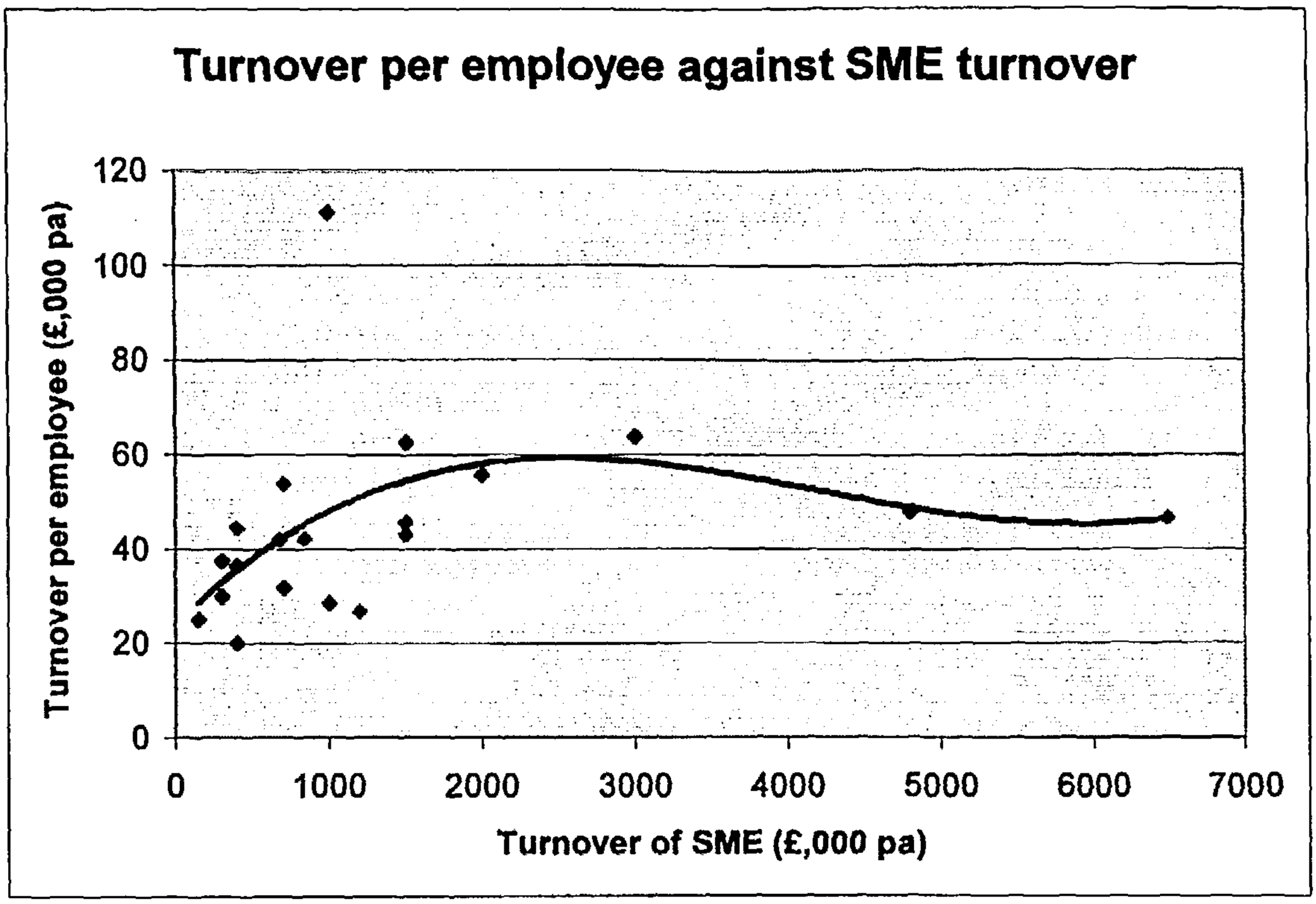


Figure 6-11 Turnover per employee pa against turnover pa of SME with polynomial regression line fitted (only complete data included) *Source*: Figure 5-8, Submission 3-2, AutoLean II interviews

Section 5.3.2, Submission 3-2 provided some observations from the Figure 6-11.

First, it could be seen that all but three of the SMEs had a turnover of £2000K per annum or below. The turnover per employee was bunched between £20K and £60K.

Within this range of SMEs there was a discernible trend upwards, so that up to about £2000K per annum turnover, the ability for the SMEs to maximise the effectiveness of the company financially increased. Above this turnover per annum figure, it was seen that the SME had to start to address issues of further structuring the company in order for it to function effectively.

Secondly for both the large SMEs, they had almost identical turnover per employee. Even allowing for rounding of the source data, such coincidence may be because larger SMEs in this particular sector had a similar turnover per employee. Thirdly, the polynomial regression line appeared to be very similar to under damped oscillation within engineering understanding (O'Neill, 1995). This could mean that such modelling may be appropriate for growing SMEs.

Such a trend line could be explained that as companies grow in size they need to become more ordered and tasks normally done by one person need to be done by several people, including expensive middle managers and specialist individuals.

6.6.3.2.7 Percentage of Non-UK Business

The AutoLean II SMEs did not consider that they should export from the UK. At the time of the interviews, 19 of the SMEs did not export overseas whereas 4 did. In future, 3 additional SMEs envisaged exporting overseas. See Table 6-4.

Overseas business	*Now (Numbers of SMEs)*	*Future (Numbers of SMEs)**
None	19	13
Some	4	7

* 3 did not know

Table 6-4 Summary of SME overseas turnover *Source*: Table 5-19, Submission 3-2, from AutoLean II interviews

6.6.3.2.8 Standards

QS9000 was the quality standard which was seen as the benchmark of quality and quality systems within the automotive industry. The purpose for asking this question was to

provide a point of discussion on the increasing requirement within the industry for QS 9000 to test commitment in the automotive industry and on quality and quality systems. At the time of interviews only four SMEs had QS9000 accreditation, and five SMEs were near or planning accreditation. See also Section 5.7, Submission 3-2.

6.6.3.3 Marketing and Competitor Overview

6.6.3.3.1 Marketing

What had been realised during the AutoLean II interviews was that any marketing strategy had emerged from the discussions from the business processes analysis, often from the Quotation Business Process. It was seen, however, that the relationship between the business processes and marketing strategy within the SME were inextricably linked. Consequently, a marketing overview and an understanding of competitors were added to the questionnaire where SOAT was applied in SMEs outside the AutoLean II programme.

There were a range of marketing strategies seen in AutoLean II. There could be a very definite one, for example in Advanced Finishing had chosen to have only a single customer, but was looking for other customers to gradually build up the customer base. This could be contrasted to Aldridge Plastics who quoted for 166 jobs per month or equivalent to one an hour but who only won 3%. AD Hayes on the other hand had a steady market of replacement parts for old models of vehicle, but were passive in what their business should be in the future. RDM were keen to proactively develop its contract design business.

6.6.3.3.2 Competitors

Section 5.2.2 of Submission 3-2 discussed why the issue of competitors did not arise within the AutoLean II SME interview. First, it could have been that competition issues were not apart of the main area of research so would not have formally been raised.

However, as the discussions were wide ranging, if competition issues had been important then they would have almost certainly come up. Secondly, it could be that competitors were not understood by the SMEs, so were not raised. Again, this would be difficult to believe, as the AutoLean II SMEs were commercially aware.

Thirdly, it could have been that the SMEs may have seen a competitor not just as a competitor but also as a collaborator. This might have arisen for example, when additional capacity was required. This was seen in the literature in Italian Industrial Districts, (Rabellotti, 1995). Observations by the author's co–interviewer, Mike Szczygiel suggested that toolmakers in the Walsall area functioned similarly, in that they were seen to be competitors but also collaborators in terms of fulfilling customer orders.

Fourthly, it could be that the competitors of the AutoLean II SMEs were not large, easily identifiable competitors but were many and various. This would mean that it was more difficult in identifying competitors.

Fifthly, although there may be many large competitors, the SMEs were often supplying into different supply chains, so it was unclear who their actual competitors might be. This was discussed in Section 5.3.6, Submission 3-2.

Sixthly the SMEs might not have had the time to consider their competitors. It was certainly the case that the people in the SMEs had more than enough potential tasks to fill their time.

In summary, it was probable that the SME was focused on the business that they might win, rather than overly concerning themselves about losing business to a competitor.

6.6.3.4 Supply Chain Data

The questionnaire asked for a number of specific pieces of information regarding the supply chain. These concerned:

- The position of the SME within the supply chain (Section 5.1, Submission 3-2),
- Customer data, including the total number of customers, regular customers and significant automotive customers, together with the name of the largest automotive customer, (Section 5.3, Submission 3-2),
- A "picture" of customer supply chains: for each of three largest SME's customers, *their* largest customer was asked for by name, (Section 5.3, Submission 3-2),
- The identity of the vehicle into which the components would be fitted to, (Section 5.3, Submission 3-2),
- Data on suppliers, including the total number of suppliers and the number of regular suppliers. The three largest or major suppliers were also requested, (Section 5.3, Submission 3-2),
- The percentage of turnover bought in, (Section 5.3, Submission 3-2).

Discussion and analysis on these issues relating to the AutoLean II SMEs were discussed in Sections 5.1 and 5.3, Submission 3-2. No obvious groupings with these factors were detected, but the data gathered from these discussions was useful in understanding the relationship between the SME, its individual customers and its market. Therefore, the information gathered from these questions was used to anticipate features or the structure of the business processes and to understand the company in more detail.

In addition, this information was used to understand which customers the SME might supply into. For example, 44 known named companies were given in the list of customer or customers' customers, and of these 15 or 34% of them were traditional West Midland automotive assemblers, Rover, Landrover and Jaguar, Figure 6-12.

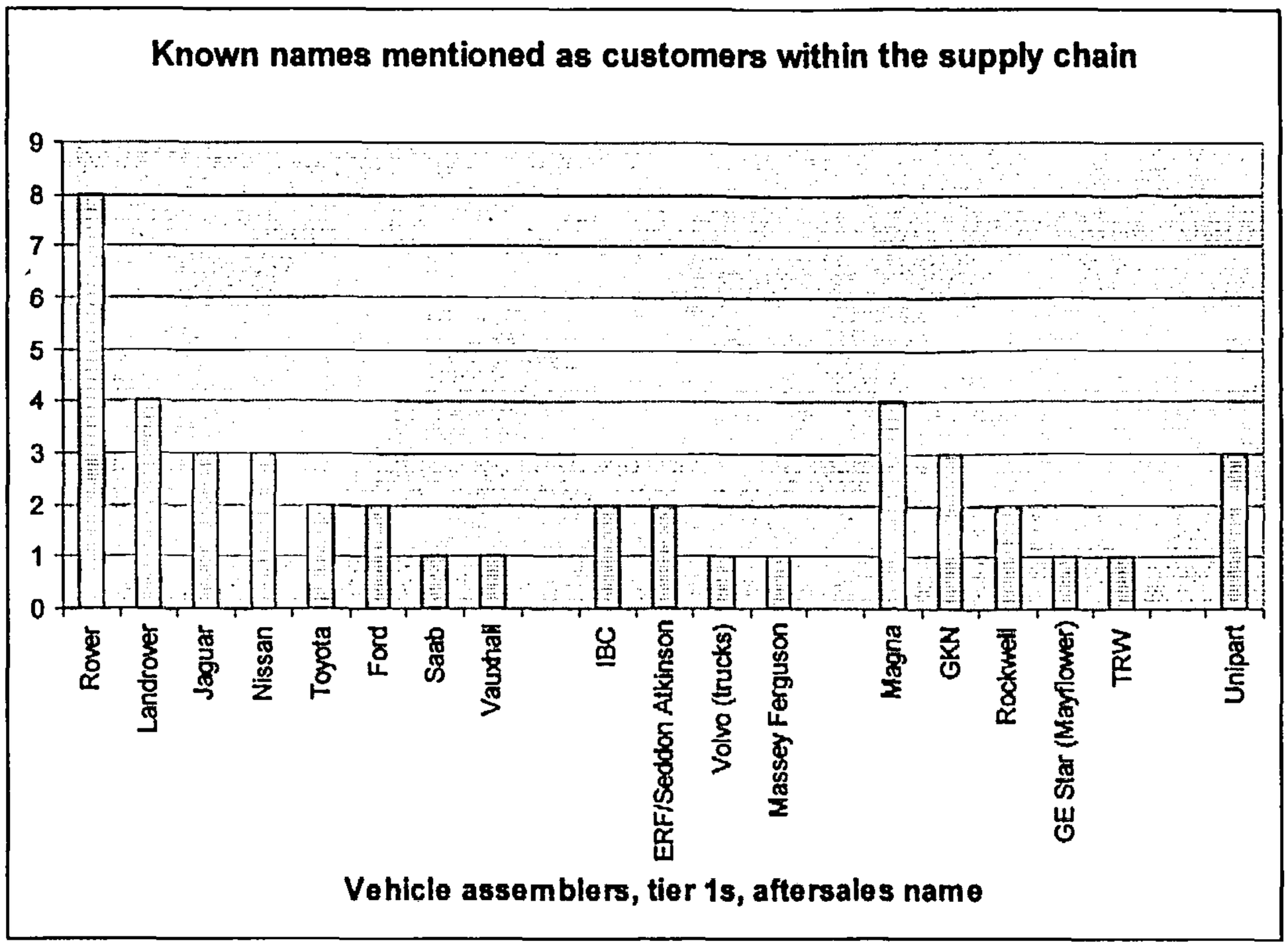


Figure 6-12 Number of times a vehicle assembler, commercial vehicle assembler, known tier one supplier and Unipart (known aftersales vendor) were mentioned *Source:* Figure 5-14, Submission 3-2, from AutoLean II interviews

6.6.3.5 Request for quotations and new product introductions

It was found that a considerable range of quotations per calendar month were received and these did not depend on SME turnover. The range of Request for Quotations (RFQs) in a month, as mentioned previously, was only one at Advanced Finishing up to 166 per calendar month at Aldridge Plastics. This gave on average of 32.7 RFQs per calendar month (pcm) and a median of 20 RFQs pcm for the AutoLean SMEs as a whole. The median was a preferred measure as it mitigated against a few high, SME RFQs figures. The spread of number of quotations requested per calendar month was plotted against SME turnover, Figure 6-13.

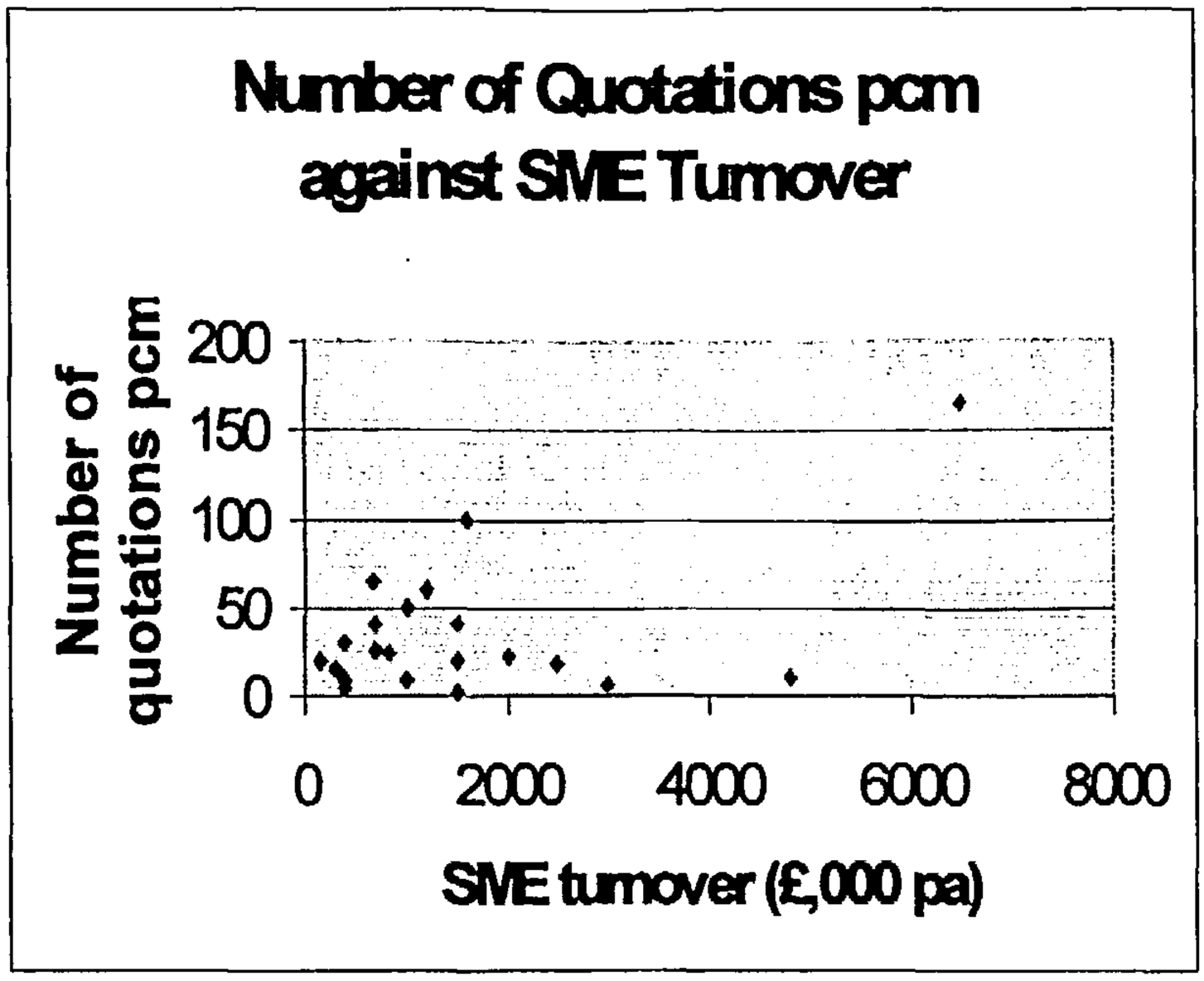


Figure 6-13 Numbers of quotations received against SME turnover *Source*: Figure 5-16, Submission 3-2, from AutoLean II interviews

What was seen to be more important was the decision-making behind the manipulation or processing of RFQs. For some AutoLean II SMEs the handling of quotations was seen proactively to gain new business, seen for example in Advanced Finishing, whereas in other SMEs the handling of quotations was seen as a mechanistic way of reacting to the market, as seen at Aldridge Plastics.

Turning now to the numbers of new products the AutoLean II SMEs introduced, Table 6-5 lists the number of new products which each SME introduced on average, and whether they had a product introduction procedure or process.

SME	*Type of technology*	*Turnover pa (£, 000)*	*No. of Product Introductions pa*	*Product Introduction Process?*
Halesowen CNC	Metal turning	400	3	Y
JBI Engineering	Metal turning	670	0	N
Marquin Engineering	Metal turning	700	2	Y
Hayfield Engineering	Metal turning	840	3	N
Chadwick Engineering	Metal turning	1500	N/A	N
AD Hayes	Metal turning	1600	10	N
James Hutton Pressings	Metal stampings	300	1-2	N
Brookvale Manufacturing	Metal stampings	1000	11	Y
C & H Howe	Metal stampings	2000	263	Y
Cooke Bros	Metal stampings	4800	3	Y
Ash Heat Treatments	Metal finishing	300	1-2	N
K & S Plating	Metal finishing	1200	2	N
Advanced Finishing	Metal finishing	1500	2	Y
Electroheat Treatments	Metal finishing	3000	Rare	N
PJS Mouldings	Injection moulding	1000	10	Y
Aldridge Plastics	Injection moulding	6500	20	Y
Concept Mouldings	Other moulding	2500	8-12	Y
Cromwell Plastics	Other moulding	Not given	0	Y
Qualplast	Plastic finishing	400	3-4	Y
RDM	Electrical assemblies	1500	150	Y
Rotech	Testing equipment	700	N/A	N
Springfield Tools	Toolmaker	400		Y
Heron Design	Design	150	N/A	Y
Average			*22.5**	
Median			*2.5**	

* Average and median calculated assuming mid range values used, and N/A equals zero.

Table 6-5 Number of new products introduced pa and if a Product Introduction Process was mapped *Source* Table 5-25, Submission 3-2, from AutoLean II interviews

It can be seen that the range of numbers of products introduced per annum ranged from nil to 263. This upper figure was probably due a difference in definition to that used by the other SMEs, but more typically up to 2.5 new products were introduced a year. The only exception was for in a case of RDM which introduced 150 new products, which could be explained because they produced electrical wiring harnesses for vehicles, which

meant that each product could be said to be a unique product in a range of products. Table 6-6 summarises the range of product introduction characteristics.

	Characteristic	*Number*	*Number*
1	SMEs who introduced *no* new products, (includes N/A, rare)	4	
2	SMEs who introduced products but who did not have a defined Product Introduction Process	5	
3	SMEs with *no* Product Introductions Process (sum of 1 and 2)		9
4	SMEs with a Product Introductions Process as seen using SOAT		14

Table 6-6 Summary of numbers of SMEs with Product Introduction Process *Source:* Table 5-26, Submission 3-2, from AutoLean II interviews

In could be seen that 14 AutoLean II SMEs had a Product Introduction Process which could be mapped whereas 9 had no Product Introduction Process. However, of these 9 SMEs, 5 had introduced new products without claiming to have a Product Introduction Process. This was discussed in Section 5-5, Submission 3-2 in that these product introductions in these SMEs were rare and so did not require a formal Product Introduction Procedure.

The interviewers observed that their seemed to be a relationship between having a procedure to introduce new products on one hand and the attitude and culture within the SME on the other. Where the SME did *not* have a Product Development Process, then the SME appeared to be *less* proactive. Conversely, the very fact of having a Product Development Process meant that the SME appeared to be adaptive and flexible in the ways that it sought to win business and work with its customers. Such proactivity might be important, for example, if the SME lost a long standing customer or where there were changes in its market and it had to develop a different product offer.

6.6.3.6 Order to Delivery Process

The data requested within the questionnaire for the Order to Delivery Process (Section 5.6, Submission 3-2) was as follows:

- The number of identifiable parts the SME supplied,
- The number of automotive part numbers supplied,
- The total number of part numbers to the largest automotive customer,
- Percentage of runners produced, and the percentage of strangers produced,
- Total volume of parts supplied per annum.

The following issues with shipments and inventory were asked (Section 5.8, Submission 3-2):

- On-time shipments for the main automotive customer,
- Inventory overall,
- Inventory held for the largest automotive customer,
- Automotive components finished stock turns per annum.

Other details requested included information on unplanned changeovers in the "shop".

Information on ordering behaviour was requested in terms of forecasts, schedules and call offs.

Despite a detailed analysis of the data collected under these different characteristics in Sections 5.6, 5.8 and 5.9, Submission 3-2, there was generally no overall understanding of ordering data which came through these figures. An exception came through mapping

the total number of part numbers supplied by the SME against the total volume of parts the SME supplied in a year, see Figure 6-14.

			Total number of parts	
			Low	High
			300	
Volume of parts	Low	<= 250000 pa	Advanced Finishing Concept Mouldings Cromwell Plastics Halesowen CNC Marquin Engineering Springfield Tools	RDM
	High		Ash Heat Treatments Brookvale Manufacturing C & H Howe Hayfield Engineering James Hutton Pressings PJS Mouldings Qualplast	AD Hayes Aldridge Plastics Cooke Bros

Not included due to lack of valid data: Chadwick Engineering, Cromwell Plastics, Electroheat Treatments, Heron Design, JBI Engineering, K & S Plating, Rotech Laboratories

Figure 6-14 Matrix of total number of parts with volume of parts pa *Source*: Figure 5–28, Submission 3-2, from AutoLean II interviews

The divide points between low and high in total number of parts numbers, and the volume of parts supplied in a year was perhaps arbitrary. What seemed to be important, and this was discussed in Section 5.6.5, Submission 3-2, was that the different quadrants within the matrix within Figure 6-14 could be used to explain different groups of SMEs, and to do so consistently. The actual values at the divide points appeared to be appropriate to the author from the data gathered from the AutoLean 11 SMEs.

As a means of applying the matrix to other data gathered from the AutoLean II SMEs, as the number of employees seemed to be a characteristic of the SME, the average number of employees for the group of SMEs within each quadrant was calculated, so see if the

assumptions about the groups of SMEs according to which quadrant the SME was placed seemed to hold true, Figure 6-15.

Number of employees and average number of employees within number of parts-volume matrix

			Total number of parts	
			Low	High
			300	
Volume of parts	Low	<= 250000 pa	Advanced Finishing 33 Chadwick Engineering 24 Cromwell Plastics N/A Halesowen CNC 20 Heron Design 6 Marquin Engineering 13 Springfield Tools 9 *Average 17.5*	RDM 35 Rotech Laboratories 22 *Average 28.5*
	High		Ash Heat Treatments 8 Brookvale Manufacturing 35 C & H Howe 36 Hayfield Engineering 20 James Hutton Pressings 10 JBI Engineering 16 PJS Mouldings 9 Qualplast 11 *Average 18.1*	AD Hayes N/A Aldridge Plastics 140 Cooke Bros 100 Electroheat Treatments 47 K & S Plating 45 *Average 83*

SMEs not included in Figure 5-28 have been placed using author's judgement.

Figure 6-15 Numbers of employees and average number of employees within number of parts-volume matrix *Source*: Figure 5-29, Submission 3-2, from AutoLean II interviews

The average number of employees is shown within each quadrant, and a explanation for the different average number of employees was given in Section 5.6.5, Submission 3-2. In essence, the low-low, upper left hand quadrant, could be seen to be typical SMEs who worked with very low numbers of employees. In contrast, the high-high, lower right hand quadrant were those companies with more sophisticated organisations, often the larger SMEs.

The other two quadrants could be characterised as follows. The low number of parts-low volume of parts, lower left hand quadrant was characterised by SMEs who had found a niche market but had only a small number of part types they produced. The benefit of this meant that they had high profitability, but the disadvantage was they or their market might draw the attention of larger companies.

The high total of number of part types-low volume of parts, the top right hand quadrant were SMEs that had a higher design input or higher variability of product. However, given that only two of the SMEs placed in this quadrant, the drawing out of the characteristics of this quadrant was more tentative.

6.6.3.7 Information Technology and People Communications

The information technology assessment of the AutoLean II SMEs was in Section 5.10, Submission 3-2 and is listed below:

- The number of personal computers in the SME, both now and in the future,
- Whether the PC's were in a Local Area Network,
- Whether a computer was used for production planning, and if so, which system,
- Whether Electronic Data Interchange, (EDI used),
- The size of the company's telephone bill,
- The presence of a company web site.

Communication issues were discussed in general in Section 5.11, Submission 3-2 and these were grouped into three different categories:

- Those which were customer related,
- Those which were supplier related,

- Those which arose out of in-house issues.

No overall grouping within the SMEs regarding the data in this area could be perceived. However, the issues to do with communications provoked a wide range of responses and this is seen in Table 6-7.

			Communications problem		
SME	*Turn-over (£,000 pa)*	*Man day visits pcm*	*Customer related*	*Supplier related*	*In-house*
Halesowen CNC	400	0	Lack of IT, Lack of being informed	None	None
JBI Engineering	670	4	None	None	??
Marquin Engineering	700	2.5	Dealing with 4/5 people on different items, buyers lack of understanding of Marquin's processes	None	None
Hayfield Engineering	840	2	Voice mail		
Chadwick Engineering	1500	very few	Connectivity to fax machine	None	None
AD Hayes	1600	4	None	None	Normal sorts of problems
James Hutton Pressings	300		Getting hold of people, voice mail	None	None
Brookvale Manufacturing	1000	1.5	Voice mail	None	None
C & H Howe	2000	2	Very little	Very little	Very little
Cooke Bros	4800	3			
Ash Heat Treatments	300	0	Phone answering		Phone not answered
K & S Plating	1200		Lack of knowledge, 20% of customers don't know what they are talking about	Very little	None
Advanced Finishing	1500		Getting to the appropriate person		
Electroheat Treatments	3000	8			
PJS Mouldings	1000	2	Terrible schedules, voice mail	None	None

Aldridge Plastics	6500	4	None	None	Lack of consistent communication interface with the customer, too many people (6)
Concept Mouldings	2500	12	None	None	None
Cromwell Plastics		8	Voice mail/ too many meetings, hard to get hold of people	Voice mail/ too many meetings, hard to get hold of people	None
Qualplast	400	1.5	No 1 point of contact, lack of visibility, treated as small company, too much paper	None	Phone not answered, time taken
RDM	1500		None	Faxes get lost, people change location and are hard to track down	None
Rotech	700	20	Phone answering	Phone answering	None
Springfield Tools	400	0	Mismatch of drawings and component data, not enough info, stop/go instruction	None	None
Heron Design	150				
Average		*4.0*			
Median		*2.5*			

Table 6-7 Other communications issues *Source*: Table 5-42, Submission 3-2, from AutoLean II interviews

These are summarised in Tables 6-8, 6-9 and 6-10.

Customer related communications problems	*Number of times mentioned*
Mismatch of right data, not enough information	11
Voice mail, phone answering	8
Getting hold of (appropriate) person	3
Too many contacts	2
Connection to fax machine	1
Customer lack of knowledge about SME	1
Inconsistent decision to start project	1
Lack of being informed	1
Lack of IT	1
Too much paper	1
Treated as small company, lack of visibility	1
None	5

Table 6-8 Summary of customer related communications problems *Source:* Table 5-43, Submission 3-2, from AutoLean II interviews

Supplier related communications problems	*Number of times mentioned*
Getting hold of (appropriate) person	2
Faxes get lost	1
Phone answering	1
Voice mail, phone answering	1
None/ very little	13

Table 6-9 Summary of supplier related communications problems *Source*: Table 5-44, Submission 3-2, from AutoLean II interviews

In-house communications problems	*Number of times mentioned*
Phone answering	2
Too many contacts with customers	1
None/ very little/ normal sorts of problems	13

Table 6-10 Summary of in-house communications problems *Source*: Table 5-45, Submission 3-2, from AutoLean II interviews

It can be seen from these Tables that there were virtually no communications issues relating to suppliers or arising in-house, but there was a range of issues with customers. Most of these issues were to do with a mismatch of the right data or not enough data or perhaps interestingly, the issue of trying to get hold of a contact in order to directly speak with him. There were several, negative comments about being put through to the person's voicemail constantly.

The purpose of including Table 6-7 is to show that the range of communication issues was wide ranging, and that they were unique to each SME. However, it was possible to be able to group such issues as could be seen.

6.6.4 Assessment of SOAT business processes content through AutoLean II data

Sections 6, 7, 8 and 9, Submission 3-2 outlined the findings and data from the AutoLean II interviews. The detail within each business process was relevant mainly to the SME itself or to any SME Service Provider.

Table 6-11 provides an overview of which SME had which processes.

SME	*Type of technology*	*Turnover (£,000 pa)*	*Processes*		
			Quotation	*Product Development*	*Order to Delivery*
Halesowen CNC	Metal turning	400	✓	✗	✓
JBI Engineering	Metal turning	670	✓	✗	✓
Marquin Engineering	Metal turning	700	✓	✓	✓
Hayfield Engineering	Metal turning	840	✓	✗	✓
Chadwick Engineering	Metal turning	1500	✓	✗	✓
AD Hayes	Metal turning	1600	✓	✗	✓
James Hutton Pressings	Metal stampings	300	✓	✗	✓
Brookvale Manufacturing	Metal stampings	1000	✓	✓	✓
C & H Howe	Metal stampings	2000	✓	✓	✓
Cooke Bros	Metal stampings	4800	✓	✓	✓
Ash Heat Treatments	Metal finishing	300	✓	✗	✓
K & S Plating	Metal finishing	1200	✓	✗	✓
Advanced Finishing	Metal finishing	1500	✓	✓	✓
Electroheat Treatments	Metal finishing	3000	✓	✓	✓
PJS Mouldings	Injection moulding	1000	✓	✓	✓
Aldridge Plastics	Injection moulding	6500	✓	✓	✓
Qualplast	Plastic finishing	400	✓	✓	✓
RDM	Electrical assemblies	1500	✓	✓	✓
Rotech	Testing equipment	700	✓	✗	✓
Springfield Tools	Toolmaker	400	✓	✓	✓
Heron Design	Design	150	✓	✓	✗

Table 6-11 Summary of Processes within SMEs *Source*: Table 6-1, Submission 3-2, from AutoLean II interviews

6.6.4.1 Quotation Process

This was reviewed in detail in Chapter 7, Submission 3-2. For each of these processes two or three analyses were set down. Here, Figure 6-16 shows the number of steps in the Quotation Process against the SME's turnover.

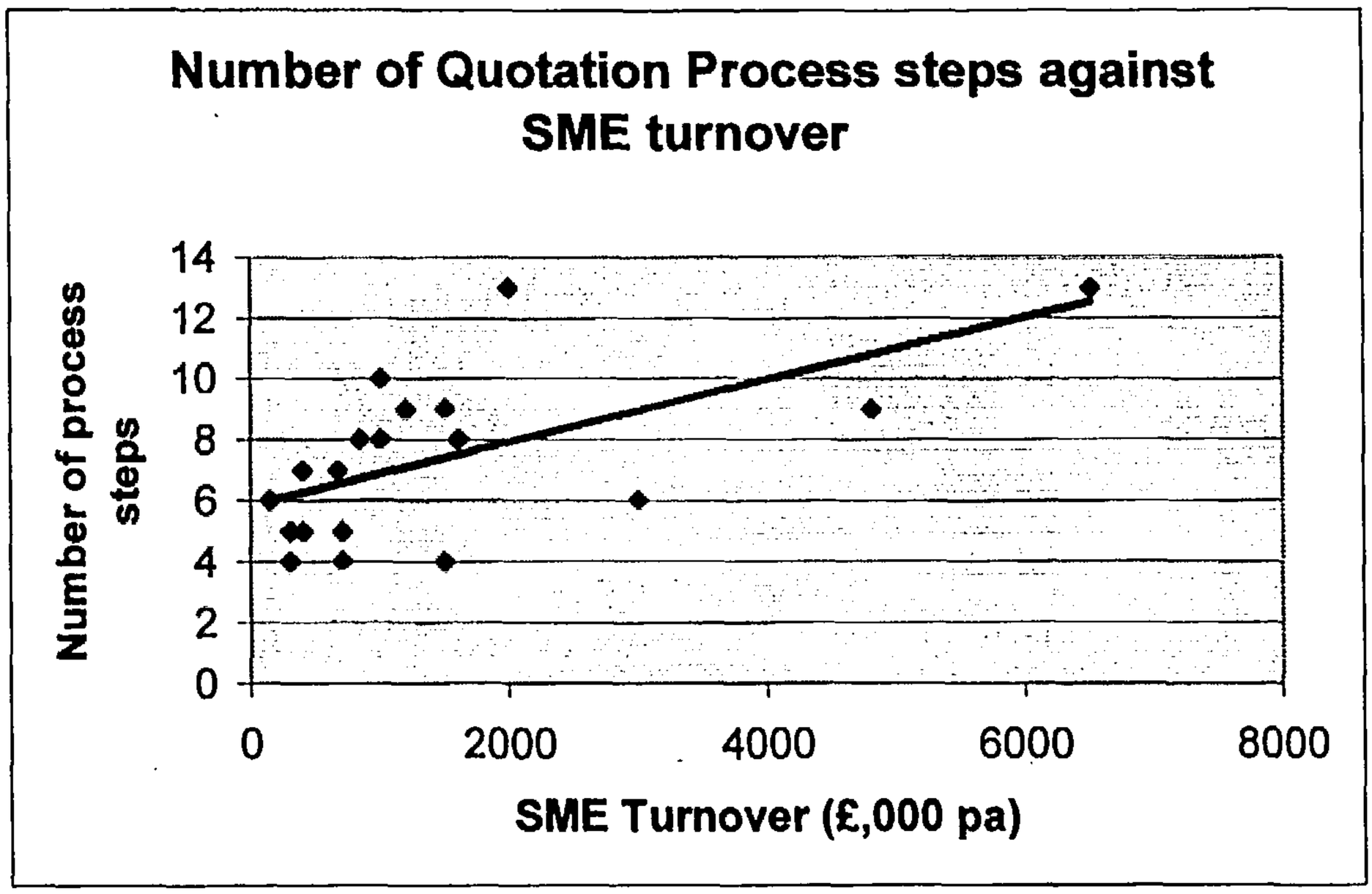


Figure 6-16 Numbers of Quotation Process steps against SME turnover *Source*: Figure7-1, Submission 3-2, from AutoLean II interviews

Most of the SMEs were clustered within a minimum number of 4 steps, up to about 10 steps. Two SMEs, Aldridge Plastics and C&H Howe were mapped with 13 steps. There did appear to be a trend as shown by the trend line added, that the larger the SME the more the number of steps within the SME's Quotation Process. However the number of SMEs over £2000K per annum turnover was small, so this trend line would be needed to be treated with caution.

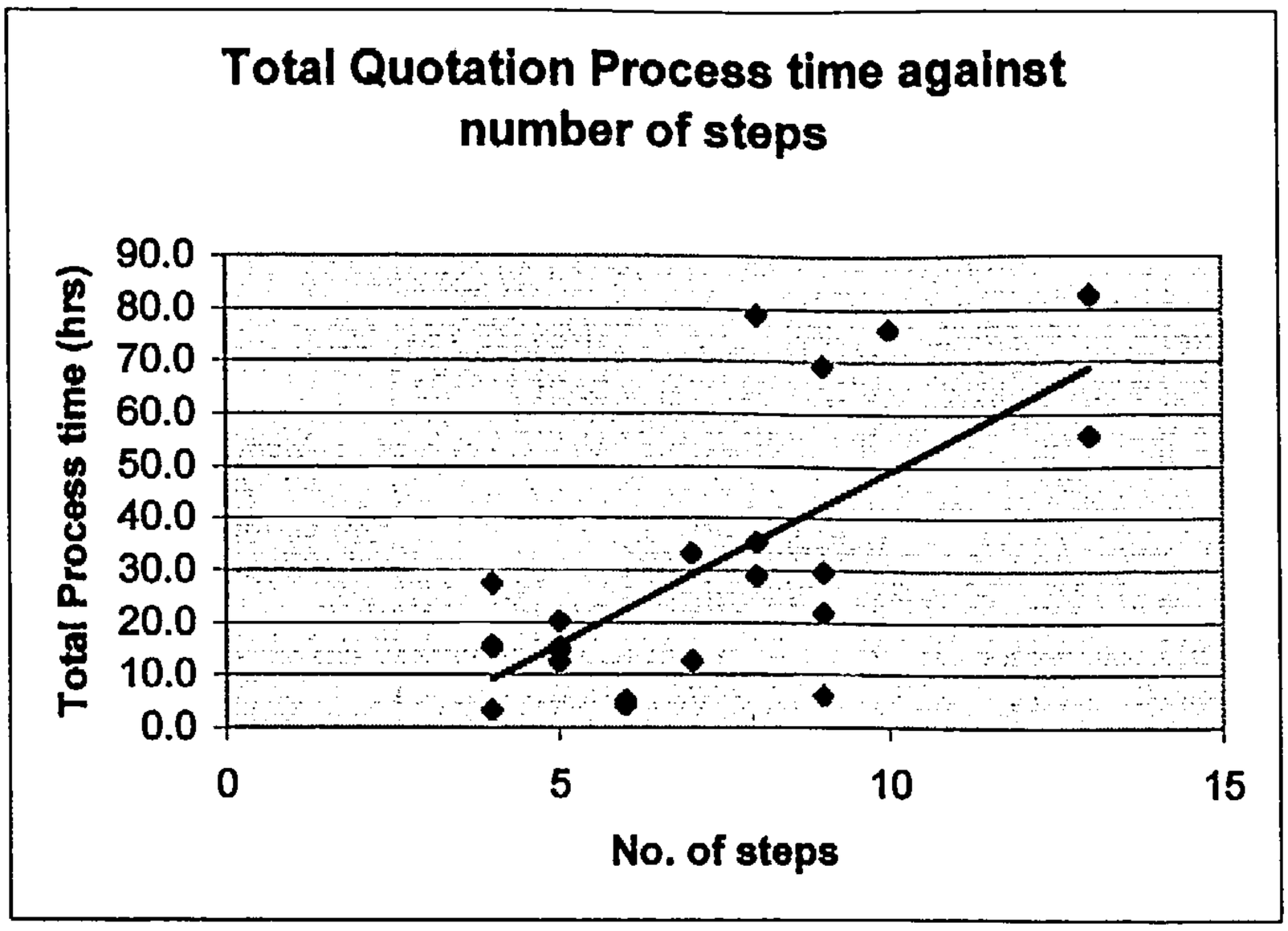


Figure 6-17 Total Quotation Process time against number of steps *Source*: Figure, 7-4, Submission 3-2, from AutoLean II interviews

Figure 6-17 relates the number of steps within the Quotation Process to the total time of the Quotation Process. It shows that where there were more process steps, the Quotation Process was longer. This provided some confirmation that the process mapping had been done consistently. Figure 6-18 uses the parts/volume matrix described above to review the characteristics of SMEs using the number of steps within the SME's Quotation Process.

Number of steps and average number of steps within number of parts-volume matrix								
			Total number of parts					
			Low			High		
			300					
Volume of parts	Low	<= 250000 pa	Advanced	Finishing	9	RDM		9
			Chadwick	Engineering	4	Rotech	Laboratories	4
			Cromwell	Plastics	4			
			Halesowen	CNC	5			
			Heron	Design	6			
			Marquin	Engineering	5			
			Springfield	Tools	7			
			Average 5.7			*Average 6.5*		
	High		Ash	Heat Treatments	5	A D	Hayes	8
			Brookvale	Manufacturing	10	Aldridge	Plastics	13
			C & H	Howe	13	Cooke	Bros	9
			Hayfield	Engineering	8	Electroheat	Treatments	6
			James Hutton	Pressings	4	K & S	Plating	9
			JBI	Engineering	7			
			PJS	Mouldings	8			
			Qualplast		5			
			Average 7.5			*Average 9.0*		

SMEs without insufficient information to be placed in Figure 5-28 have been assigned with interviewer's judgement

Figure 6-18 Number of steps placed on number of parts-volume matrix with average number of steps per quadrant *Source*: Figure 7-9, Submission 3-2 AutoLean II interviews

From the characteristics of SMEs, these averages in the various quadrants could be seen to be consistent with this explanation. For the low-low quadrant (top left) where they were typical SMEs organisational structure the number of steps was low. For the high-high (bottom right) quadrant with more sophisticated organisational structures the average number of steps was almost twice that of the low-low quadrant. For the other two quadrants the average number of steps was somewhere in the middle.

6.6.4.2 Product Development Process

An in-depth analysis of the Product Development Process was given in Chapter 8, Submission 3-2. Figure 6-19 shows the number of steps within the Product Development Process against the SME's turnover per annum.

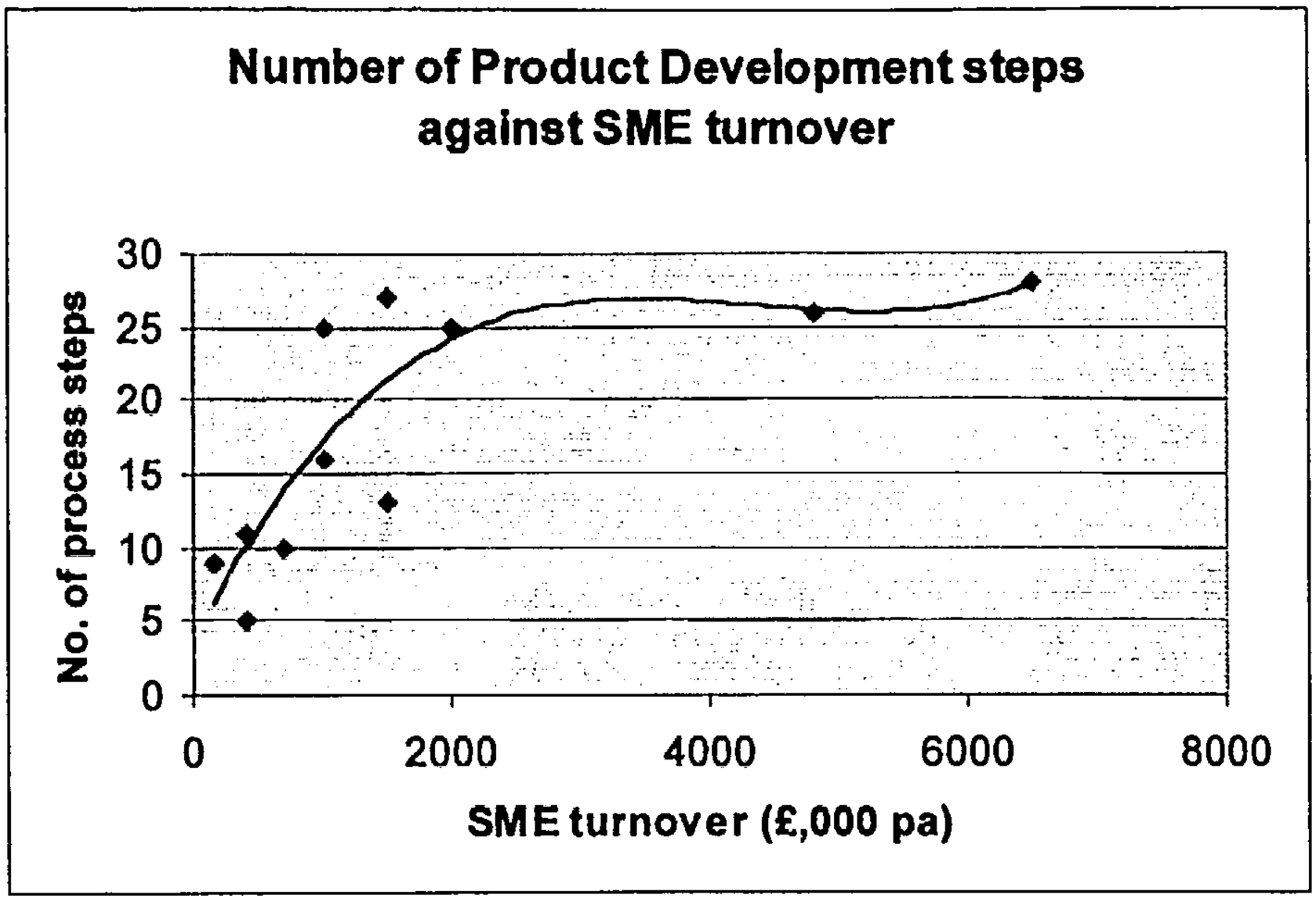


Figure 6-19 Numbers of Product Development Process steps against SME turnover
Source: Figure 8-1, Submission 3-2, AutoLean II interviews

The Product Development Processes were characterised by significantly more steps in the process than in either the Quotation Process or the Order to Delivery Process. It was also characterised by considerable interplay between the SMEs, customer and supplier. The simplest Product Development Process was Qualplast, and the most complicated was Aldridge Plastics who had designed and produced a head support for a Landrover, designed in plastic instead of the metal and plastic combination used previously.

A polynomial trend line has been added to Figure 6-19. A rise in the number of steps with SME turnover could be clearly seen for the SMEs up to about £2000K per annum

turnover. Over this size of SME, the Product Development Process was uniformly complicated in terms of number of steps.

Figure 6-20 shows the total of Product Development Process time against the SME's turnover per annum, excluding two largest SMEs

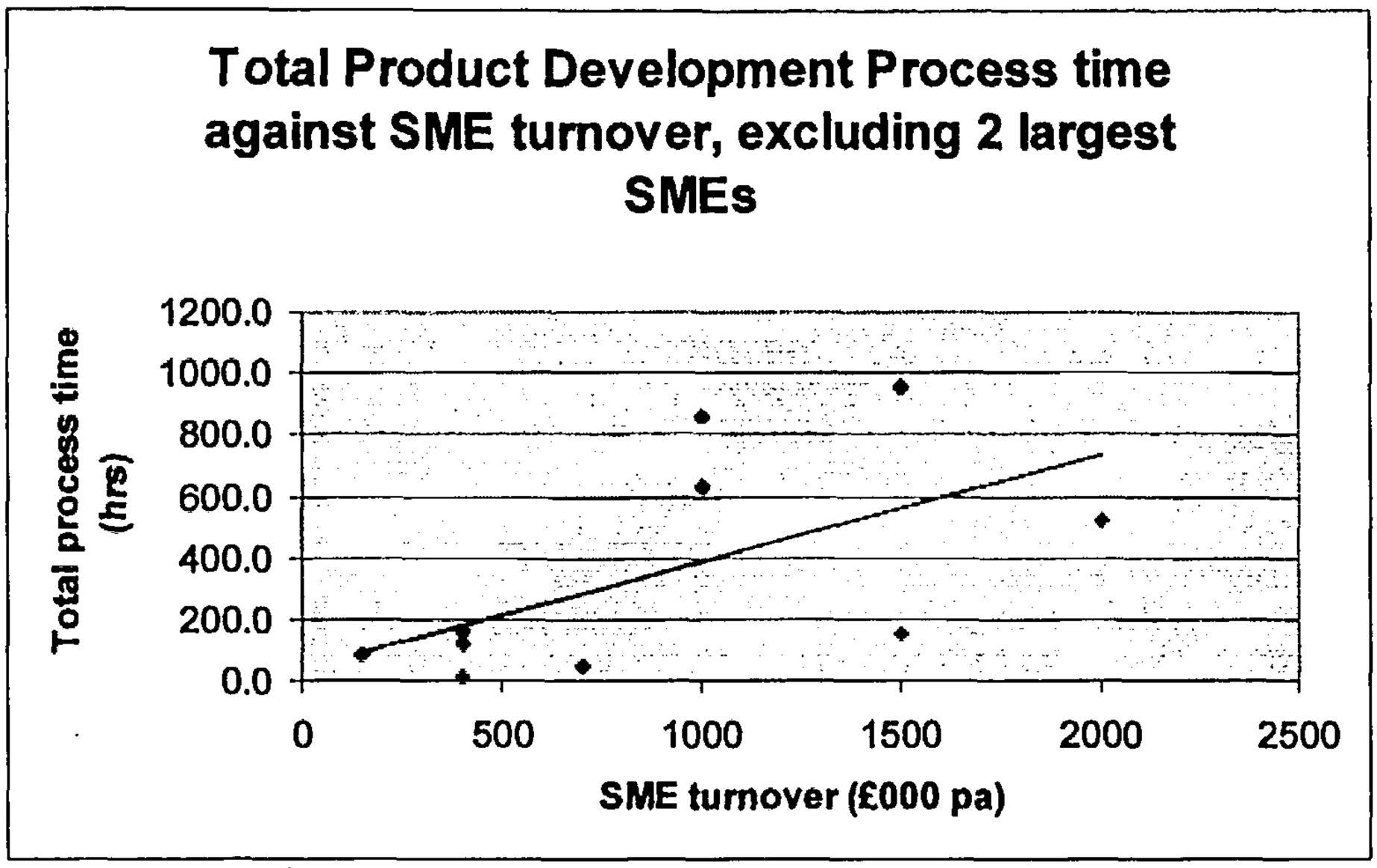


Figure 6-20 Product Development Process total time against SME turnover excluding 2 largest SMEs, Aldridge Plastics and Cooke Bros *Source*: Figure 8-3, Submission 3-2, from AutoLean II interviews

For small SMEs, there appeared to be a relationship between the size of the SME and the total time it took to develop and introduce a product. This appeared to make sense as the micro SMEs were flexible and could do things more quickly whereas with increasing size of company, the company's systems became more structured.

Figure 6-21 shows total Product Development Process time against number of steps.

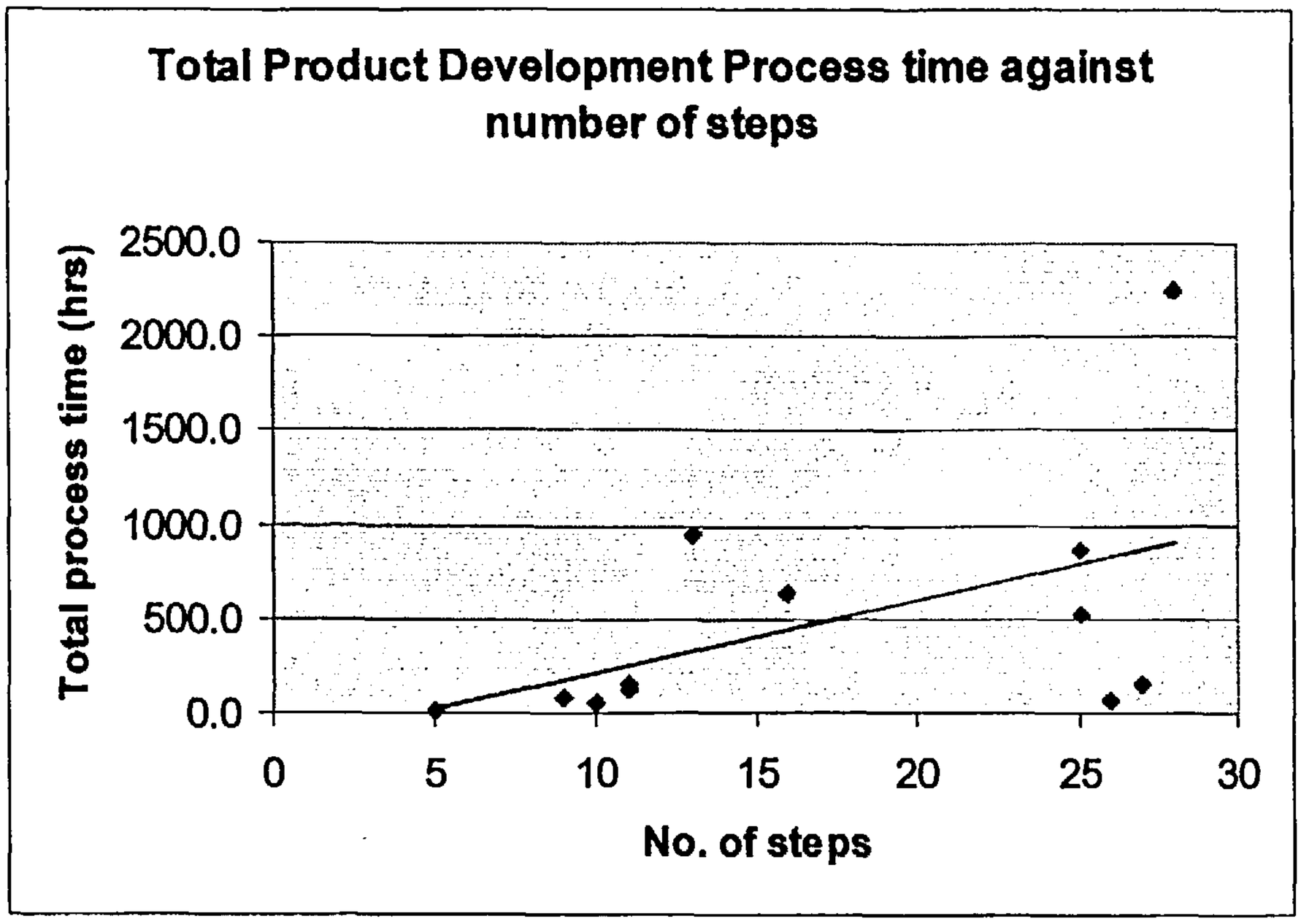


Figure 6-21 Total Product Development Process time against number of steps *Source*: Figure 8-5, Submission 3-2, from AutoLean II interviews

As seen with the Quotation Process, the Product Development Process time increased with the number of steps within the process. In particular in the Product Development Process, a considerable amount of time was expended waiting for replies from customers and also from suppliers, waiting for information.

Figure 6-22 again uses the number of parts–volume matrix looking at the number of steps in the Product Development Process, as similarly used for the Quotation Process in Figure 6-18.

Number of steps and average number of steps within number of parts-volume matrix				
			Total number of parts	
			Low	High
			300	
Volume of parts	Low	<= 250000 pa	Advanced Finishing 13 Chadwick Engineering N/A Cromwell Plastics 21 Halesowen CNC 11 Heron Design 9 Marquin Engineering 10 Springfield Tools 11 *Average 12.5*	RDM 27 Rotech Laboratories N/A *Average 27*
	High		Ash Heat Treatments N/A Brookvale Manufacturing 25 C & H Howe 25 Hayfield Engineering N/A James Hutton Pressings N/A JBI Engineering N/A PJS Mouldings 16 Qualplast 5 *Average 17.8*	A D Hayes N/A Aldridge Plastics 28 Cooke Bros 26 Electroheat Treatments N/A K & S Plating N/A *Average 27*

SMEs without insufficient information to be placed in Figure 5-28, Submission 3-2, have been assigned with author's judgement

Figure 6-22 Number of Product Development Process steps placed on number of parts-volume matrix with average number of steps per quadrant *Source:* Figure 8-10, Submission 3-2, from AutoLean II interviews

The relationship between the average number of steps in the different quadrants is similar here to the relationship between the quadrants in Figure 6-18, except for the high number of part numbers, low volume produced (top right).

In Figure 6-22, the relationship between the average number of steps between quadrants is more pronounced. The low-low SME, upper left hand quadrant would indicate a typically small SME, able to flexibly develop new products. A high-high SME, lower right hand quadrant were larger SMEs with structured systems, possibly introducing ranges of products with higher capital investment. The low number of part numbers but high volume SMEs, lower left hand quadrant, had a perhaps similar flexibility to the

SMEs in the low-low quadrant, but because of the volume to be produced, more time would be needed to ensure lower costs through value engineering. Lastly, the high number of part numbers, but low volume SMEs, upper right hand quadrant were seen to have an average number of steps to that of large SMEs. Probably, the high number of parts numbers meant that there would be a high variety of products, so the number of steps required might be the same for any high number of parts irrespective of the total volume made. Again caution is required as there was only one SME value in this last quadrant.

6.6.4.3 Order to Delivery Process

Chapter 9, Submission 3-2 gave more detailed overview. Figure 6-23 gives the Activity process time as a percentage of total Order to Delivery Process time plotted against a number of steps

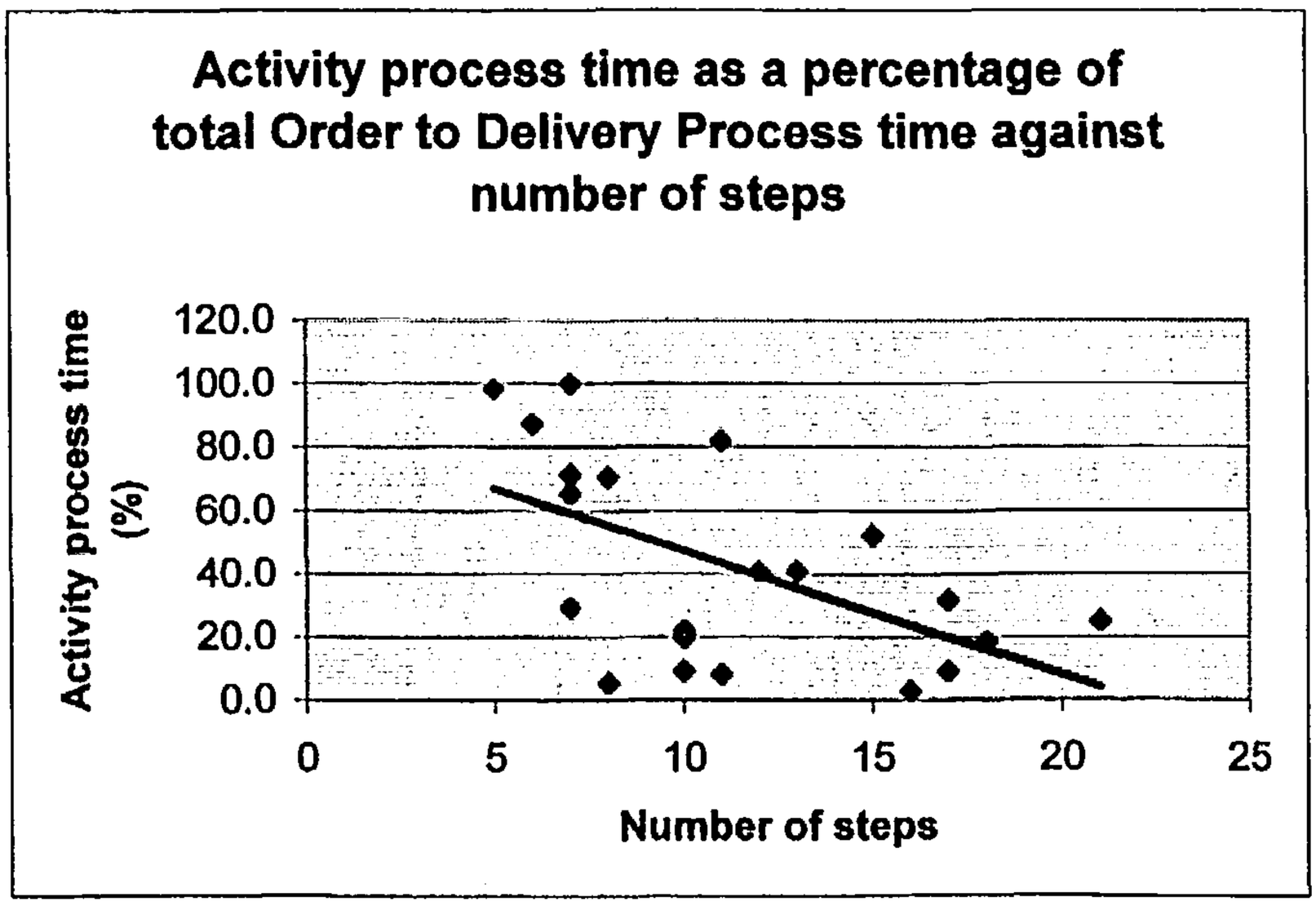


Figure 6-23 Activity process times as a percentage of total Order to Delivery Process time against number of steps *Source*: Figure 9-6, Submission 3-2, from AutoLean II interviews

This Figure shows that the percentage of Activity time fell with an increase in the number of steps. This would indicate that with the greater the number of steps there was an inherent increase in Waste time as information was waiting to be processed. Figure 6-24 shows the Order to Delivery Process steps in the parts-volume matrix.

Number of steps and average number of steps within number of parts-volume matrix				
			Total number of parts	
			Low	High
			300	
Volume of parts	Low	<= 250000 pa	Advanced Finishing 10 Chadwick Engineering 13 Cromwell Plastics 12 Halesowen CNC 6 Heron Design N/A Marquin Engineering 15 Springfield Tools 5 *Average 10.2*	RDM 10 Rotech Laboratories 7 *Average 8.5*
	High		Ash Heat Treatments 10 Brookvale Manufacturing 8 C & H Howe 7 Hayfield Engineering 16 James Hutton Pressings 8 JBI Engineering 17 PJS Mouldings 7 Qualplast 7 *Average 10*	A D Hayes 17 Aldridge Plastics 18 Cooke Bros 11 Electroheat Treatments 11 K & S Plating 21 *Average 15.6*

SMEs without insufficient information to be placed in Figure 5-28, Submission 3-2, have been assigned with author's judgement

Figure 6-24 Number of Order to Delivery Process steps placed on number of parts-volume matrix with average number of steps per quadrant *Source:* Figure 9-10, Submission 3-2, from AutoLean II interviews

Unlike the Quotation and the Product Development Process, the differences between the quadrants was less noticeable, although high-high quadrant was higher on average then the other three quadrants. The lack of variation could possibly be because the Order to Delivery Process was of such importance to all SMEs, that overall, a considerable amount

of effort was expended to ensure product was delivered to customers despite any inefficiencies within the process.

What was seen was that there appeared to be a wider range of business processes in the lower number of part numbers and high volume, lower left hand quadrant. This could possibly be explained as it was these SMEs that were in one of the various stages of maturation and which meant that the development of systems were in different stages of completeness.

Stage	*Top management role*	*Management style*	*Organisation structure*
1: Inception	Direct supervision	Entrepreneurial, individualistic	Unstructured
2: Survival	Supervised supervision	Entrepreneurial, administrative	Simple
3: Growth	Delegation/ co-ordination	Entrepreneurial, co-ordinate	Functional, centralised
4: Expansion	Decentralisation	Professional, administrative	Functional, decentralised
5: Maturity	Decentralisation	Watchdog	Decentralised functional/product

Table 6-12 Management role and style in the five stages of small business growth
Source: Scott and Bruce (1987)

6.6.5 Overall Assessment of SME using SOAT

The SOAT methodology provided a significant amount of information on the SME, both within the questionnaire part of the interview and when mapping the business processes. Through the business processes a detailed understanding of the SME was discovered, both internally and with respect to its interaction with customers and suppliers. An assessment of each business process was made. In addition, the SMEs' strengths, weaknesses and challenges were asked of the interviewee, and these were assessed and added to by the interviewers afterwards. A typical example of the analysis is given in Box 6-1.

Opportunities for Improvement, Summary: Company and Internet

The AutoLean Programme aims to apply communication technologies to supply chain interactions in order to improve the effectiveness and efficiency of both the customer and the supplier. The following perceptions of strengths, weaknesses and challenges provide a context for identifying and assessing opportunities.

Company

Perceived Strengths

- Well established in niche markets,
- Solid production system, good use of planning tools for production,
- Excellent delivery performance,
- Quality,
- Long relationship with Jaguar,
- Own everything.

Perceived Weaknesses

- Low win rate on quotations,
- No CAD,
- Limited vision for new business opportunities,
- Lack of awareness of their competence and not cashing in on it (the Jaguar connection),
- Low turnover per employee (£28.5K),
- Lack of resources to improve product

Perceived Challenges

- Finding partners for bigger jobs,
- Broadening tier 1 relationships,
- Meeting threat from other materials,
- Upgrading technical resources,

- Balance engineering verses business interests,
- Coming to terms with globalisation.

Opportunities Offered by the Internet

Short Term

The introduction of E-mail and Internet conferencing will allow the opportunity for:

- Overall reduction in the cost of customer communications by reducing the need for use of fax, telephone and face-to-face meetings,
- Structured management of customer communications providing a *consistent interface* with the customer,
- Reduction in general time wasting "hassle" related to communications fax running out of paper, illegible fax pages, misplaced or lost fax pages lines engaged voice mail phone tag,
- Customer call off schedules sent via e-mail and entered onto the in-house system without re-keying.

Web site for show-casing capabilities.

Long Term

This vision for long term radical improvement is presented based upon the opportunities and threats faced by the company. These look beyond the life of the AutoLean programme but will radically improve the effectiveness of the business in the long term, providing a vision of where the company could evolve.

- *Electronic Commerce* The growth of electronic commerce using the Internet will permeate through industry giving new opportunities to develop new and improved relationships with customer staff facilitated by the Internet.
- *ANX/ENX.* ANX, Automotive Network Exchange is a global communications system designed specifically for the automotive industry using Internet technology. Development was spearheaded by the North American Big 3 Vehicle Makers and several big name tier 1 suppliers. ENX, European Network Exchange, the European equivalent of ANX spearheaded by BMW is intended to support the European automotive community with the same approach. Both are very similar and together they will provide a safe, reliable and low cost way for automotive trading partners (at all levels in the supply chain) to communicate on a global basis using low cost Internet technology. A whole new grouping of trading relationships and virtual commercial groupings is most likely to emerge with a high degree of integration between trading partners. Both systems can be expected to make their appearance in the UK within the next 12 months. Brookvale Group Ltd should be alert to the opportunities they will provide for expanding business into new automotive markets. BMWs lead in pushing for the development of ENX should be noted with its implications for Rover and its supply chains.

Box 6-1 Typical overall analysis of an AutoLean II SME, Brookvale Manufacturing
Source: AutoLean II interview

All this was put into a report which was sent to the SME, and the SME had the opportunity to comment on what had been written. These comments and feedback are given in Chapter 8.

7 SOAT: Innovation within a known research background: Research Methodology

7.1 Introduction

This section reviews some of the underlying research methodologies on which SOAT was based and Chapter 3.1, Submission 3-2 listed a number of reasons for doing so:

There was a need to demonstrate that the research from which SOAT was generated could be characterised within a recognised and understood research methodology or philosophy. A mainly phenomenological approach was followed, and this was seen in the use of mainly qualitative, empirically based research. SOAT could be seen to have had credibility in that it could be identified in a number of strands within phenomenological research, and these were Action Research, case studies and Grounded Theory.

In Grounded Theory, SOAT should be able to be used and judged on its own merits for it to be considered " formal" theory, (Glaser and Strauss, 1967). In other words, that SOAT should be able to be "cut off" from its AutoLean roots and be able to be used in other applications. Three non-automotive companies, where SOAT was successfully applied, were described in Submission 3-3 and Chapter 8 below. Thus, SOAT could be said to have been applied "free standing", divorced from its automotive, AutoLean roots, and thus be said to be formal theory.

As SOAT was an interpretative, qualitative tool, the validity and reliability of SOAT and its output was discussed and was found to be valid and reliable.

7.2 Phenomenological Methodological Requirements

Hussey and Hussey (1997) in their review of business research requirements highlighted a number of requirements needed within a methodological approach. These included data integrity, reliability, validity and the need to triangulate the data. These were justified in Section 3.2, Submission 3-3.

Gummesson, (1991) and Normann, (1970) specified phenomenological research needed to have a generalised "ability" where research and understanding from one setting might be transferable to other settings. This again could be justified in the application of SOAT to other SMEs from supply chains other than automotive, and for the primary purpose of SME assessment rather than for the purposes of the programme from which SOAT arose, internet access. The application of SOAT was described in Submission 3-3.

7.3 Action Research

Gummesson (1991) listed characteristics of what he calls Action Science, another name for Action Research. He specified seven characteristics of Action Science and these were discussed and justified in Section 3.3, Submission 3-2. Action Science should always involve two goals. First, it should solve a problem for the client and secondly it should contribute to understanding. Therefore, SOAT is argued to have fulfilled the requirements of Action Science.

7.4 Case Studies

The AutoLean II interviews formed a series of case studies. Case studies were to be used for a number of purposes and Section 3.4, Submission 3-2 discussed how the AutoLean programme and SOAT fulfilled such purposes. Briefly, Hussey and Hussey (1997) stated

that one of the purposes of case studies was for exploratory research, and that this was the case with the AutoLean II programme. Scapens (1990) described other types of purpose of case study: descriptive, illustrative, experimental, and explanatory. The AutoLean II interviews fulfilled all of the categories.

Yin (1994) identified further characteristics of case studies, which were also argued as being satisfied in AutoLean II interviews, and these were also discussed at length in Section 3.4, Submission 3-2. For example, Yin stated that case study research should not only explore certain phenomena, but also to explain them in the situation in which they arose. It could be said that the phenomena were the business processes, but by their very nature in that each business process was individual to the particular SME, and the way of gathering data using individuals within the SME, meant that both the phenomena, the business processes, and the situation into which these were placed was addressed.

7.5 Grounded Theory

Section 3.5, Submission 3-2 discussed SOAT and how it arose using Grounded Theory put forward by Glaser and Strauss (1967). Essentially, they suggested that theory should emerge from actual, practical and realistic situations. These were seen in that SOAT came from the AutoLean programme which was to do with internet access and business processes. It then came through AutoLean II, which provided a wider understanding of SMEs as well as using the internet, and so to use SOAT as a free standing methodology free from its original roots. Included within the characteristics of Grounded Theory was first, a need for establishing structural boundaries and these have been found to have been satisfied, Submission 3-3, and also that the theory should have emerged from the research. Structural boundaries have been developed for SOAT and are in Chapter 8, Submission 3-2, showing that SOAT came out of the AutoLean research programme.

7.6 Qualitative Research

Section 3.6, Submission 3-2 discussed the issue of qualitative research to the AutoLean programme data and SOAT. Section 3.6, Submission 3-2 justified the AutoLean II research and SOAT in terms of qualitative research, for example by looking at Bryman and Burgess' (1994) characteristics which distinguished qualitative research from quantitative research. First, that there should be no standard approach to the analysis of qualitative data. Secondly, that data analysis related not only to technical procedures but also to the social relations' aspects of gathering the data. Thirdly, the qualitative research required as much implicit as explicit behaviour and understanding in data gathering. All these things were seen to be so within AutoLean II and SOAT, and so SOAT could be said to fall within the main characteristics of qualitative research.

7.7 Validity and Reliability

Chapter 4, Submission 3-3 discussed the validity and reliability of qualitative data (Kirk and Miller, 1986) in relationship to SOAT. For example, SOAT was seen to have had *apparent validity* in that the procedures to gather data, there was evidence that the theoretical paradigms used, the business processes, correctly corresponded to observation, (Kirk and Miller on Cronbach and Meehl, 1995). This could be seen from Chapter 6, Submission 3-3 which demonstrated that the SMEs considered the business process mapping of their own companies were substantially accurate, and also that the general understanding of the SME by the interviewers were appropriate and accurate. This was the case for both the AutoLean II SMEs, and in the Application SMEs.

Kirk and Miller also stated that for a theory to be valid, the results of the new methodology could be replaced by using an alternative procedure that was itself accepted as valid. This they termed *instrumental validity.* In Chapter 4, Submission 3-3, the author suggested that such a definition provided some difficulty for SOAT, as the methodology of mapping processes was a base methodology for many other tools. In this case, SOAT

could not be said to have instrumental validity. Nevertheless, this base process methodology had been shown to be useful and effective by others.

However, because the concept of business processes has been shown to be accepted in the literature, that business processes have been used successfully in a number of different business methodologies, for example, by Gregory and Rawling, (1997) and Hines *et al.*, (2000), then SOAT can be said to have *theoretical validity.*

8 SOAT: Innovation through application

8.1 Introduction

The AutoLean programme was aimed at assisting SMEs with internet access. In the AutoLean II programme the tools to assist with business analysis to aid internet usage were expanded to provide a fuller assessment of the SMEs. This tool was called the SME (Operations) Assessment Tool, SOAT, and this was seen as the Innovation as required by the Engineering Doctorate. SOAT was then taken and used for the primary purpose of assessing the SME. This was seen as fulfilling the Application part of the Engineering Doctorate. In addition, none of the three SMEs so assessed were in the automotive supply chain for the supply of components. One was a supplier of specialist paints into the construction sector, the second was a supplier of Ultra-Violet based insect traps, and the third supplied specialist chemicals for mould and model making.

SOAT was seen to be useful not only to the SME, but also to organisations which supported SMEs, so called SME Service Providers, and two different service providers made use of SOAT.

This chapter demonstrates the successful application of innovation, discussed at length in Submission 3-3, the innovation being SME (Operations) Assessment Tool, SOAT, for assessing the SMEs. Submission 3-1 described the AutoLean project, whilst Submission 3-2 reviewed the data from the AutoLean II interviews and justifies the innovative nature of SOAT.

SOAT was a two stage tool for assessing SMEs. First, there is a semi-structured questionnaire and secondly, the requirement to map the core business processes of

Quotation, Product Development, and Order to Delivery in terms of process flow and time spent. SOAT was carried out by an external third party to the SME, with the Managing Director or owner of the business as the most important interviewee to be present. SOAT took half a day interview on the SME's site, with a report being written afterwards and then sent to the SME.

Application of SOAT was demonstrated in a number of ways.

It is shown, through the use of three questions asked. These assessed whether the SOAT analysis was seen by the SME interviewed to be accurate. Next they assessed whether there were significant outputs from the SOAT analysis of further or other issues raised, and whether actions were in place, or to be put in place. In general, the SOAT analysis was seen to be accurate and that it had generated further issues, some of which were being taken forward.

Application was also shown through the SOAT assessment of three SMEs in different technology types supplying into non-automotive supply chains. Two of these SMEs were obtained through providers of services and support for SMEs, and the SOAT assessment was shown to be beneficial for both the SME assessed and for the SME Service Provider.

The Autolean II SMEs interviewed were retrospectively checked via a telephone interview to assess whether the SOAT assessment had been seen to be more widely applicable in the SME, and what decisions had resulted from the SOAT assessment. It was found that the SOAT assessment had, in general, been seen to provide a wider and fuller understanding of the business, which was then to be taken forward.

The AutoLean II SMEs and Application SMEs were compared, so as to discuss the suitability of SOAT, revealing limitations to appropriate usage of SOAT. Other gaps in

SOAT were described. Characteristics which could be investigated in the SMEs before SOAT may be applied were listed.

The SOAT tool was seen to be an effective assessment tool of SMEs for a wide variation SME types, sizes and markets. Third party SME service providers were also seen to benefit from using SOAT. Areas for improvement in SOAT were identified together with characteristics of an SME, which would provide for clearer SOAT application.

Overall, SOAT was shown to have been applied successfully.

8.2 Fit into Engineering Doctorate

Submission 3-3, reviewed here fitted into the Engineering Doctorate in a number of ways.

- The main fit was that this chapter reviewed the demonstration of successful application of the SOAT (SME (Operations) Assessment Tool) as discussed in Submission 3-3, following on from a demonstration of its innovativeness in Submission 3-2.
- In the author's literature review within Lean paradigms, Submission 1, one of the gaps in the body of knowledge identified for address by the author was that there was a need to understand how Lean paradigms could be "managed into supply chain culture", (Point 4, p. 118, Section 8.4, Submission 1). The SOAT tool did so by managing business processes across Customer–SME-Supplier. By first focusing on and addressing internal business process issues and mapping, the SME would be able to address customer and supplier issues. This was clearly seen in the case of Brandenburg (UK), where as a result of mapping the Order to Delivery process and times, there was a discernible relationship between slack in the internal manufacturing processes and the time suppliers delivered in. Brandenburg (UK) acknowledged that it was a priority to address supplier delivery times in order to increase the service to customers by reducing manufacturing times.

8.3 Structure of Chapter

Submission 3-3 provided a "package" whereby SOAT may be considered to have been applied successfully.

Section 8.4 summarises Chapter 3, Submission 3-3, which described and justified the three questions developed for judging the success of the SOAT tool. These questions formed the basis for feedback discussions with both the AutoLean II SMEs and also the three SMEs where SOAT was applied primarily as an assessment tool, called here "Application SMEs".

Section 8.5 summarises Chapter 5, Submission 3-3, which analysed the data gathered within the interviews from the Application SMEs and the Autolean II SMEs to compare these two groups of SMEs, and to compare characteristics within the Application SMEs. This was to provide an overall assessment of the Application SMEs with regard to the known AutoLean II SMEs, and also to show how SOAT was able to identify individual characteristics of each SME assessed.

Section 8.6 summarised Chapter 6, Submission 3-3, which analysed the feedback from the individual Application SMEs and from the AutoLean II SMEs, using the three questions outlined here in Section 8.4.

Section 8.7 introduces Chapter 7, Submission 3-3, which introduced those involved from providers of services to SMEs, called SME Service Providers, in the application of SOAT within the Application SMEs. This feedback included benefits for SME Service Providers and for the SMEs being analysed using SOAT.

Section 8.8 summarises the SME's characteristics suitable for effective usage, and SOAT's areas for improvement.

8.4 Assessment of the SOAT Tool

In assessing the SOAT tool, three questions were asked which would demonstrate the success of its application, by examining the "outputs" from the analysis of the SME.

Question 1 asked whether the business processes had been accurately mapped. As SOAT depended on an accurate mapping of these business processes, then not to have mapped them accurately would have been seen as a major weakness with SOAT.

Question 2 asked whether the SOAT analysis had revealed any further issues. Any assessment should be able to move the SME on, and if SOAT was not able to reveal anything of substance worth further consideration, then its usefulness at an assessment tool could be called into question.

Question 3 asked whether any of these further issues, or other issues raised as a consequence of SOAT were to be acted upon. This was perhaps the key test in any consultation. If there was to be no change within the SME, then again the value of SOAT could be called into question.

The main person providing feedback on these questions was the most senior person interviewed within the SME, both within the Application SMEs and within the AutoLean II SMEs. In addition, comments from SME Service Providers were included in the discussions of SOAT, Chapter 7, Submission 3-3.

These questions were discussed in Chapter 3, Submission 3-3, and are repeated here.

8.4.1 Question 1: Accuracy of Business Process Mapping

Question 1 examined whether the SME believed that the processes within the company were accurately mapped.

"Did the business processes analysis accurately reflect what happened in the business?"

This question was asked for three reasons.

First, given SOAT was based around an analysis of these business processes, it was important that they should be accurately mapped.

Secondly, by being accurately mapped it was possible to assert that together with the questionnaire, a fuller understanding of the SME was possible. Without the business processes being accurately drawn, the validity of the SOAT analysis might well have been lost. In addition, if SOAT was to be variable in its accuracy, then the reliability of SOAT would also have been questioned.

Thirdly, by mapping the business processes accurately, it was possible to assert that the findings from Autolean I (Chapman, undated) were also valid for Autolean II, as the business process mapping methodology was identical. This meant that there was continuity of this part of SOAT, irrespective of who did the SOAT analysis.

Result: in the feedback from both from the Application SMEs and from the Autolean II SMEs, it was seen that the business processes had been were accurately mapped, Section 8.6.

8.4.2 Question 2: Generation of further/other issues

Question 2 sought to discover any result or output from the SOAT analysis, and this was done through asking whether further or alternative issues had been raised as a consequence of the SOAT analysis.

"Did the interview and /or report reveal any further issues, not directly related to business process flows?"

The reason for asking for output from the SOAT analysis was for the following reasons:

First, if the SOAT analysis had not found any further issues of substance to the SME, then the value of SOAT might then be debatable, however accurate the mapping of the business processes. *Result:* in feedback from both the Application SMEs and the AutoLean II SMEs, issues were raised, and the report in many of the SMEs had been considered at some length.

Secondly, the SOAT analysis was claimed to provide a fuller understanding and assessment of the SME. It would be unlikely that areas of concern or major issues would have been revealed unless the analysis was in sufficient breadth and depth for the SME to take such issues seriously. *Result:* the fact that SMEs used SOAT to take issues raised forward with some urgency, provided a confirmation that the SOAT analysis had been sufficiently broad in scope but detailed enough, to reveal such issues.

For example, part of the output from the SOAT analysis was an analysis of the SME's current strengths and weaknesses, and the SME's future challenges. In the report provided to the SME, drawn up after the visit, there was an interviewer's summary of the SME as a whole. One SME, Rotech Laboratories, was to use this summary as a basis for developing the coming year's business plan.

8.4.3 Question 3: Actions in response to the SOAT analysis

Question 3 examined whether there has been any change in the SME as a result of the SOAT analysis.

"Were issues from the SOAT assessment recognised that they should be acted upon, were intended to be acted upon or had been acted upon? These issues could be related to business processes from, or further issues, either raised in the interview and/or report, or as a consequence of the SOAT analysis".

This question was asked for the following reasons:

If nothing was done following the SOAT analysis then it would be argued that the exercise provided no or little value for the SME. *Result: h*owever, this was not the case, both for the Application SMEs and for the majority of the Autolean II SMEs. This showed that the output from the SOAT analysis could be visibly seen.

Actions in response to the SOAT analysis could have suggested whether there had been changes within the SME. Any changes as a result of SOAT could have been trivial. *Result:* some of the issues raised were not trivial. For example, in two of the Application SMEs, Alchemie and Brandenburg (UK), there was a commitment to look to employing an extra person to manage the Product Introduction Process. Also at Brandenburg (UK), the company had used the business mapping technique to map another process within the business.

8.5 Analysis of non-AutoLean SMEs where SOAT was applied compared to AutoLean II SMEs

8.5.1 Introduction

Chapter 5, Submission 3-3 compared the data gathered from the non-AutoLean II SMEs where SOAT was applied primarily as an assessment tool, against the data gathered during the interviews with the AutoLean II SMEs. The aim of this analysis was to compare the Application SMEs with the AutoLean II SMEs. If the Application SMEs were similar to the AutoLean II SMEs, and SOAT was seen to be successfully applied, then it could be said that SOAT had Synchronic Reliability, Section 4.2, Submission 3-3. This would mean that the Apparent and Theoretical Validity demonstrated with the AutoLean II SMEs would also be present with SOAT used in the Application SMEs.

There were three Application SMEs: Alchemie, a manufacturer of specialist chemicals and resins for the mould making industry; Brandenburg (UK), a manufacturer of insect control equipment "fly catchers" using ultraviolet for the food hygiene industry; and Carboline Europe, a supplier of specialist paints to the construction sector. The reports written and given to these three SMEs were in Appendices A, B and C respectively, Submission 3-3. Alchemie and Brandenburg (UK) had been recommended through SME Service Providers, whilst Carboline Europe came through a contact in WMG. The report for Brandenburg (UK) is placed in Appendix C.

In general, the Application SMEs were similar to the AutoLean II SMEs in that they transformed physical product, though they were somewhat larger in turnover than the average sized AutoLean II SME. One of the Application SMEs, Carboline Europe was double the size in turnover than the largest AutoLean II SME, and the benefits of SOAT were seen to be less immediate, partly as Carboline Europe had more of a large company

"feel". This assisted in placing an upper limit on the size of company where SOAT might be useful.

In other ways, as a whole, the SMEs were different from each other. Chapter 5, Submission 3-2 analysed the data provided by the AutoLean II SMEs to find ways for grouping the SMEs. Although for some characteristics, it could be seen that some of the SMEs fell into groups, there was no consistency of the SME grouping over different characteristics. Certain key characteristics suggested themselves and these were SME turnover, SME turnover per employee, and a new matrix developed by the author matching the number of part numbers to the total volume of parts produced per annum.

Despite this difficulty in grouping SMEs for assessing the business, SOAT was successfully applied to both the AutoLean II SMEs and to the Application SMEs.

This section below summarised the data gathered in the interviews, both with AutoLean II and with the Application SMEs. Chapter 6, Submission 3-3 reviewed the feedback from both the AutoLean II SMEs and the Application SMEs, and is summarised in Section 8.6 below.

Chapter 6, Submission 3-3 showed, and summarised here in Section 8.6 shows, that SOAT was successfully applied.

8.5.2 Ownership

The range of ownership of the Application SMEs was similar to AutoLean II, Table 8-1. For the smaller SME, Alchemie, the ownership was family, whilst for the larger two SMEs, others had an equity stake. However, the Application SMEs were seen to have

more external influence in the shape of external equity holders. However, this influence was differently exercised. For Brandenburg (UK) it was a monitoring role as the directors were left to get on with running the business, whereas with Carboline Europe, it was seen to be more constraining, as Carboline Europe was being absorbed into a larger parent company.

SME	*Ownership*
Alchemie	Family
Brandenburg (UK)	Directors + investment
Carboline Europe	Subsidiary
AutoLean II	Mostly private or family

Table 8-1 Ownership of SMEs *Source:* Table 5-1, Submission 3-3, Application SME interviews and Section 5.1.4, Submission 3-2 for AutoLean II SMEs

8.5.3 Basic product line or service

It can be seen from Table 8-2 that the technology areas and the market addressed by the Application SMEs were very different to AutoLean II SMEs. This was one way through which application could be assessed, as SOAT was developed using mostly automotive supply chain SMEs, whilst the Application SMEs were not automotive supply chain SMEs, except for Alchemie which had a small presence in the new product development activity into automotive assemblers.

SME	*Type of technology and market*
Alchemie	Mould making chemical components, for rapid prototyping
Brandenburg (UK)	Manufacture and assembly, into food hygiene sector
Carboline Europe	Specialist paints into construction
AutoLean II	Metal turning, stamping and finishing Plastic injection moulding, other moulding and finishing Electrical assembly Toolmaker Design

Table 8-2 SME technology type and market of Application SMEs and AutoLean II SMEs *Source:* Table 5-2, Submission 3-3, Application SME interviews and Section 5.1.5, Submission 3-2 for AutoLean II SMEs

8.5.4 Number of employees

In terms of employees, Carboline Europe was of a similar size to Cooke Bros, the largest AutoLean II SME, Brandenburg (UK) would be at the top end of the majority of SMEs in AutoLean II, whilst Alchemie might be termed a typical SME in terms of numbers of employees, Table 8-3.

SME	*No. of employees*
Alchemie	22
Brandenburg (UK)	50
Carboline Europe	100
AutoLean II range	6 to 140
AutoLean II average	32.0
AutoLean II median	21

Table 8-3 Number of employees *Source*: Table 5-3, Submission 3-3, taken from Application SME interviews and Section 5.1.6, Submission 3-2 for AutoLean II SMEs

8.5.5 Marketing overview

The three Application SMEs could be seen to have very different attitudes and understandings of their market, Table 8-4. Brandenburg (UK) had an excellent understanding of the market which drove the rest of the business, whilst Carboline Europe's understanding of its market was confused, as the decision makers in the market had changed but Carboline Europe's market address had not. Alchemie's position was somewhere in between these two extremes in that it understood its market, but the nature of the business itself was changing. Alchemie had been a market follower, which meant that it had been just a sales and technology organisation, but as it had then developed a full range of products in its core market, it was in the process of searching for a new approach. This new marketing approach was one of the areas of discussion within the interview.

Generally, most of the AutoLean II SMEs had a clear understanding of who they were. This could be because they were generally smaller and were owner managed, so they had to be clearer in their market address. Alternatively, it could be that supplying that automotive sector made the market address clear.

What was interesting to note was that the same SOAT tool was used to bring out very different situations in very different markets using very different technology types.

Characteristic	*Alchemie*	*Brandenburg (UK)*	*Carboline Europe*
Current focus	Technology and sales focused	Marketing focused: drives policy	Product and sales focuses
Relationships	Maintains good relationships	Good relationships with 2 major customers	Poor relationships with largest customer
Processes	Excellent Order to Delivery Process, poorly structured Product Development Process	Supported by satisfactory business processes	Business process excellent, but drives the business
Future thinking	Sales expansion and product line expansion	Market focus leads to the desire to develop a range of innovative products	Technical focus leads towards
SOAT analysis	Product Manager required to structure and manager product introduction process	Product Manager required to structure and manager product introduction process Suppliers to reduce delivery times	Market focus required Build relationships with identifies customers

Table 8-4 Marketing overview *Source:* Table 5-4, Submission 3-3, taken from Application SME interviews

8.5.6 SME Turnover

All the three Application SMEs were seen to be larger than the average AutoLean II SME, Table 8-5. Alchemie would be considered a larger than average AutoLean II SME, Brandenburg (UK) similar in size to both Aldridge Plastics and Cooke Bros, whilst Carboline Europe was more than twice the size of any SME in AutoLean II.

SME	*SME Turnover £K pa*
Alchemie	2500
Brandenburg (UK)	6750
Carboline Europe	12000
AutoLean II range	400 to 6500
AutoLean II average	1500

Table 8-5 SME Turnover per annum *Source:* Table 5-6, Submission 3-3, taken from Application SMEs interviews and Section 5.3.1, Submission 3-2 for AutoLean II SMEs

8.5.7 Turnover per employee

Table 8-6 indicates that the Application SMEs were sound businesses financially. The Application SMEs were all considerably above some of the turnover per employee figures seen with the AutoLean II SMEs. The benefit though of the SOAT analysis was that it could see through any apparent financial strength to reveal underlying issues, and this was certainly the case with Carboline Europe with its market address as discussed in Section 6.2, Submission 3-3. It could also be seen through the apparent contradiction in Carboline Europe's case, that it had excellent delivery systems, but they were designed for a market address which was fading quickly. On the other hand, the lack of financial analysis was also seen as a potential weakness for the SOAT analysis, Section 6.3.2, Submission 3-3, and discussed in Section 8.11 below.

Neither did these turnover per employee figures fit on the line given in Figure 5-8, Submission 3-2, indicating that the graph fitted there may only be applicable for automotive SMEs, or some other characteristic.

SME	*1999 Turnover per employee (£,K pa)*	*2000 Turnover (budgeted) per employee (£,K pa)*
Alchemie	90	114
Brandenburg (UK)	96	135
Carboline Europe	100	120
AutoLean II range	20 to 111	N/A
AutoLean II average	44.7	N/A

Table 8-6 Turnover per employee per annum *Source:* Table 5-7, Submission 3-3, taken from Application SMEs interviews and Section 5.3.1, Submission 3-2 for AutoLean II SMEs

8.5.8 SME Automotive business as percentage of turnover

Table 8-7 summarises the difference in market address of the Application SMEs to AutoLean II SMEs. It could be seen that Brandenburg (UK) and Carboline Europe's business was not automotive, whereas Alchemie's automotive business was small. Discussions with Alchemie revealed that the automotive business was for model making, an area not addressed by any of the AutoLean II SMEs. Thus, SOAT was applied successful in markets and supply chains that were different to the markets and supply chains where SOAT had been originally developed.

SME	*SME's automotive business*
Alchemie	Small (not disclosed)
Brandenburg (UK)	NIL
Carboline Europe	NIL
AutoLean II range	7% to 100%
AutoLean II average	50.9%
AutoLean II median	65%

Table 8-7 Application SME's automotive business as proportion of turnover *Source:* Table 5-9, Submission 3-3, taken from Application SME interviews and Section 5.3.6, Submission 3-2 for AutoLean II SMEs

8.5.9 Percentage of business outside the UK

The Application SMEs were very different in their approach to overseas business, and the reasons for the difference were not clear, Table 8-8. It could be that the automotive supply chain within which the AutoLean II SMEs were placed was a global market with many suppliers in different markets, whereas the Application SMEs had niche products, even where there were larger competitors as in the case of Alchemie. Alternatively, for the AutoLean II SMEs, it could be that the culture in the West Midlands automotive supply chain had been one of complacency, as the length of relationships with often a single customer, (almost always Rover) lead to an inward looking, risk averse

management culture. The issue of relationships was discussed in Section 5.3.5.3, Submission 3-2.

SME	*Current overseas business*	*Future overseas business*
Alchemie	10-15%	Increase substantially
Brandenburg (UK)	50%	Increase substantially
Carboline Europe	£3M	Remain same
AutoLean II range	NIL to 5%	NIL to 5%

Table 8-8 Application SME overseas business *Sources:* Table 5-10, Submission 3-3, taken from Application SMEs interviews and Section 5.3.8, Submission 3-2 for AutoLean II SMEs

8.5.10 Numbers of customers

Alchemie had considerably more customers than any of the AutoLean II SMEs, and this number of customers probably gave the company its unfocused feel in terms of market address, Table 8-9. Brandenburg (UK), on the other hand, was building on a clear understanding of customer requirements because it was located close to its three main customers. Carboline Europe's issue was not the number of customers, but who these customers were.

SME	*No. of customers*	*No. of regular customers*
Alchemie	1500	800-1000
Brandenburg (UK)	3	3
Carboline Europe	100	6
AutoLean II range	1 to 1000	1 to 300
AutoLean II average	148.5	52.2
AutoLean II median	50.0	32.5

Table 8-9 Number of customers and regular customers *Source:* Table 5-11, Submission 3-3, drawn up from Application SMEs interviews and Section 5.3.9, Submission 3-2 for AutoLean II SMEs

8.5.11 Number of quotations

Both Alchemie and Carboline Europe had a quotations based culture, Table 8-10. For Alchemie, this could be seen in their history of using quotations as a means of obtaining business as a market follower. For Carboline Europe it was a physical representation of their arm's length relationship with their customers. By contrast, Brandenburg had a very close relationship with their few customers, working together to develop new products and to reduce the cost of existing products. By contrast, the AutoLean II SMEs displayed a wide range of numbers of quotations received, with a wide range of percentage won. This was a significant area of difference between the Application SMEs and the AutoLean II SMEs.

SME	*No. of quotations pcm*	*% quotations won*	*% major jobs*	*Turnover (£K, pa)*
Alchemie	300	25	N/A	2500
Brandenburg (UK)	N/A	N/A	N/A	6750
Carboline Europe	50+ *per day*	40	2	12000
AutoLean II range	1 to 166	3 to 89	0 to 100	150 to 6500
AutoLean II average	32.7	31.2	21.6	1500
AutoLean II median	20	22.5	10	

Table 8-10 Number of quotations done pcm and percentage won *Source:* Table 5-13, Submission 3-3, taken from Application SMEs and Section 5.4.1, Submission 3-2 for AutoLean II SMEs

8.5.12 Number of product introductions

All three Application SMEs had a culture of developing new solutions to customers' needs, Table 8-11. For Alchemie and Brandenburg (UK) it was the development of new products, for Carboline Europe it was the testing and recommendation of existing products for new applications on site. The issue raised for both Alchemie and for Brandenburg (UK) was the lack of structure within the product introduction process.

The Application SMEs were similar to the AutoLean II SMEs in their range of numbers of products introduced. However, they were different from a number of the AutoLean II SMEs in that these AutoLean II SMEs did not recognise the need to introduce new products.

SME	*No. of Product Introductions (pa)*	*Product Introduction Process?*
Alchemie	10-12 now 20-30 in future	Y
Brandenburg (UK)	2	Y
Carboline Europe	1	Y
AutoLean II range	0 to 150	
AutoLean II average	22.5	
AutoLean II median	2.5	

Table 8-11 Number of product introduction *Source:* Table 5-14, Submission 3-3, taken from Application SME interviews and Section 5-5, Submission 3-2 for AutoLean II SMEs

8.5.13 Order to Delivery Process

All three Application SMEs were generally low volume producers of specialist products, but their ability to delivery was very different, Table 8-12. Both Alchemie and Carboline Europe had made their name and reputation on high customer service, part of which was delivery from stock, though both ironically had to generate stock information internally as they did not receive any other information from customers. Both these SMEs stated that their competitors made to order, so delivery times were poor from their competitors.

On the other hand Brandenburg (UK) dealt with a few customers and with a considerable amount of order information. This was one reason why, possibly, the Order to Delivery Process in Brandenburg (UK) had a culture of six to eight week delivery, rather than matching the delivery times to the process times. The result of the analysis was that Brandenburg would seek to work with suppliers to reduce their delivery time, as delivery

times from suppliers was the largest part of their Waste time within the Order to Delivery Process.

One of the significant differences among the AutoLean II SMEs was the wide variations in the way orders were structured. Some of the AutoLean II SMEs worked only from schedules, whilst others worked more on a day to day basis. However, what distinguished the AutoLean II SMEs from both Alchemie and Carboline Europe, was that both Alchemie and Carboline Europe had no visibility of forward orders, despite being companies that were quotations based. This was an indication of the lack of collaboration that these companies had with they customers, perhaps reflecting the culture within the particular supply chain.

SME	*No. of parts' types*	*% runners*	*% strangers*	*Volume of parts*	*Delivery*
Alchemie	50	50	50	330 tonnes	Next day from stock
Brandenburg (UK)	20	50	50	40000	To customer forecast and schedule
Carboline Europe	21	28	72	12000	Next day from stock
AutoLean II range	20 to thousands	0 to 100	0 to 100	40000 to millions	
AutoLean II average	381				
AutoLean II median	200				

Table 8-12 Order to Delivery Characteristics *Source:* Table 5-15, Submission 3-3, Application SMEs and Section 5.6, Submission 3-2 for AutoLean II SMEs

Submission 3-2 introduced a matrix of numbers of parts sold to total volume of parts delivered, and Figure 8-1 places the three Application SMEs into the matrix. Both Alchemie and Brandenburg (UK) could be placed in the low-low quadrant, so could be seen to be typical SMEs.

Carboline Europe was more difficult to place. The total quantity of product sold was low, so should possibly be placed in position A. However, the actual number of pieces Carboline Europe supplied out of the warehouse was likely to be high, as the business' core market was in small volumes, so should be in position B. The author cannot be sure of this position as these volumes were not recorded in the interview. In position B, SMEs were often very profitable, but they started to impinge on the competency of large businesses, so were therefore vulnerable. This was what happened at Carboline Europe. The original owner built up the business until it could not be ignored by large companies, and had been bought out two years previously.

			Total number of parts	
			Low	High
			300	
Volume of parts	Low	<= 250000 pa	Alchemie Brandenburg Carboline Europe? - position A	
	High		Carboline Europe? - position B	

Figure 8-1 Matrix of total number of parts with volume of parts pa *Source*: Figure 5-1, Submission 3-3, taken from Application SME interviews and Section 5.6.1, Submission 3-2

8.5.14 Summary

This comparison of the Application SMEs with the AutoLean II SMEs with this range of selected characteristics shows that, although the three companies were somewhat larger than the AutoLean II SMEs, the characteristics were often related to the increased size of company. In some respects, the Application SMEs were like the AutoLean II SMEs, in that both tended to have simple organisational structures with the ability to change and adapt quickly, and to be open to change. Carboline Europe was seen to be most like a large company, with its parent company, and the difficulty it had in changing from one

market address to a newly developed one. Nevertheless, the SOAT methodology was still used successfully with all the Application SMEs, providing insights to the company. All the Application SMEs were happy to spend the time and provide the information, as significant issues came out of the interview itself. Feedback from the interviews and the report sent now follows.

8.6 Assessment of SOAT in non-AutoLean SMEs and in Autolean SMEs through telephone feedback

Sometime after the interviews, and after a report had been sent to the SME, the interviewees were contacted, and an assessment made on the accuracy and appropriateness of the interview and report. Feedback from the SMEs was based around the three questions outlined in Section 8.4 above.

Chapter 6, Submission 3-3 answered the three questions in turn, taking each Application SME separately for each question. In addition, each question was answered by the analysing the feedback from the AutoLean II SMEs. This is summarised below.

8.6.1 Question 1: Accuracy of business process mapping

Question 1: *"Did the business process analysis accurately reflect what happened in the business?"*

8.6.1.1 Application SMEs

8.6.1.1.1 Alchemie

Alchemie stated that the business processes drawn up had been accurately mapped, but that the Product Development Process was a more of a wish list of what should happen rather than a reflection of reality.

Alchemie also liked the way the Order to Delivery Process had been presented, in a way which was new to them, showing how more time could be taken out of the process. The Quotation Process had not been mapped because quotations were done by the sales force and did not appear to be an issue needing to be addressed at that time.

The Product Development Process revealed a gap between Research and Development (R&D) and sales. Currently ideas for new products came from the sales force, but they, in fact, bore no responsibility for actual specification of product, so this was left to R&D.

Then when the products were ready for launch, the sales force had no particular responsibility to go and sell the new product. To overcome these problems, it was recommended that a Product Manager should be appointed to take responsible for all aspects of the new product development process. Alchemie agreed that this was a priority.

8.6.1.1.2 Brandenburg (UK)

Brandenburg (UK) stated that it was helpful and valuable to think about the business in terms of the three business processes, Quotation, Product Development, and Order to Delivery. They recognised that the time compression could provide a valuable competitive edge and that were grateful for the input of WMG by those with knowledge of Time Compression.

Brandenburg (UK) felt that both the details from the questionnaire and in the business processes were accurate, except for some details which had changed anyway because of moving the business forward.

The weakness which stung the most was the comment in the report feedback to Brandenburg (UK), that the company had a six to eight week supply culture in its Order to Delivery Process. Despite initially defending the status quote, Brandenburg (UK) did acknowledge that these time scales were as a result of supplier lead times, and that the existing manufacturing processes currently were structured to deal with these lead times. Brandenburg (UK) recognised that it must collaborate with suppliers in order to reduce lead times.

8.6.1.1.3 Carboline Europe

Carboline Europe stated that the report had "90%" accurately reflected the business processes. Part of the reason for the disagreement was that the proposals given for Carboline Europe's Quotation Process would not fit in with their customer base. However, during the feedback more information emerged which would have meant that the author would have put a different emphasis on the analysis. The author suggested that such information had not come out in the original discussions was due, in part, to the fact that Carboline Europe was a significantly larger company than any of the other SMEs interviewed. Carboline did though agree that Carboline Europe had fallen behind with its usage of electronic communications technology, the area of disagreement.

8.6.1.2 Autolean II SMEs

The Autolean II SMEs were telephoned asking for their feedback on the SOAT report provided.

Ten AutoLean II SMEs, Table 6-1, Submission 3-3, were able to provide feedback. A further two AutoLean II SMEs contacted had not yet read the report, which had been sent over three months previously, and four AutoLean II SMEs had not received the report via

email, or had not received a readable copy. The seven other AutoLean II SMEs interviewed were not able to be contacted.

Except for plastic injection moulders not included in the ten SMEs above, these SMEs providing feedback, were representative of the range of technology types. They were also representative of the size of business.

In answer to Question 1, "*Did the business processes analysis accurately reflect what happened in the business?*" the nine SMEs, who gave a response, stated that the report did accurately reflect the business processes, either "Fully" or "Mostly", Figure 8-5, with "Fully" having six replies.

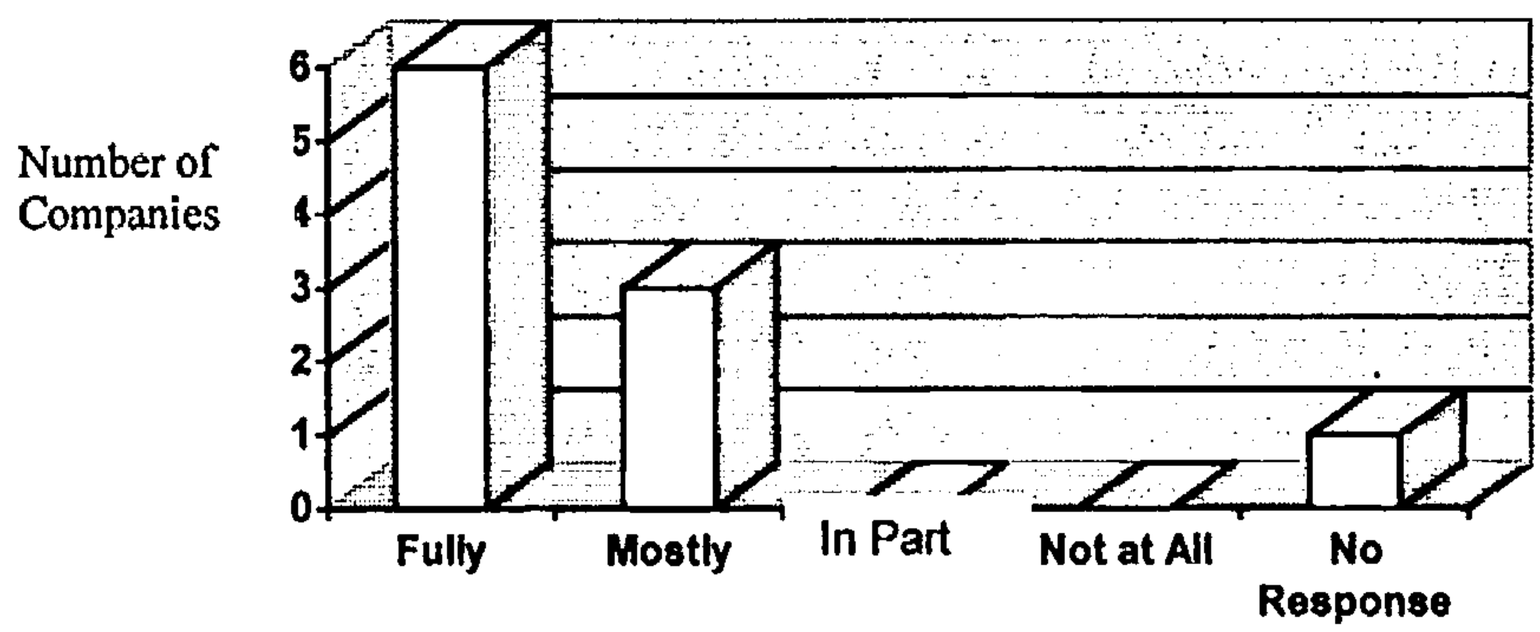


Figure 8-2 Business process accuracy of the SME as stated in the Autolean II report
Source: Figure 6-4, Submission 3-3, taken from AutoLean II SME telephone feedback interviews

These figures confirm Chapman's (undated) feedback on the twenty-one SMEs in the original Autolean 1 programme, which found that sixteen of the AutoLean 1 SMEs reported that the business process analysis had been *Accurate*, whilst three reported *Minor errors*, Figure 8-3.

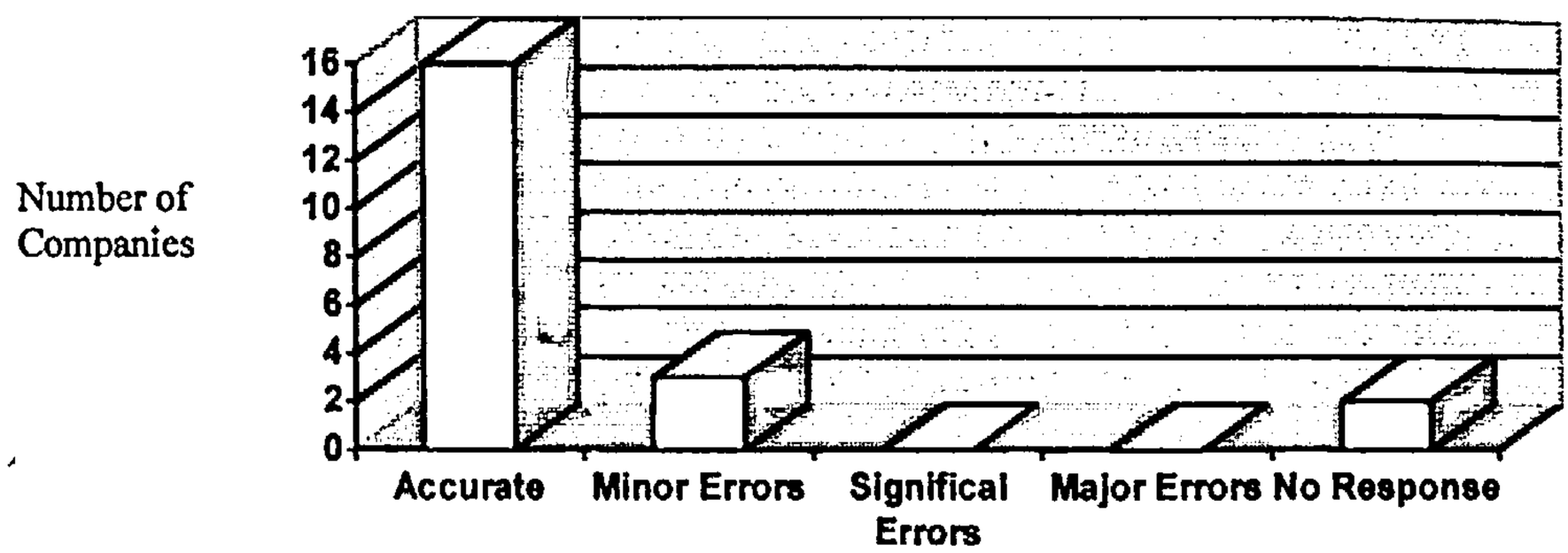


Figure 8-3 Assessment of data accuracy of business processes with Autolean I SMEs
Source: Chapman (undated)

8.6.1.3 Question 1:Summary

It was seen that the business processes analysis provided an accurate representation of the business processes within the SME. In addition, SOAT showed both Diachronic Reliability (Section 4.3.2, Submission 3-3) in that the accuracy of the business process mapping was accurate over the period within which AutoLean 1 and AutoLean II were carried out. SOAT also showed Synchronic Reliability (Section 4.3.3, Submission 3-3) as the observations within the discrete time periods within which AutoLean 1 and AutoLean II was done, led to the accurate mapping of the business processes

8.6.2 Generation of further/other issues

Question 2: "*Did the interview and/or report reveal any further issues, not directly addressed to business process flows?*"

8.6.2.1 Application SMEs

8.6.2.1.1 Alchemie

At Alchemie, the main point raised in the interview and emphasised in the report was that, given the company was a knowledge-based company, nothing had been written down. All the knowledge resided with two employees, neither of which was the owner. By placing this issue on paper, the urgency and importance had forceably struck the owner.

8.6.2.1.2 Brandenburg (UK)

Brandenburg (UK) recognised the need for two distinct areas to be addressed from the interview and from the report. These were the appointment of a Product Manager, and the use of electronic or e-commerce, Section 6.3.2, Submission 3-3.

8.6.2.1.3 Carboline Europe

Carboline Europe agreed that the need for a marketing focus was probably the most important point to come out of the report and interview.

8.6.2.2 Autolean II SMEs

The purpose of the Autolean II Programme was to assess SME's business processes in order to enable effective Internet access.

In the telephone feedback from the Autolean II SMEs, the SMEs were asked "Did the interviews and/or report provide information apart from the business processes?" The aim here was to test retrospectively, whether the SOAT analysis as a whole had provided a full a picture of the SME as the interviewers were expecting, Figure 8-4.

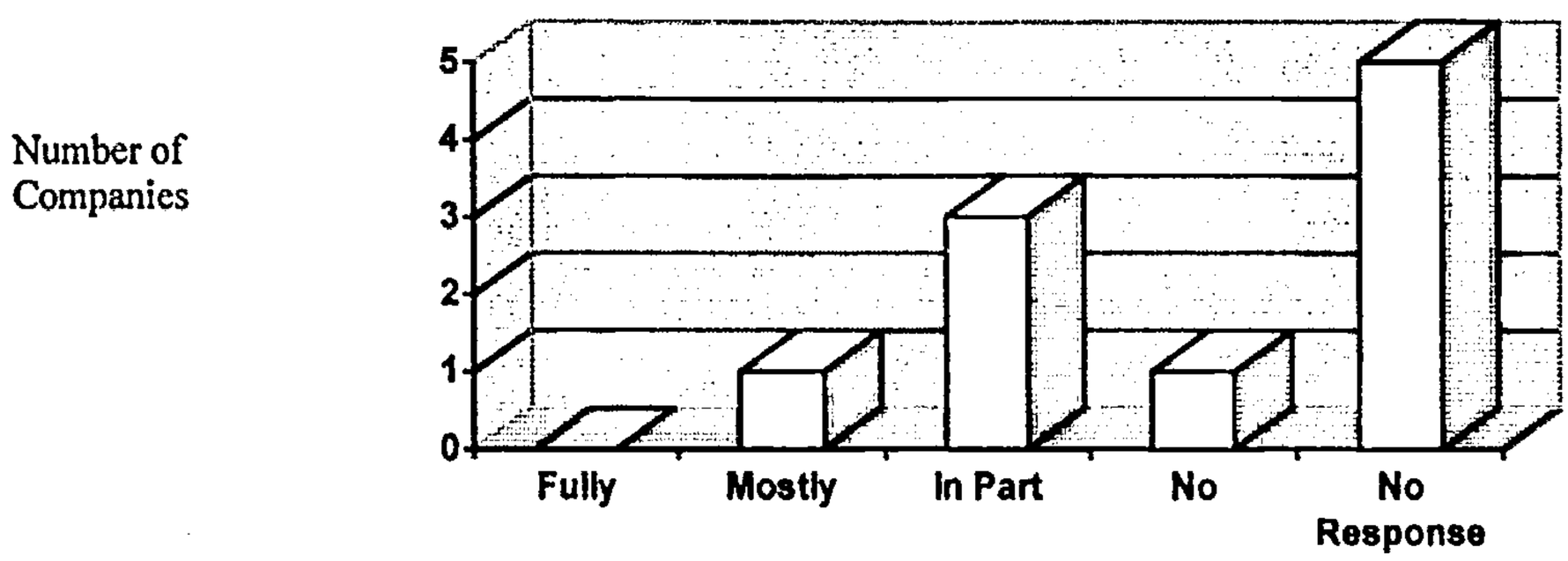


Figure 8-4 Further information provided by the SOAT analysis *Source:* Figure 6-6, Submission 3-3, taken from Autolean II SME telephone feedback interviews

The feedback from the AutoLean II SMEs was less clear cut. Three of the SMEs stated that SOAT had raised further issues "in part". This was seen in the analysis in Section 6.2.4, Submission 3-3 to reflect the fact that the SME knew their company, and that SOAT provided an incremental understanding to their business. The discussion in Section 6.2.4, Submission 3-3 discussed the appropriateness of the question, in that "Fully" revealing further issues would be unlikely, and that the large number of "No Responses also indicated that the SME might not have understood the question.

The single "No" response was from an SME which had considered SOAT within the company, but was also seen by the interviewers that the SME was weak in its assessment

of its relationship to its market, issues which had been included in the report sent to the SME. This was seen to be a lack of openness to what the report stated.

8.6.2.3 Question 2: Summary

In summary, despite the initial ambivalence to the question asked, SOAT had raised further issues, or known issues presented in a new way, which were worthy of consideration. Further issues were clearly seen in the Application SMEs, but only to a limited extent with the AutoLean SMEs. It is argued that with the Application SMEs, the raising of further issues was a key consideration.

8.6.3 Question 3: Actions in response to the SOAT analysis

Question 3: "*Were the issues from the SOAT assessment recognised that they should be acted upon, were intended to be acted upon or had been acted upon? These issues could be related to business process flow or further issues; raised in the interviewer and/or report, or as a sequence of the SOAT analysis.*"

8.6.3.1 Application SMEs

8.6.3.1.1 Alchemie

Alchemie recognised actions needed to be taken, Section 6.3.1, Submission 3-3, in the need to appoint a Product Manager to be responsible for product development and introduction, and also the need to develop a Product Introduction Procedure. Alchemie also acknowledged the need to have a structure and processes to capture the knowledge within the company.

8.6.3.1.2 Brandenburg (UK)

Brandenburg (UK) recognised two clear actions to be taken forward: firstly, the appointment of a Product Manger, a new position responsible for Product Introduction; and secondly, the need to challenge suppliers about their delivery performance.

They had also recognised that consideration needed to be given to improve production flow with WMG or with another consultancy, especially as Brandenburg (UK) had designed what was currently in place. They were open to suggestions of how any new production flow might be designed. The need to reduce sheetmetal production times was

also acknowledged. In terms of the consequences of the SOAT analysis, Brandenburg (UK) had already used the business process methodology to map out the Sales Order Process to ensure quality controls. The results of this were not discussed with the author, but the fact that the methodology was used showed that SOAT and its business process analysis was applicable in a non-automotive SME and perceived to be valuable.

8.6.3.1.3 Carboline Europe

The actions or intended actions were not so clear or forthcoming with Carboline Europe. Section 6.3.3, Submission 3-3 listed a number of probable reasons. Firstly, the Managing Director was not involved in the interview so the authority to immediately action things was not present and secondly, Carboline Europe was a considerably larger SME with a number of other senior people. It was twice the size of any AutoLean II SME in turnover.

Thirdly, Carboline Europe was part of a larger group and fourthly, some of the issues for consideration, the use of email and internet, and the need to redress customer focus were not in the interviewee's area of responsibility.

8.6.3.2 Autolean II

It could be argued that even where a further understanding of a SME was revealed, if nothing was done about such revelations then the interview methodology within which SOAT was placed might not have any enduring value. For this reason the Autolean II SMEs were asked if the interview and report had been considered further, Section 6.3.4, Submission 3-3. Six SMEs stated that the report had been used for decision making, with one SME expecting the report to be used in the near future (Figure 8-5).

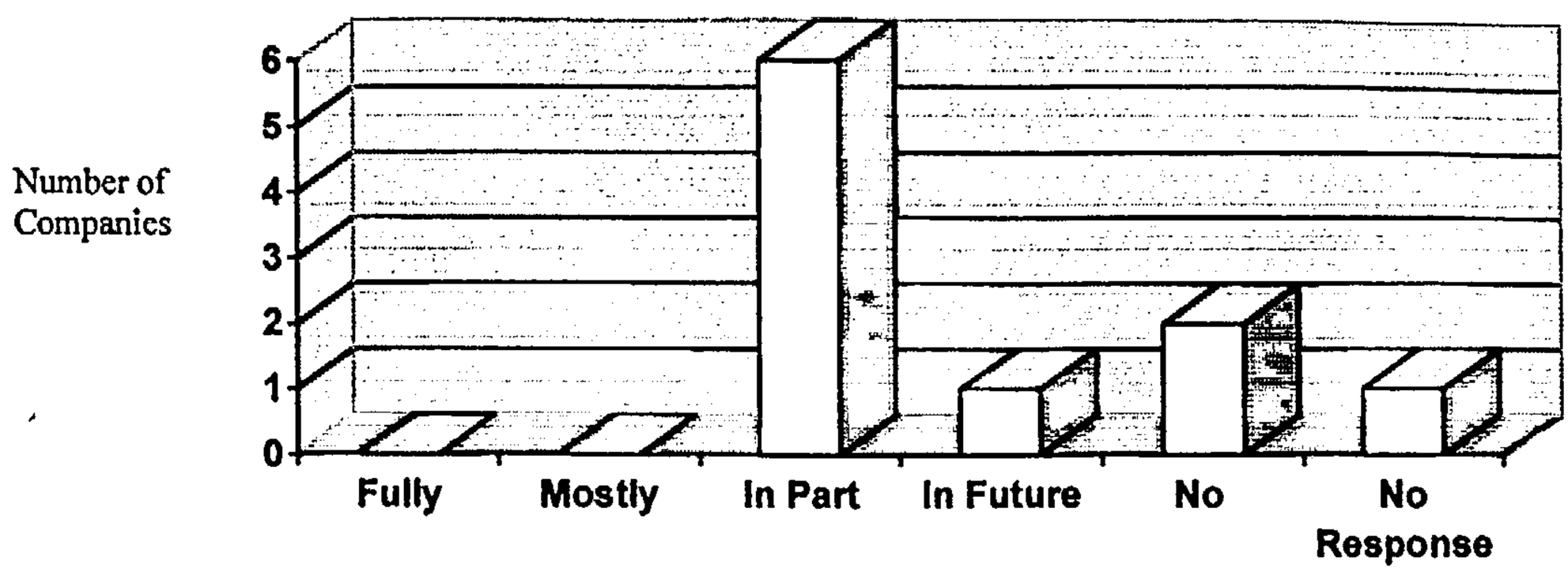


Figure 8-5 SOAT analysis to be used as an aid to decision making *Source:* Figure 6-7, Submission 3-3, taken from Autolean II SME telephone feedback interviews

A reason for that the report was seen to provide Further information "In Part", Figure 8-4 and "In Part", Figure 8-5, was possibly because the report provided an accurate summary of the company which as company owner or interviewee was aware. In this case, any further understanding of the business as revealed by an external consultant was liable to be only incremental, and any changes that the SME committed to was also likely to be incremental. Thus if an SME's attention was drawn to an issue, then it should be expected that it should have done something about the issue. This was seen to be the case with the AutoLean II SMEs.

8.6.3.3 Question 3: Summary

A number of the AutoLean II SMEs had seriously considered the SOAT report, and further issues raised were to be addressed.

With the Application SMEs, the impact of the SOAT analysis was clearer. The report had raised issues which both Alchemie and Brandenburg were set on actioning, whilst the report at Carboline Europe was to be considered by the senior management team.

In addition, at Brandenburg (UK), the company had used the business process mapping technique to map another business process, their Sales Order Process. This at least recommended the use of this methodology, and could be seen as a successful outcome of SOAT.

8.6.4 Overall summary

For both the Application SMEs and the AutoLean II SMEs, SOAT had mapped the business processes accurately. The literature review in Submission 3-2 showed that these three business processes these were core business processes. Again, for both the Application SMEs and the AutoLean II SMEs, through SOAT, further issues had been raised, and further actions were been planned.

In addition, given the wide variation in SMEs, SOAT still mapped the business processes accurately and revealed important further issues, and this was discussed in Section 8.4, Submission 3-3. One was of overcoming such variations was the development and use of the parts/volume matrix for classifying SMEs, Figure 8-6.

			Total number of part numbers	
			Low	High
			300	
Volume of parts pa	Low	<= 250000 pa		
	High			

Figure 8-6 Matrix of total number of parts with volume of parts pa *Source*: Figure 8.1, Submission 3-3

Thus, it is believed that SOAT was successfully applied.

8.7 SOAT and SME Service Providers

The role of SME Service Providers was discussed in Chapter 7, Submission 3-3 and summarised in Section 8.2. It was seen that SOAT would provide a useful tool for such organisations.

Benefits of SOAT were seen for both the SME and the SME Service Provider (Section 8.3, Submission 3-3).

These benefits were that SOAT contained both qualitative and quantitative elements within it. SOAT also presented the information on the SME in a way which can be easily understood and used. Next, the external, third party assessor was essential in ensuring a rigorous approach to assessment and the structured interview ensured that there were no "gaps" in the SME's assessment. Lastly, the business processes mapping revealed important areas for the SME to address.

8.8 SOAT: characteristics for effective usage and areas for improvement

Section 8.6, Submission 3-3 listed a range of characteristics which a SME might show for a successful application of SOAT to be completed. This was not to say that SOAT could be used with other SMEs, only that these characteristics were observed as being generally present in the SMEs where SOAT was applied successfully:

- The SME should have more than 10 employees, otherwise there is no requirement for an understanding of structured procedures as outlined in SOAT. In other words the SME should be larger than a micro-SME.
- The SME should be in the business of selling physical products, rather than services or information. However, there needed to be no restriction of the type of physical product.
- The SME should have relatively simple organisational structures.
- SMEs within the automotive industry would certainly seen to be assessed accurately given the focus within this industry.
- SMEs over approximately £6Million would most likely be similar to large companies, where the benefits of SOAT are untested.
- The attitude of the SME's leader was very important. He or she should be open to change.

SOAT could be improved by developing the analysis of the SME's marketing and financial status (Section 8.5). The issue of marketing was partly addressed within the Application SMEs, but it was seen that a further strengthening of SOAT's financial assessment might be required. A risk could be that the inclusion of a significant financial element might lessen the uniqueness of SOAT.

8.9 Summary of Innovation

What was seen to be innovative was that a semi-structured questionnaire together with a business process mapping set of tools could be used for assessing the more general performance of the SME.

Such innovation could be claimed in part from the little research discovered in assessing SMEs using business processes and secondly, the requirement for such a tool, a requirement arising from the SME itself and from organisations providing services for the SME. This new assessment tool, the SME (Operations) Assessment Tool, SOAT was in research methodological terms from a qualitative phenomenological research philosophy. In addition, what was being researched was not a narrow terminological understanding of "processes", but the spirit and understanding of processes, procedures and ways of working which were considered to be "business processes".

Innovation was not claimed in research into SMEs or the SMEs sector, but a justification for research into SMEs was shown. Neither was there innovation in the background research methodology used within the SOAT tool, as seen in the various research methodologies.

However, putting the various approaches together provided for a tool which was seen to be innovative and which was successfully applied.

9 ECLOS Project and Memorandum of Understanding and Intent: Innovation not Applied

9.1 Introduction

The Memorandum of Understanding and Intent was developed in response to concerns raised by companies and organisations involved with making and developing relationships between such companies and organisations. These companies were involved in a research project run through WMG called ECLOS (Effective Contractual and other Legal obligations in Strategic Alliances in the Aerospace Sector) which aimed to address disparities between contractual and legal processes, and Product Introduction Processes.

However, one of the main outcomes from the project was the concern for good and appropriate relationships between the companies and organisations. This chapter points to the work done by the author in addressing this issue.

Submission 4-1 put forward a number of models of customer-supplier relationships, mostly from the area of Relationship Marketing, whilst Submission 4-2 provided an initial solution to those wishing to engage in a new relationship by putting forward a framework whereby those involved commit themselves to appropriate responsibilities, attitudes and behaviours. This framework was called the Memorandum of Understanding and Intent (MUI), and the justification for this was provided in Submission 4-2 and repeated in this chapter. MUI was claimed to provide Innovation as required by the Engineering Doctorate, and such claims are repeated here. There was no opportunity to apply MUI because the author developed MUI at the end of his registration period. Also, application of such a document was seen to take a considerable time to be applied through discussions with the ECLOS research team and then "sold" to participating organisations and companies within the ECLOS project.

9.2 Objectives and Structure of the Chapter

This chapter puts forward the third area of innovation, the Memorandum of Understanding and Intent (MUI), and the reasons why MUI was created.

The chapter is structured in the following way.

A statement of how the MUI fits into the Engineering Doctorate and how MUI arose from within its "sponsoring" project, ECLOS, is given in Section 9.3

The ECLOS project is described in Section 9.4, whilst Section 9.5 describes the findings from the research which was the continuing need for good relationships between organisations.

Section 9.6 and 9.7 explain the context for MUI in terms of the lack of understanding of the areas researched, the bringing together of contractual and legal processes, and more traditional commercial and engineering processes. No existing MUI was found to exist.

MUI is described in Section 9.8. The full MUI is in Appendix D, and a commentary and justification for MUI was given in Submission 4-2. An example of one of the factors included in MUI also is given.

The innovation claimed is summarised in Section 9.9.

9.3 Fit into Engineering Doctorate

ECLOS provided an example of Innovation. This was MUI which was to be used between a potential customer and supplier in order to set a framework for the way the two organisations might continue to work together. A fuller description of the MUI was given in Submission 4-2. Such a requirement come out of the literature reviews within ECLOS and from the interviews with the participating companies and organisations, who all were keen to improve the relationship they had with others with whom they dealt with. The author put together for the ECLOS project in one document, a number of models concerned with interorganisational relationships, because of this requirement for improved relationships. This was the content of Submission 4-1. These in turn reinforced the need to ensure appropriate and collaborative relationships.

9.4 Description of the ECLOS project

The ECLOS (Effective Contractual and other Legal obligations in Strategic Alliances in the Aerospace Sector) project aimed to compare the contractual process with the Product Introduction Process within and between organisations. This was seen to be necessary as the Contractual Processes and the Product Introduction Process were not seen to fit together, indeed sometimes the contractual process was used as a vehicle for deliberately holding up the Product Introduction Process in order to better the conditions of the overall contract.

ECLOS was an EPSRC funded project under the Innovative Manufacturing Initiative (IMI) programme. It was a collaborative programme within various UK aerospace companies, in particular BAe, previously known as British Aerospace. A justification for the choice of project subject matter is not included in this Executive Summary.

The project was through literature review and a case study approach. The case studies from a range of industries were selected as it was seen to be important to obtain best practice from wherever it might be. These industries included not only military aerospace as the main target for the programme, but also civil aerospace, construction, Defence Estates and automotive. The case studies were conducted through unstructured interviews conducted by WMG research staff assigned to ECLOS, including the author, with a senior person from the case study organisation. A report was written from each case study. An example of one case done by the author with the company, TRW is Appendix A, Submission 4-1.

9.5 Need for good relationships

The need for good relationships, particularly at the start of any collaboration or contract was seen as a consistent requirement from a number of different sources. These sources were the different literature reviews: the first came from the ECLOS project itself; secondly from the author's literature review of customer-supplier relations (Submission 1) and the subsequent proposal for updating the Lean Supply Model on which Submission 1 was based; thirdly, from the review of models associated with relationship, included in detail in Submission 4-1; and fourthly, from the industry participants within ECLOS, not only those from the aerospace sector, but also other industries, and this was again reviewed in Submission 4-1.

9.5.1 ECLOS literature review

ECLOS Interim report-EC002 (2000) described the changes within legal and economic theory to explain changes within the area of contracts, including traditional contracts, transaction cost economics (Williamson, 1979), relational contracting (Hviid, 1998,1999) and the issue of trust in long-term contracts (Campbell and Harris, 1993). This Interim Report classified trust as "the missing link" in contract relations.

9.5.2 Lean supply literature review

Submission 1 reviewed the area of Lean Supply using Lamming's (1993) model of customer-supplier relations. Submission 1 also reviewed the area of Lean Supply using two other models, the Lean Enterprise Model from the Lean Aircraft Initiative, and also the model from Womack and Jones' (1996) work *Lean Thinking*. Inherent in these models was the need for organisations, companies and individuals to work collaboratively and positively together for the good of the relationship and for the tasks at hand. This was recognised by the author, so a number of Additional Factors to

put alongside Lamming's existing Lean Supply Factors were suggested (Submissions 2-1, 2-2 and 2-3). Included in these factors were the need for cooperation and trust, and also the commitment of individuals to the relationship.

9.5.3 Literature review of models of relationships

Submission 4-1 reviewed principally models associated with Relationship Marketing, together with other models of relationships from a marketing and customer facing perspective.

9.5.3.1 Change in marketing: the importance of relationships

There has been a fundamental shift in understanding about the role and understanding of marketing as practised and by academics within the marketing discipline. Gummesson (1998) and Gronroos (1997) both talked about a paradigm shift within marketing. Kotler (1992), no less, suggested so. What was this major change, this paradigm? As Kotler said (p.1), "companies must move from a short-term transaction-orientated goal to a *long-term relationship-building* goal" (italics added). At another time, Kotler (1991) stated that

> "A paradigm shift, as used by Thomas Kuhn..., occurs when a field's practitioner are not satisfied with the field's explanatory variable or breadth... What I think we are witnessing today is a movement away from a focus on exchange -- in a narrow sense of transaction -- and toward a focus on building value-laden relationships and marketing networks ... We start thinking about how to hold onto our existing customers ... Our thinking therefore is moving from a marketing mix focus to a relationship focus" (pp 1,4).

The principle and traditional model within marketing was the Four P model, Price, Product, Promotion and Place (see for example Adcock *et al.*, 1995; Blythe, 1998; Kotler, 1984). Gronroos (1997, p.322) believed that this Four P model had "become a straight jacket, fostering toolbox thinking" rather than being a "multi-faceted social process". The marketing mix paradigm that has reigned supreme for forty years was being challenged by one based around relationships (Gronroos, 1992; Jackson, 1985; Gummesson, 1987a and 1987b; Gummesson, 1997; Dwyer *et al.*, 1987; Gronroos, 1991; Christopher *et al.* 1991). Such thinking and emphasis on relationships was seen both within services marketing (Gronroos, 1982; Gronroos, 1990; Berry and Parasuraman, 1991) and industrial marketing (Håkansson, 1982; Turnbull and Valla, 1986; Ford, 1990).

In addition, the focus of marketing literature was now changing from being focused on competition to being focused on collaboration, (Gummesson, 1997).

A further range of models was given in Submission 4-1. These reviewed different aspects of customer-supplier relationships, and although these provided further insights to such relationships, they were within the broad theme outlined here of the importance of relationships between organisations and companies, so are not be further discussed.

9.5.4 ECLOS Case Studies

Chapter 3, Submission 4-1 provided a brief outline of the case studies used as industrial examples.

9.5.4.1 Defence Estates

Defence Estates was the construction and estates maintenance arm of the Ministry of Defence. Defence Estates was the lead Government department trialing a

collaborative contracting arrangement with the private sector. These Prime Contractors were to be given responsibility for design, build and run Defence Estate properties. The Ministry of Defence was using SIBET (Soft Issue Bid Evaluation Tool) which although principally aimed at satisfying various pieces of legislation, was at least a first attempt to break away from the fixed price contract, and the contract mentality of procurement. These soft issues included attitudes to partnering, and attitudes to partnering with the MoD, attitudes to change, commitment to joint working, supplier communications and involvement of other potential suppliers. Up to 60% of the bid evaluation was to be done on these so-called soft issues.

9.5.4.2 SCRIA.RET

An interview with Sigma, a management consultancy responsible for the use of a relationship evaluation tool called SCRIA.RET (Supply Chain Relationships in Action Relationship Evaluation Tool) with UK aerospace companies. This tool was developed by Lamming (of customer-supplier relationships, Lean Supply Model, 1993) and a team at Bath University for the Society of British Aerospace Companies (SBAC). Thus, the pedigree of the tool was sound, and the fact that the aerospace industry voluntarily came to understand that relationship issues were important gave weight to the need for good and appropriate relationships between organisations.

9.5.4.3 TRW

The aerospace components division in TRW discussed its recently introduced Fleet Air Hour Agreement, whereby the customer only paid for the product when in-service use. Part of the changes to enable this agreement to work was a closer cooperation with customers, both in acquiring the information in order to compute the actual hours flown, but also in terms of dispersal of stock for replacement. Spare product had to be kept close to where it was needed, but this was mostly in the customer's premises, but not paid for by the customer until required. It also was accompanied by a change internally within TRW to enable more effective and efficient handling of the customer requirements, which required a closer internal cooperation.

9.5.4.4 AMEC Construction

AMEC Construction, a large construction company was looking to move away from competitive tendering to work with designated customers to more collaborative ways of working. In addition, AMEC saw that at present, the legal profession had a vested interest in making contracts more complex, and within these newly formed collaborative relationships, these legal attitudes were being confronted by honesty, truthfulness and openness within the relationship.

9.5.4.5 Nissan

Nissan was interviewed. The automotive assemblers were often seen as the leaders in any changes in industry, and was seen with Nissan's handling of relationships with its suppliers. Given the need to shorten time to market, then any suppliers were engaged without a full contract being signed, and this was done by Nissan, using the history of working closely with the supplier, and also by the signing of an initial Memorandum of Understanding. This memorandum ensured that the supplier was paid for any work done, and that intellectual property and know-how would be retained within the relationship. The ECLOS team visiting did not have sight of Nissan's Memorandum, they were only told of its intent.

9.5.5 Summary of literature and case studies

ECLOS Interim Report 002 (2000) dealt with legal, contractual and economic literature. The author's reviews of literature of Lean Supply, together with the review of Relationship Marketing and other models normally associated with a marketing and customer facing perspective, all pointed to the need to ensure close collaborative and co-operative relationships. This then showed that there was a need to research the workings of relationships between customer and supplier.

The Memorandum of Understanding used by Nissan with its suppliers seemed a practical starting point for addressing issues of relationships. As the Nissan

memorandum was not provided, nor any other similar memorandum known as there was nothing in the literature mentioning such a document, then the Memorandum of Understanding and Intent (MUI) was created.

9.6 Why develop a Memorandum of Understanding and Intent?

Chapter 3, Submission 4-2 addressed this issue, which is repeated here.

No standard or generic Memorandum of Understanding was found within the public domain, and the one used by Nissan was not made available. There were contracts within the public domain, but these were traditional contracts, for example within the construction sector, but these were industry specific (for example tri-party) and were not phrased in terms of shared values.

In addition, MUI was seen to have a legal function different to that of a traditional contract. A traditional contract both contained issues of governance and proxy. Governance, in this legal sense, referred to the overall way the relationship between the parties was to be managed, both legally and in a business sense, whereas proxy referred to those parts of a contract which dealt with the processes of delivering on the objectives, and often in great detail (Holstrom, 1979, 1982, 1999). It was the inclusion of an ever expanding and detailed definition of proxy that was the principal reason for contracts to be ever expanding and growing in sophistication and complexity. Thus, MUI could be said to address governance issues alone. In general, this meant trying to return to the spirit of what was to be done together, rather than being tripped up by the potential consequences of not doing things together.

9.7 A context for MUI: why a Memorandum of Understanding and Intent has not been written before (Nissan excepted)

The issue of the context for MUI was discussed in Section 4, Submission 4-2, and is presented here.

Part of the issue for ECLOS had been to define the role and boundaries of its subject area. Although the project was to research the Contractual Process and to compare it to the Product Introduction Process, such a detailed analysis did not appear to have been important in the minds and concerns of those interviewed within the case studies. As has been stated, the understanding and assessment of relationships was key. Part of this assessment of relationships between customer and supplier was seen to be an area requiring research, and it was one of the areas of further intended research arising from the author's review of lean supply literature (Section 8.4, Submission 1).

In addition, there was probably some ambiguity within the case study companies and within the ECLOS research team of exactly what to research. This was possible as it was probably the first time within the UK that a study of legal issues and processes, not only at a strategic level, but also at an operational level had been undertaken, combined with commercial and engineering processes and procedures. For example, the ECLOS project was the first time that its sponsor, the Engineering and Physical Sciences Research Council (EPSRC) has sponsored a legally based project.

One result on a practical level was to know where to start the research, both in terms of content and context. This could be seen by understanding the processes by which any field of research and understanding were to be made clear, for example by using Stafioleas's (1998) vicious circle for studying Strategic Alliances, Figure 9-1.

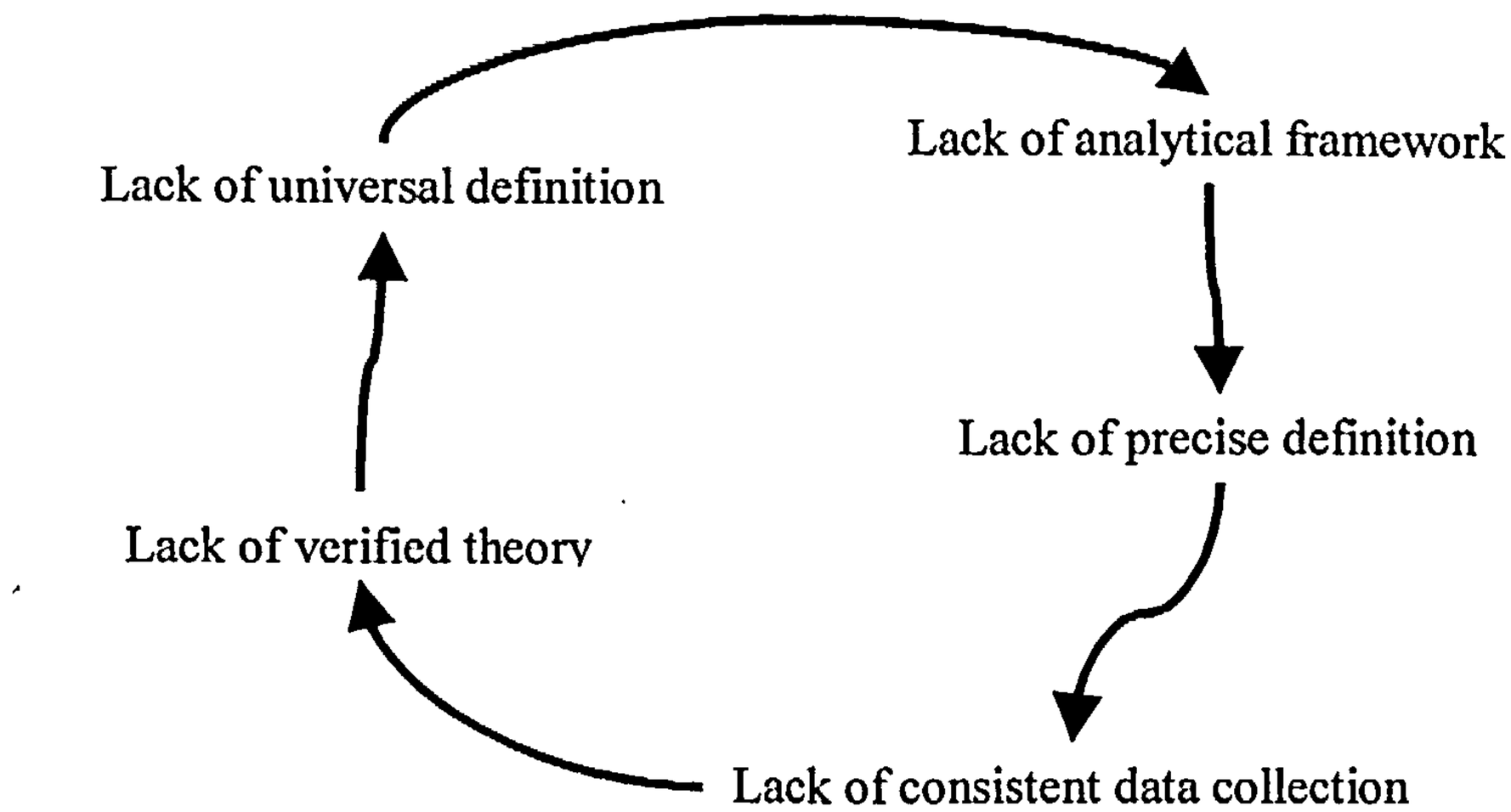


Figure 9-1 The vicious circle of studying the issues within ECLOS: source adapted from Stafioleas *et al.* (1998)

In an area of undefined research, part of the difficulty was where to start in the vicious circle. The ECLOS team had had preliminary interviews with a number of representatives from the case study companies, but had difficulty in knowing in what form to gather the data and so how best to interpret the data so gathered. The creation of a Memorandum of Understanding and Intent was an attempt to provide one part in an analytical framework within which the ECLOS project data may be defined.

9.7.1 Why no framework has suggested itself from the literature.

Firstly, contract. Contract had traditionally seen itself as being separate from the ongoing commercial, engineering and technical issues (ECLOS Interim Report-EC002, 2000). As has been stated, the ECLOS project aimed to bring such thinking together for the first time.

Secondly, the customer-supplier "environment" within the Product Introduction Process was taking place and was evolving within a new willingness to collaborate and take account of issues of relationship, as seen for example in the MoD's Smart

Procurement Initiative (Ministry of Defence Smart Procurement, 1999; Hitchins, 1999).

Thirdly, the basis for the understanding of these relationship issues was currently only just being defined, definitions being held within new and academically unproven customer-supplier relationship assessment tools (Sybet and SCRIA), described in Section 3.2, Submission 4-1.

Fourthly, the SMART procurement process for product development and acquisition within the MoD, which replaced the previous fixed price competitive tender procurement process had again only been in place for 18 months.

The Memorandum of Understanding and Intent started to provide an analytical framework for the setting up and maintaining of governance structures within a relationship between parties to the relationship, based on openness, honesty and trust.

9.8 Memorandum of Understanding and Intent (MUI)

The Memorandum of Understanding and Intent (MUI) (see Appendix D, below), aimed to provide a general description of the attitudes by which individuals, companies and organisations should come together to collaborate. Its aim was to provide a framework for the initial contact and workings within a new and prospective relationship or project, a set of values by which the participants could move forwards with commitment and respect for each other, at a time when other ways of governing the relationships may not yet be established, through, for example, historical understanding or contract.

The Memorandum itself was in the form of an introduction followed by proposed suitable headings, under which there was a description of issues, values or ways of working. The headings have been taken from sources dealing directly with the issues of customer supplier relationship through enhancing value through the supply chain, so called *lean supply*. A commentary and justification for the points raised was given in Chapter 5, Submission 4-2.

Both the headings and content of MUI came from research. The headings were the Lean Supply Factors (Lamming, 1993), and Additional Factors to be put to Lamming's Lean Supply Factors (Submissions 2-1, 2-2 and 2-3). These Additional Factors arose from the author's literature review (Submission 1). These were models aimed at customer-supplier relationships. Other headings used were from Womack and Jones' (1996) *Lean Thinking* Model, and although these were not directly related to customer-supplier issues, given that the focus of both the Lean Supply Model and the Additional Factors were within the Lean paradigm, and as the Lean Thinking factors were general issues within the Lean paradigm, it seemed appropriate to include them.

The content under the headings have come from research: the ECLOS case studies and models of customer-supplier relationships (Submission 4-1), ECLOS Interim Report-EC002 as mentioned above, observations from the author's own research in a

related area of assessing Small and Medium sized Enterprises (SMEs) through the AutoLean project (Submissions 3-1, 3-2, and 3-3), and from the author's literature review critiquing issues with lean supply, especially customer-supplier relationships (Submission 1).

A commentary and justification for the content under each heading was given in Chapter 5, Submission 4-2, and an example is shown in Box 9-1.

1. Definition of Value

All participants within the relationship shall work towards an understanding of value in terms of what is seen by the end customer or consumer.

Justification

Womack and Jones (1996) outline the need for all supply chains to start with an understanding of customer requirements. The debate between customers and consumers (see for example Blythe, 1998, p.4) need not get in the way here of trying to understand the needs of those at the end of the value chain who actually use or consume the product.

Box 9-1 Example of MUI heading, content and justification *Source:* Section 5, Submission 4-2

In total 22 different headings were used. Table 9-1 lists the heading and their source.

Heading	*Source*
Definition of Value	Lean Thinking Model
Identification of Value Streams	Lean Thinking Model
Organising around flow	Lean Thinking Model
Responding to Pull through the value chain	Lean Thinking Model
Cooperation, trust and relationship management	Additional Factors
Commitment of individuals to the relationship: The psychology of sharing	Additional Factors
Supplier associations and networks	Additional Factors
The acknowledgement and use of power	Additional Factors
Team working structures	Additional Factors
Time based competition	Additional Factors
End customer	Additional Factors
The impact of new technology	Additional Factors
Knowledge management	Additional Factors
Intellectual Property Rights	Additional Factors
Nature of competition	Lean Supply Model
Basis of sourcing decisions	Lean Supply Model
Role and mode of data, information exchange	Lean Supply Model
Management of capacity and delivery practice	Lean Supply Model
Dealing with price changes	Lean Supply Model
Attitude to quality	Lean Supply Model
Level of pressure	Lean Supply Model
Perfection	Lean Thinking Model

Table 9-1 Headings within MUI and their sources *Sources:* Lean Thinking Model, Womack and Jones (1996); Additional Factors, Submission 2-2; Lean Supply Model, Lamming (1993)

9.9 Statement of Innovation

As has been shown in this chapter, the Memorandum of Understanding and Intent was created to satisfy requirements from those involved with creating relationships and making relationships work between organisations and companies, Section 9.5.4, and Section 3, Submission 4-1.

It also was in line with the current literature on the need to have good relationships between organisations. This was seen in the ECLOS literature review of contractual and legal areas, Section 9.5.1, from the author's own literature review of Lean Supply, Section 9.5.2, and from the literature review on customer-supplier relationship models Section 9.5.3.

However, the area between contractual and legal issues and processes, and other commercial and engineering processes was only just being addressed, both in academic understanding, and also practical ways. This was addressed in Section 4, Submission 4-2, and repeated in Section 9.7.

MUI provided an academically justified approach for a starting to practically address one of the current concerns raised, addressed in Section 9.8 above and in Section 1, Submission 4-2. The one company where such a document existed, no access to it was given. No other similar MUI was found in the literature.

The need to have effective collaborative relationships continues to be seen as a way of gaining and sustaining competitive advantage whilst reducing overall costs. MUI was put forward as one way of ensuring such collaborative relationships might be established.

10 Review of developments within the Engineering Doctorate, and recommendations for continuation of the research

10.1 Review of developments

The author has developed the following within the Engineering Doctorate:

- The **SOAT** tool for assessing SMEs, and the claimed innovation and its application, Chapters 4 to 8 inclusive, and Submissions 3-1, 3-2 and 3-3,

- **MUI** provided a framework within which for collaborative business relationships could be conducted, Chapter 9 and Submissions 4-1 and 4-2. This tool was shown to be innovative, but had not been applied,

- The **literature review** within the area of Lean Supply and customer-supplier relationships, Chapter 2 and Submission 1. MUI could be seen to be directly related to this literature review. SOAT came out of a separate programme, AutoLean II, but the importance of a marketing element grew within the programme, and retrospectively could be seen to meet the areas of further research named in the literature review,

- The three papers published within the Engineering Doctorate, Chapter 3 and Submissions 2-1, 2-2 and 2-3. These arose directly out of the literature review and the research programme into which the literature review was part of. However, the theory suggested, stood by itself, alongside Lamming's Lean Supply Model (1993), from where the author's whole research began.

10.2 Recommendations for continuation of the research

The author can identify three areas.

10.2.1 Application of MUI

The Memorandum of Application of Understanding and Intent was needed to be applied. This was seen to be part of the continuing ECLOS project.

10.2.2 Common ground between SOAT and MUI

Although SOAT and MUI were developed for different purposes, one area of common ground between them was the issue of relationships between organisations. For MUI, this was overt, but for SOAT, business processes were seen to be more effective across organisations where the relationships between the organisations were highly collaborative. In this way, SOAT could be said to have dealt with new relationships, but with SMEs, whereas MUI dealt with existing relationships with large companies. This is summarised in Figure 10-1.

		Size of company	
		SME	Large
Status of relationship	New		MUI
	Existing	SOAT	

Figure 10-1 SOAT and MUI with respect to company size and status of relationship

From the author's research, it is not known how the two empty quadrants in Figure 10-1 might be filled. Neither does the author know how the variables of size of business and status of the relationship might effect what model should be used where these variables are not presented in this way. For example, what happens when the companies are of different sizes, does the market sector make a difference, can all relationships be "boiled" down to two types? All these issues are ones for further research.

10.2.3 Commercialisation of SOAT

The author had considered the possibility of putting SOAT into a state where it could be sold. The market was seen to be both the SMEs themselves and SME Service Providers, albeit with different "packages". What was thought was required was the use of suitable software, designed for mapping processes, rather than the use of Microsoft Word, Excel and Powerpoint as had been done to date. The development of a suitable database was needed to easily compare data and SMEs. In commercialisation the most money would be probably made on the SME assessments, so if SOAT was sold to a Service Provider, it was difficult to see where the return would come from. So there were issues about know-how.

Despite these difficulties, the author believed, and continues to believe that SOAT could be made into a product which would assist SMEs and their Service Providers in ways which have not been considered to date, and which would assist the SME to identify areas for improvement.

References

Ahmed, N. Montagno, R. Firenze, R. (1996), "Operations strategy and organisational performance: an empirical study", *International Journal of Operations and Production Management*, Vol. 16, No. 5, pp. 41-53

Amos, L., (1999), "Beyond the factory gates", *Overseas Trade*, October, 1999, p. 21

Armistead, C., Harrison, A., Rowlands, P. (1995), "Business process re-engineering: lessons from operations management", *International Journal of Operations and Production Management*, Volume 15, No. 12, pp. 46-58

Augoustinos, M. and Walker, I. (1995), *Social cognition; an integrated approach*, Sage: London

Berry, L.L. and Parsuraman, A. (1991), *Marketing Services: competing through quality*, Free Press/Lexington Books, Lexington, MA

Blythe, J. (1998), *Essentials of Marketing*, Financial Times, Pitman Publishing

Boter, H. and Holmquist, C. (1997), "Industry characteristics and internalization process in small firms", in *The Internationalisation of SMEs, the Interstratos project*, eds. Haahti, A, Hall, G and Donckels, R., Routledge, p. 19-42

Bradley, P. (1996), "Familiarity breeds confidence. (Eastman Kodak Co.'s single sourcing policy)", *Logistics Management*, Vol. 35, No. 3, pp. 67-69

Brodie, R., Coviello, N., Brookes, R., Little, V. (1997), "Towards a paradigm shift in marketing? An examination of current marketing practices", *Journal of Marketing Management*, Vol. 13, pp. 383-406

Bryman A. and Burgess R.G. (1994), "Developments in qualitative data analysis: an introduction", in *Analyzing qualitative data*, eds. by Bryman, A. and Burgess, R.G., pp.1-17, Routledge

Burnes, B. and New, S. (1997), "Collaboration in customer-supplier relationships: Strategy, operations and the function of rhetoric", *International Journal of Purchasing and Materials Management*, Vol. 33, No. 4, pp. 10-17

Campbell, D. and Harris, D. (1993) "Flexibility in Long-term contractual relationships", *Journal of Law and Society*, Vol. 20, No. 2, pp. 166-191

Carrier, C. (1994), "Intrepreneurship in large firms and SMEs: a comparative study", *International Small Business Journal*, Vol. 12, No. 3, pp.54-61

Chapman, P. (undated), "An application of the Performance Improvement Methodology to identify and analyse processes in West Midlands SME automotive component suppliers and guide the adoption of Internet based Information and Communication Technologies", Submission 4-3 for Engineering Doctorate

Chapman, P., James-Moore, M., Szczygiel, M., Thompson, D. (undated), "Building Internet Capabilities in SMEs", Working document within the AutoLean programme

Christopher, M., Payne, A., and Ballentyne, D. (1991) *Relationship Marketing: Bringing Quality, Customer Service and Marketing Together*, Butterworth, London

Commission of the European Community, Employment in Europe, 1992, Luxembourg/Brussels

Cranfield School of Management, (2000), *Marketing Management, a relationship marketing perspective*, MacMillan Business

Cronbach, L.J. and Meehl, P.E. (1955), "Construct validity in psychological tests", *Psychological Bulletin*, Volume 52, No.4, pp. 281-302

Dwyer, F.R., Shurr, P.H. and Oh, S. (1987) "Developing buyer and seller relationships", *Journal of Marketing*, Vol. 51, April, pp. 11-27

ECLOS Interim report-EC002 (2000), Internal report, WMG, University of Warwick

Economist, The, (1995), "Jac the Knife / Ford fights its costs", 14 October 1995

Economist, The, (2000), "Seller beware", 4 March 2000, pp. 85-86

Ellram, L.M. (1991), "A managerial guideline for the development and implementation of purchasing partnerships", *International Journal of Purchasing and Materials Management*, Vol. 27, No. 3, pp. 2-8

Ford, D. (1990) (ed.), *Understanding business markets: interactions, relationships and networks*, Academic Press, London

Ford, D., Gadde, L.-E., Håkansson, H., Lundgren, A., Snehota, I., Turnbull, P., Wilson, D. (1998), *Managing business relationships*, Wiley

Foster, R. (1986), *Innovation*, Macmillan

Gardner, G. (1997), "The coming capacity crunch," *Ward's Auto World*, Vol. 33, No. 5, p. 60

Ghobadian, A. and Gallear, D. N. (1997), "TQM and organisation size", *International Journal of Quality and Reliability Management*, Vol. 10, pp. 47-64

Glaser, B. G. and Strauss, A. L. (1967), *The discovery of Grounded Theory, strategies for qualitative research,* Aldine Publishing

Gregory, I.C. and Rawling, S.B. (1997), *Profit from time - speed up business improvement by implementing time compression*, Macmillan Business

Gronroos, C. (1982), "Swedish Management and Marketing in the Service Sector", Swedish School of Economics and Business Administration, Helsinki, Finland (published in 1983 in the USA by Marketing Science Institute and in the UK by Studenliteratur/Chartwell-Bratt)

Gronroos, C. (1990), *Service Management and Marketing, Managing the Moments of Truth in Service Competition*, Free Press/Lexington Books, Lexington, MA

Gronroos, C. (1991), "The marketing strategy continuum: a marketing concept for the 1990s", *Management Decision*, Vol. 29, No. 1, pp. 7-13

Gronroos, C. (1992), "Quo vadis, marketing? Towards a neo-classical marketing theory" in Blomquist, H., Gronroos, C and Lindqvist, L. (Eds.), *Economics and Marketing Essays in Honour of Gosta, Economy and Society, no. 48*, Swedish School of Economics and Business Administration, Helsinki, Finland, pp. 109-124

Gronroos, C. (1997), "From marketing mix to relationship marketing - towards a paradigm shift in marketing. (Relationship Marketing)", *Management Decision*, Vol. 35, Nos. 3-4, pp. 322-339

Gummesson, E. (1987)a, "The new marketing -- developing long-term interactive relationships", *Long Range Planning*, Vol. 20, No. 4, pp 10-20

Gummesson, E. (1987)b, *Marketing -- A Long-Term Interactive Relationship*, Contribution to a New Marketing Theory, Marketing Technique Center, Stockholm, Sweden

Gummesson, E. (1997), "Relationship marketing – the emperor's new clothes or a paradigm shift?", *Marketing and Research Today*, February, pp. 53-60

Gummesson, E. (1998), "Implementation requires a marketing paradigm", *Academy of Marketing Science Journal*, Vol. 26, No. 3, pp. 242-249

Håkansson, H. (Ed.) (1982), *International Marketing and Purchasing of Industrial Goods: An Interactive Approach*, London, Wiley

Hall, R. (1994), "A framework for identifying the intangible sources of sustainable competitive advantage", in *Competence-Based Competition*, eds. Hamel, G. and Heene, A., Wiley, pp. 149-169

Halley, A. and Guilhon, A. (1997), "Logistic behaviour of small enterprises: performance, strategy and definition", *International Journal of Physical Distribution and Logistics Management*, Vol. 27, Nos. 7-8, pp. 475-495

Hammer, M. (1996), *Beyond Reengineering*, Harper Business, New York

Hill, T. (1987), *Small business, production/operations management*, Macmillan Education

Hill, T. (1991), *Production/Operations Management*, 2nd edition, Prentice-Hall

Hill, T. (1993), M*anufacturing strategy*, 2nd edition, MacMillan

Hines, P. (1994), *Creating World Class Suppliers, Unlocking Mutual Competitive Advantage*, Pitman

Hines, P. (1998), "Supply chain management: from lorries to macro-economic determiner", *Logistics Research Network Conference*, Cranfield University, 10-11 September

Hines, P., Lamming, R., Jones, D., Cousins, P., Rich, N. (2000), *Value Stream Management - Strategy and Excellence in the Supply Chain*, Prentice Hall

Holstrom B. (1979), "Moral Hazard and Observability", *Bell Journal of Economics*, Vol. 10, pp. 74-91

Holstrom B. (1982), "Moral Hazard and Teams", *Bell Journal of Economics*, Vol. 13, pp. 324-340

Holstrom B. (1999), "The Firm as a Sub Economy", *Journal of Law and Economic Organisation*, April, Vol. 15, No. 1, pp. 74-100

Honeycutt, Jr., E.D., Flaherty, T., Benassi, K. (1998), "Marketing Industrial Products on the Internet," *Industrial Marketing Management*, Vol. 27, pp. 63-72

Hunt, S. (1997), "Competing through relationships: grounding relationship marketing in resource-advantage theory", *Journal of Marketing Management*, Vol. 13, pp.431-445

Hussey, J. and Hussey, R. (1997), *Business research, a practical guide for undergraduate and postgraduate students*, Macmillan Business

Hviid, M. (1998), "Relational contracts, repeated interaction and contract modification", *European Journal of Law and Economics*, Vol. 5, pp. 179-194

Hviid, M. (1999), "Long term contracts and relational contracts", in Boudewijn, B. and De Geest, G. (eds.), *The encyclopaedia of law and economics*, Edward Elgar Press

Jackson, B.B. (1985), "Build customer relationships that last", *Harvard Business Review*, Vol. 63, November-December, pp. 120-128

Kaplan R. and Norton, D. (1996), *The balanced scorecard, translating strategy into action*, Harvard Press

Keen, P., Balance, C., Chan, S., Schrump, S. (1998), *Electronic commerce relationships, trust by design*, Prentice Hall PTR

Khare, A. (1997), "Strategic advantages of good supplier relations in the Indian automobile industry", *Technovation*, Vol. 17, No. 10, pp. 557-568

Kirk, J. and Miller, M. (1986), *Reliability and validity in qualitative research*, California: Sage

Kotler, P. (1992), "It's time for total marketing", *Business Week Advance Executive Brief*, Vol. 2, pp. 1

Kuriloff, A.H, Hemphill, Jr., J.M., Cloud, D (1993), *Starting and managing the small business*, 3rd edn., McGraw-Hill

Lamming, R. (1990), "Strategic options for automotive suppliers in the global market", *International Journal of Technology Management*, Vol. 5, No. 6, pp. 649-684

Lamming, R. (1993), *Beyond Partnerships*, Prentice-Hall

Lamming, R. (1996), "Squaring lean supply with supply chain management. (Lean Production and Work Organisation)", *International Journal of Operations and Production Management*, Vol. 16, No. 2, pp. 183-196

Lee, G. L. and Oakes, I. (1995), "The 'pros' and 'cons' of TQM for smaller firms in manufacturing: some experiences down the supply chain", *Total Quality Management*, Vol. 6, No. 4, pp. 413-426

J.K.Lasser Institute (1994), *How to run a small business*, 7th edn., McGraw-Hill

Lewis, J. C., Naim, M. M. and Towill, D. R. (1997), "An integrated approach to engineering material and logistics control", *International Journal of Physical Distribution and Logistics Management*, Vol. 27, Nos. 3-4, pp. 197-209

Lowe, J., Delbridge, R. Oliver, N (1997), "High-performance manufacturing: evidence from the automotive components industry", *Organisation Studies*, Vol. 18, No. 5, pp. 783-798

MacDuffie, J.P. and Helper, S. (1997), "Diffusing lean production through the supply chain", *California Management Review*, Vol. 39, No. 4, pp. 118-151

McKenzie, R. (1999)a, "A critical evaluation of the Lean Supply Model (Lamming, 1993), the Lean Aircraft Initiative Model, and the Lean Thinking Model (Womack and Jones, 1996)", Submission for Engineering Doctorate, 18 February 1999; Submission 1, Engineering Doctorate, WMG, University of Warwick

McKenzie, R. (1999)b, "Doing more with less", *Aircraft Technology Engineering & Maintenance*, Issue 42, pp. 56-60; Submission 2-3, Engineering Doctorate, WMG, University of Warwick

McKenzie, R. and Brennan, N. (1999), "Lean Supply in the Automotive Industry – Factors identified for successful customer-supplier relationships", Logistics Research Network Annual Conference, University of Northumbria, September 1999; Submission 2-2, Engineering Doctorate, WMG, University of Warwick

McKenzie, R. and Goodhead, T. (1999), "Supply chain development - What comes after lean supply?", 3rd Annual Airline Purchasing & Aviation Suppliers Conference, Brussels, Belgium, 14-15 April 1999; Submission 2-1, Engineering Doctorate, WMG, University of Warwick

McKenzie, R. (2000)a, "AutoLean II: Description of the Project", 1Submission 3-1, Engineering Doctorate, WMG, University of Warwick, September 2000

McKenzie, R. (2000)b, "The SOAT tool: an Innovative Approach to SME assessment", Submission 3-2, Engineering Doctorate, WMG, University of Warwick, September 2000

McKenzie, R. (2000)c, "Application of SOAT tool", Submission 3-3, Engineering Doctorate, WMG, University of Warwick, September 2000

McKenzie, R, (2000)d, "ECLOS The role of relationships between customer and supplier: description of relationship models", Submission 4-1, Engineering Doctorate, WMG, University of Warwick, June 2000

McKenzie, R. (2000)e, "Commentary on and Justification of ECLOS Memorandum of Understanding and Intent", Submission 4-2, Engineering Doctorate, WMG, University o

Mitchell, R.K., Agle, B.R., Wood, D.J. (1997), "Towards a theory of stakeholder identification and salience; Defining the principle of who and what really counts", *Academy of Management Review*, Vol. 22, No. 4, pp. 853-886

Morris, M.J. (1988), *Starting a successful business*, 2nd edn., Kogan Page

Mroz, R.P. (1998), "Unifying marketing: The synchronous marketing process," *Industrial Marketing Management*, Vol. 27, pp. 257-279

Newell, F. (2000), *loyalty.com*, McGraw-Hill

Normann, G. (1979), *A personal quest for methodology*, Stockholm, Scandinavian Institutes for Administrative Research

O'Neil, P. V. (1995), *Advanced Engineering Mathematics*, 4th Edn., PWS Publishing

Peters, K.M. (1998), "Leading the business revolution", *Government Executive*, Supplement 1998 Top 200 Federal Contractors, pp. 103-104

Piercy, N.F. and Morgan, N.A. (1997), "The Impact of Lean Thinking and the Lean Enterprise on marketing: threat or synergy?", *Journal of Marketing Management*, **13**, pp. 679-693

Porac, J. and Ventresca, M. (1996), *The social construction of markets and industries*, Pergamon: Oxford

Purchasing, (1996), "Carlos Mazzorin tightens grip at Ford", Vol. 120, No. 2, p. 93

Rowley, T.J. (1997), "Moving beyond dyadic ties: A network theory of stakeholder influences", *Academy of Management Review*, Vol. 22, No. 4, pp. 870-910

Sako, M. (1992), *Prices, Quality and Trust: Inter-firm relations in Britain and Japan*, Cambridge University Press: Cambridge

Saunders, M. (1997), *Strategic Purchasing and supply chain management*, 2nd edition, Pitman Publishing

Scapens, R. (1990), "Researching management accounting practice: the role of case study methods", *British Accounting Review*, Vol. 22, pp. 259-281

Scott, M. and Bruce, R. (1987), "Five stages of growth in small businesses", *Long Range Planning*, Vol. 20, No. 3, pp. 45-52

Searle, J.R., (1996) *The construction of social reality*, Penguin: London

Slack, N., Chambers, S., Harland, C., Harrison, C., Johnston, R. (1995), *Operations Management*, Pitman Publishing

Storey, D. (1994), *Understanding the Small Business Sector*, Thomson International

Submission 1: see McKenzie, R. (1999)a,

Submission 2-1: see McKenzie, R. and Goodhead, T. (1999),

Submission 2-2: see McKenzie, R. and Brennan, N. (1999),

Submission 2-3: see McKenzie, R. (1999)b,

Submission 3-1: see McKenzie, R. (2000)a,

Submission 3-2: see McKenzie, R. (2000)b,

Submission 3-3: see McKenzie, R. (2000)c,

Submission 4-1: see McKenzie, R, (2000)d,

Submission 4-2: see McKenzie, R. (2000)e,

Turnbull, P.W. and Valla, J-P (1986) (eds.), *Strategies for international industrial marketing*, Croom Helm, London

Whittington, R (1993), *What is strategy - and does it matter?*, Thomson Business Press, London

Wiele, T. van der and Brown, A. (1998), "Venturing down the TQM path for SMEs", *International Small Business Journal*, Vol. 16, No. 2, pp.50-58

Williamson, O.E. (1979), "Transaction cost economics: the governance of contractual relations", *Journal of Law and Economics*, Vol. 22, pp. 233-261

Womack, J., Jones, D., Roos, D. (1990), *The Machine that Changed the World*, Rawson Associates

Womack, J. and Jones, D. (1996), *Lean Thinking, Banish waste and create wealth in your corporation*, Simon & Schuster

Yin, R. (1994), *Case Study Research: Design and Methods*, Beverly Hills: Sage

A Appendix A An example AutoLean I report and analysis ASP Group Ltd

AutoLean[1] Project

Initial Study of ASP Group Ltd.
June 26, 1998

Compiled by Paul Chapman[2] & Michael Szczygiel[3]

[1] AutoLean is supported by ACCELERATE with funds from the European Regional Development Fund.
[2] Paul Chapman is a Research Fellow with Warwick Manufacturing Group, University of Warwick.
[3] Mike Szczygiel is Information Services Director with the European Automotive Initiative Group.

Visit Context & Objectives.

The AutoLean programme aims to assist small and medium sized automotive suppliers in the West Midlands to apply electronic communication tools which minimise waste in their order management process. In particular, this company visit aimed to understand how Unipart places orders with ASP Group, how that information is used to organise production and how orders are delivered.

To achieve these objectives, the order management process was mapped, detailing all the steps along it. In addition, the effectiveness of the process was measured in terms of the value adding time it contains and its level of defects. This data has identified opportunities to improve the process which will lay the basis for determining how improved communications will deliver quantifiable benefits.

Company Details

Table 1

Company Name	ASP Group
Contact Name	Ian Quinn
Position	Sales & Marketing Director
Address	Second Avenue, Pensnett Estate Kingswinford West Midlands. DY6 7PP
Telephone Fax E-mail	01384-291 900 01384-400344 ASPGROUP@compuserve.com
Ownership	Private Ltd. Company (4 owners)
Number of Employees	22
Turnover	£ 3.4 million
Total Number of Part Numbers Supplied Number of Runners Number of Repeaters Number of Strangers	Value added : hundreds Calsonic: 70 All: thousands Calsonic:55 Calsonic:10 Calsonic:5
Total Volume of parts supplied (# of units)	millions Calsonic: 1 million
Total Number of customers Number of Regular Customers	100 45
Major Customers Names	Calsonic, Scahade ITW, AMTL, Covrad, AU Automation
Total Number of Suppliers Number of Regular Suppliers	600 300-400 Schade 33 Calsonic 2
Major Suppliers Names	EBSLOH AG (Part of same group)
Request for Quotations (RFQs) per month	30/40 Automotive: 10
New Product Introductions per year	100
Calsonic Contact	

Process Mapping

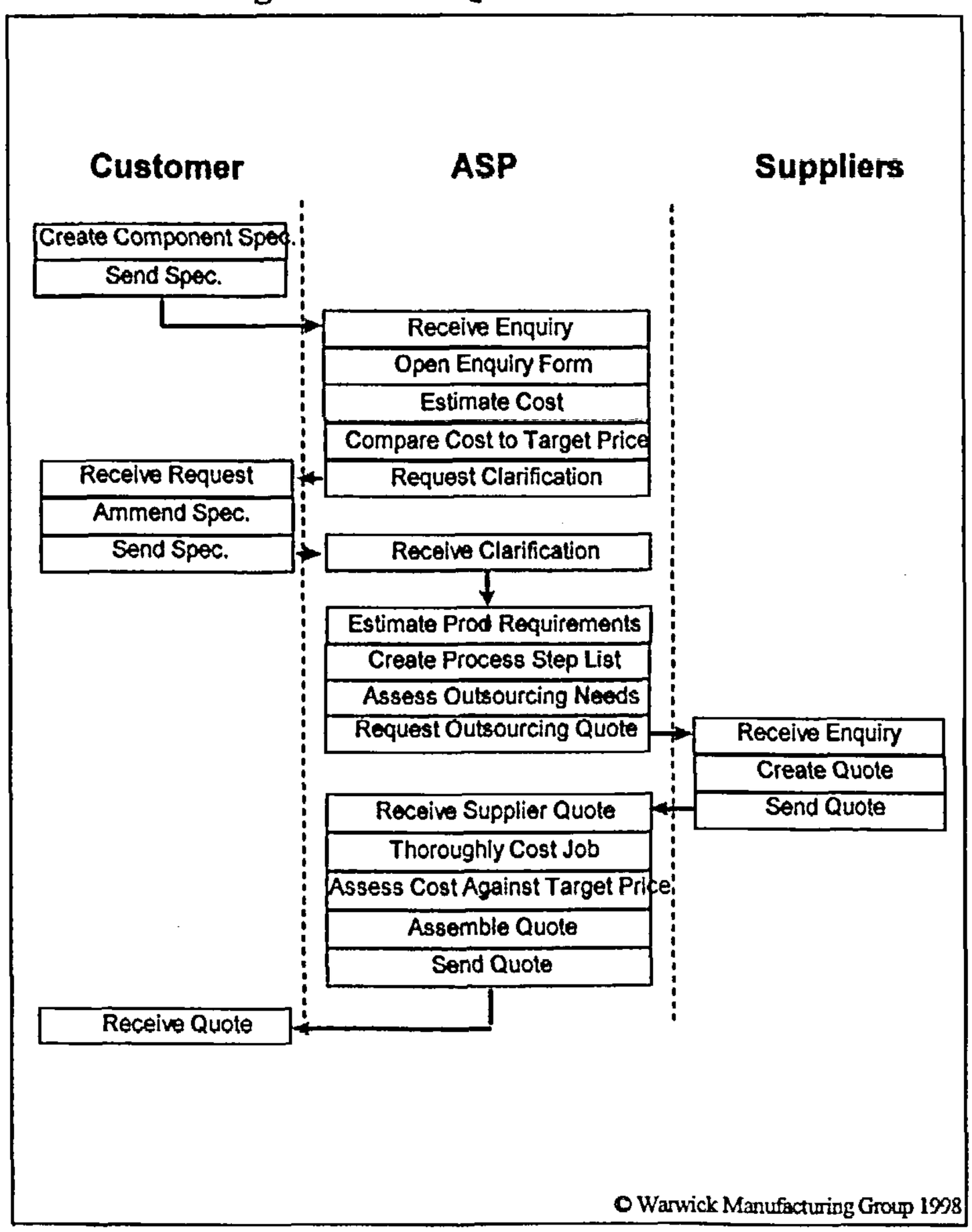
Processes are used to convert inputs into outputs. In production processes, raw materials are converted into goods and products. In a similar way, the order management process uses customer orders and other data as its raw materials, converting them into the information necessary to produce the required products. Often this process is lengthy both in terms of the time it takes and the number of steps it contains.

Our investigation at ASP revealed that the complete order management process can be broken down into three sections: Quotation, New Product Introduction and Delivery. The results of the analysis of these processes is shown below:

The Quotation Process.

In order to understand the complexity found in the order management processes, it needs to be mapped. The flow charts shown below simplify the processes allowing them to be understood through capturing all steps and illustrating how they relate to each other.

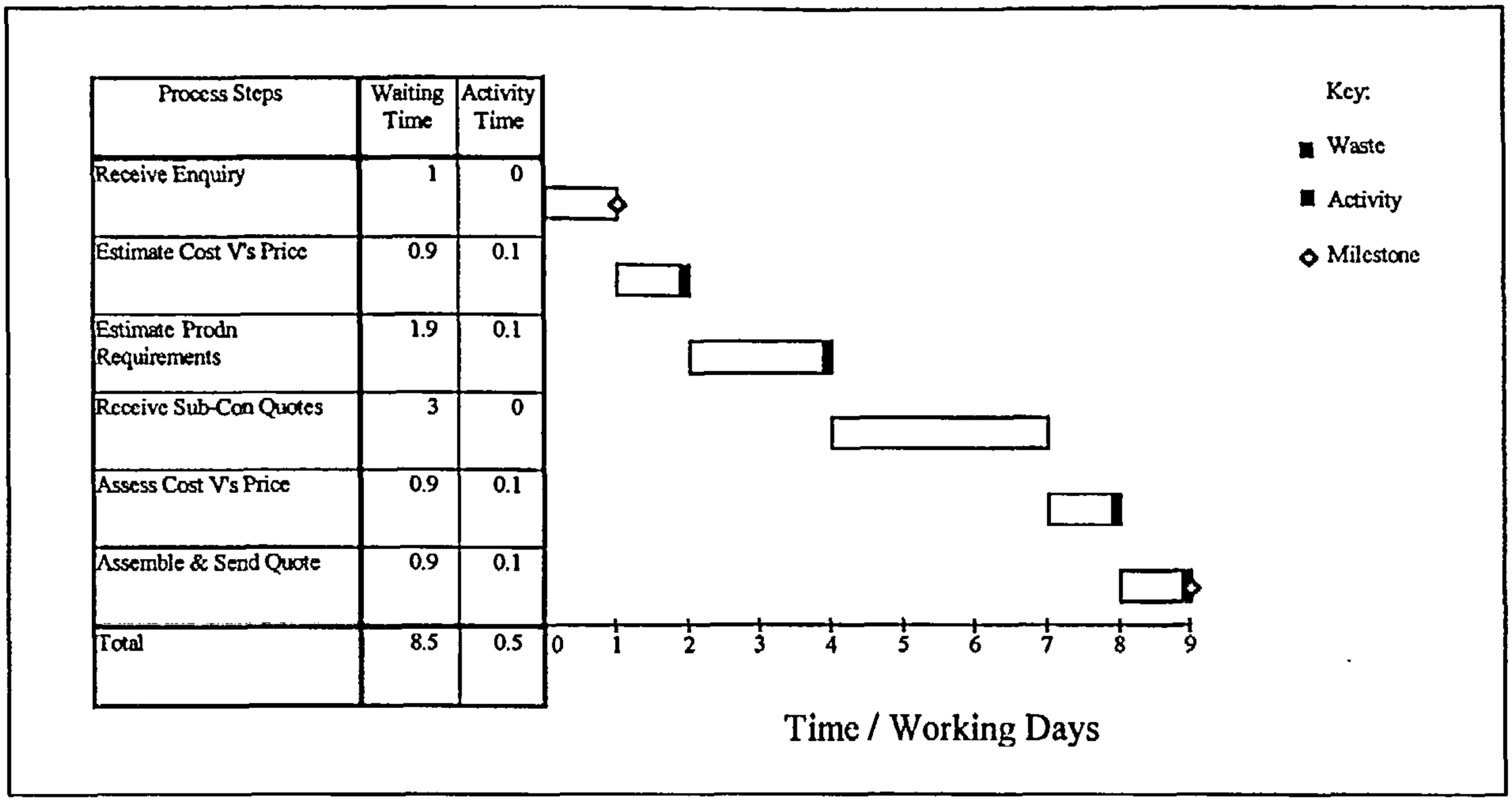
Figure 1. The Quotation Process



Time Based Analysis.

In order to establish the performance of the process shown in Figure 1, measurements are required. The key metric used in this exercise is time. Measuring the process in relation to time establishes a performance baseline. The data collected during this analysis is displayed here in the Time Based Process Map, Figure 2. Time Based Process Mapping is a technique for visually representing the steps in a process in relation to time.

Figure 2. Quotation Process - Time Based Process Map



Process Steps	Waiting Time	Activity Time
Receive Enquiry	1	0
Estimate Cost V's Price	0.9	0.1
Estimate Prodn Requirements	1.9	0.1
Receive Sub-Con Quotes	3	0
Assess Cost V's Price	0.9	0.1
Assemble & Send Quote	0.9	0.1
Total	8.5	0.5

The measurement of time across the process has been categorised in two different ways:

Wasted Time
Activity Time

Here activity time is used as a measure as it provides an approximation for value added activity. Time is considered to be truly value adding only when all three of the following rules are true:
The product/document/information was physically changed
The customer cares about that change
The change was done right first time

Activity time only takes into account the first of these rules, i.e. that the thing in the process was physically worked upon. Whether this is actually Value Added depends upon the end customer caring about that change and doing it right first time.

Non-value adding time is everything else and will include time where the thing going through the process stood idle, was being reworked or underwent a step the customer did not care about. Examples of this are waiting in queues, waiting for decisions, rework and unnecessary operations.

Analysis of the Quotation Process.

The quotation process begins when a customer sends ASP an enquiry. This process can be considered complete when the person generating that request receives ASP's quote in reply.

Examining the process in Figure 1 which creates this quote, it is clear that an extensive process exists. From the point of view of the quote passing the process, there are 24 steps it needs to go through before reaching the customer.

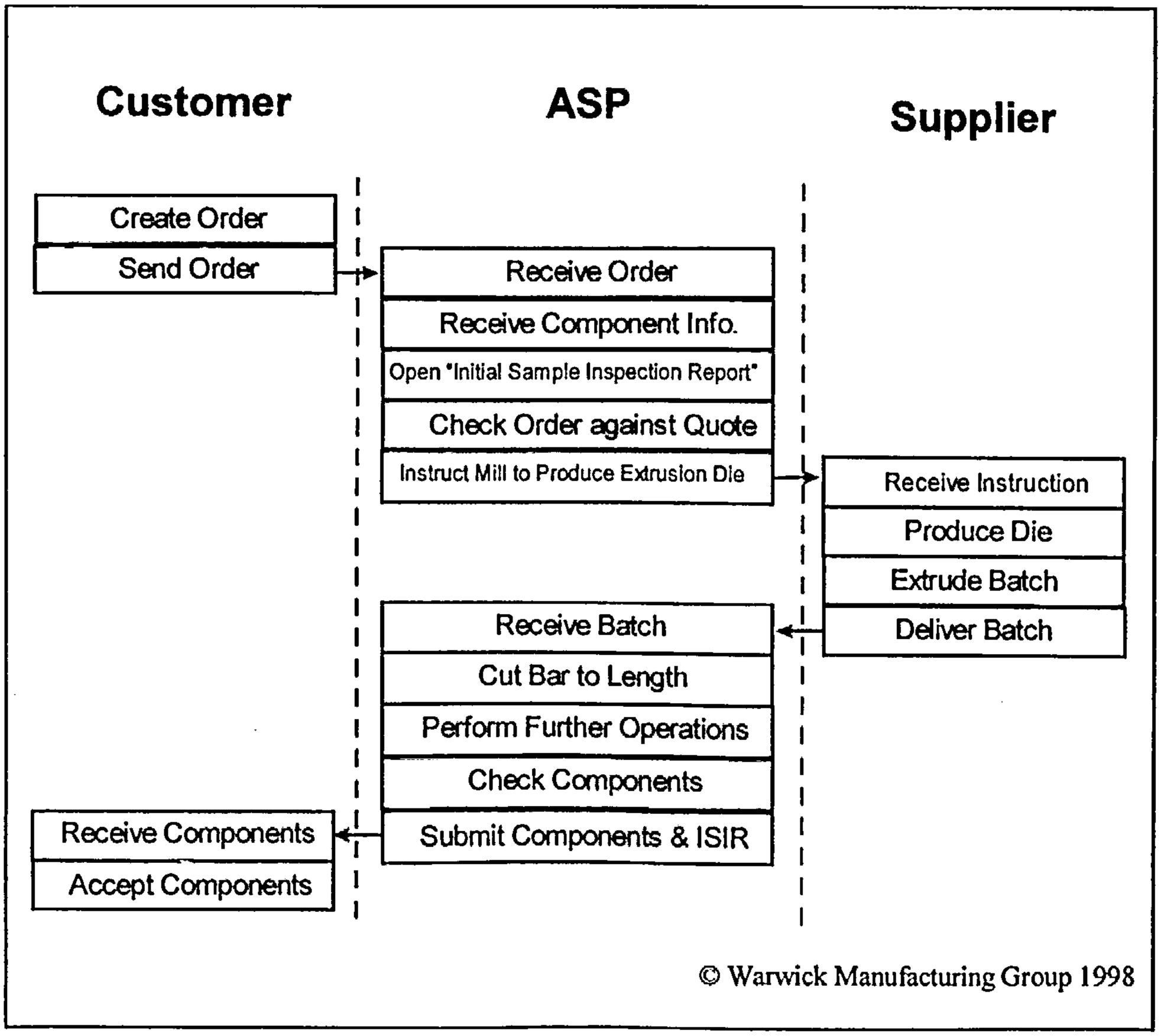
The performance of this process is revealed in Figure 2, the Time Based Process Map. It can be seen that much of the time the quote spends during this process is idle. In fact, the amount of time the quote was worked on was only 5½ % of the time that elapsed.

Given the importance most customers stress upon timely responses to their needs, it is clear that this process contains opportunities to improve.

New Product Introduction Process.

Once a customer accept a quote for a new product from ASP they create an order for it. The New Product Introduction process is then followed until the customer accepts a first off production sample. This process is captured in Figure 3.

Figure 3. - New Product Introduction Process

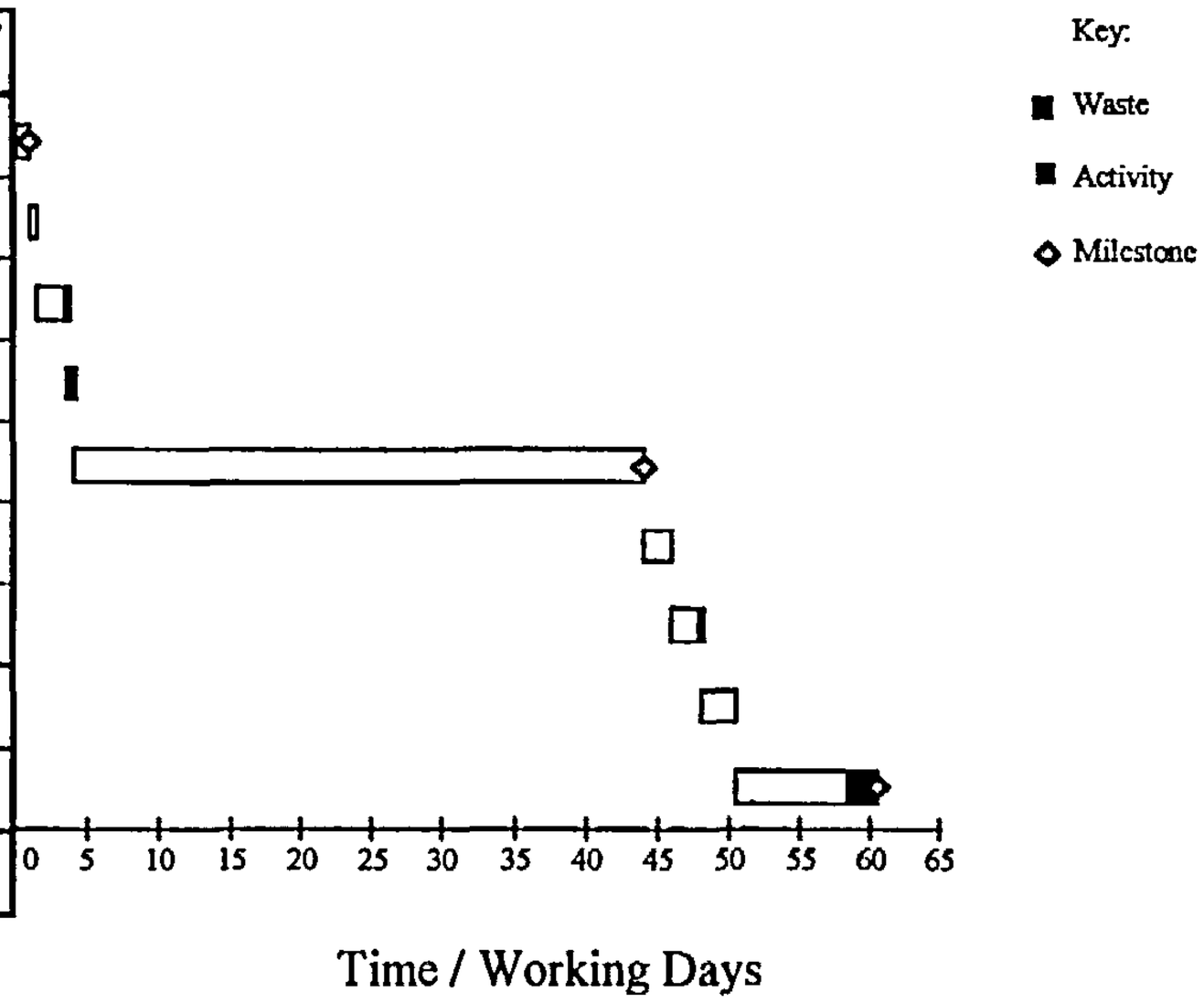


Analysis of the New Product Introduction Process.

Once again, the process is measured in terms of the consumption of time, as shown in Figure 4.

Figure 4. New Product Introduction - Time Based Process Map

Process Steps	Waiting Time	Activity Time
Receive Order	1.0	0.0
Open ISIR	0.4	0.1
Check Quote	1.9	0.1
Instruct Mill to Produce	0.4	0.1
Receive Material	40.0	0.0
Machine Component	1.9	0.1
Check Component	1.9	0.1
Submit Component & ISIR	2.5	0.0
Accept ISIR	8.0	2.0
Total	57.9	2.6



Considering the process from the perspective of the thing flowing through it there appears to a substantial amount of wasted time. In this case, during only 4¼ % of the elapsed time does any activity happen. In other words, over a process that lasts nearly three months, only two and a half days are spent working on the new product.

Scheduled Order to Customer Receipt of Components Process

The final order management process undertaken at ASP is the ongoing supply of goods. This process begins with an order or a call-off against a blanket order and finishes with the receipt of goods by the customer. This is shown below in Figure 5. Figure 6 shows the corresponding Time Based Process Map.

Figure 5. - Scheduled Order to Customer Receipt of Components Process

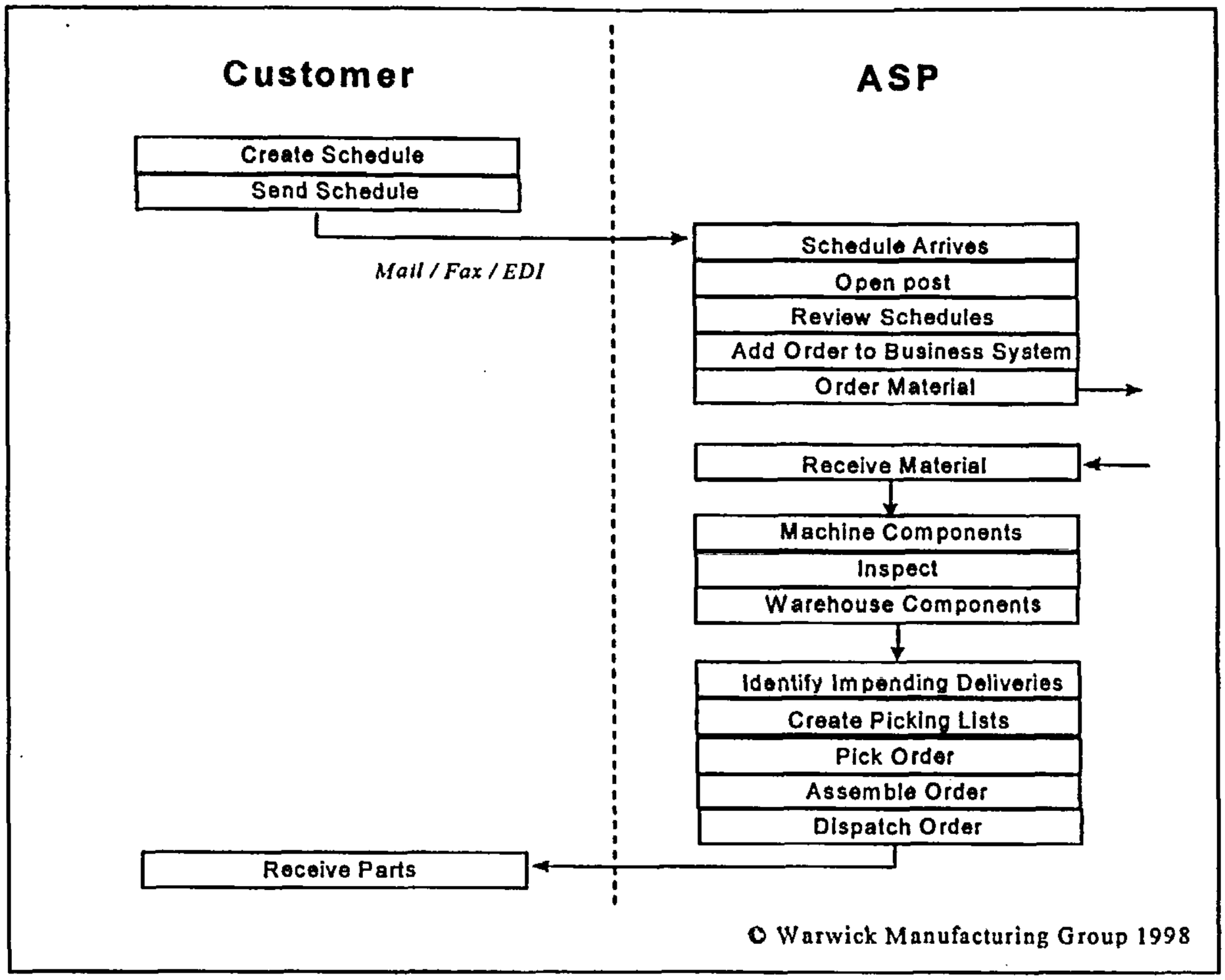
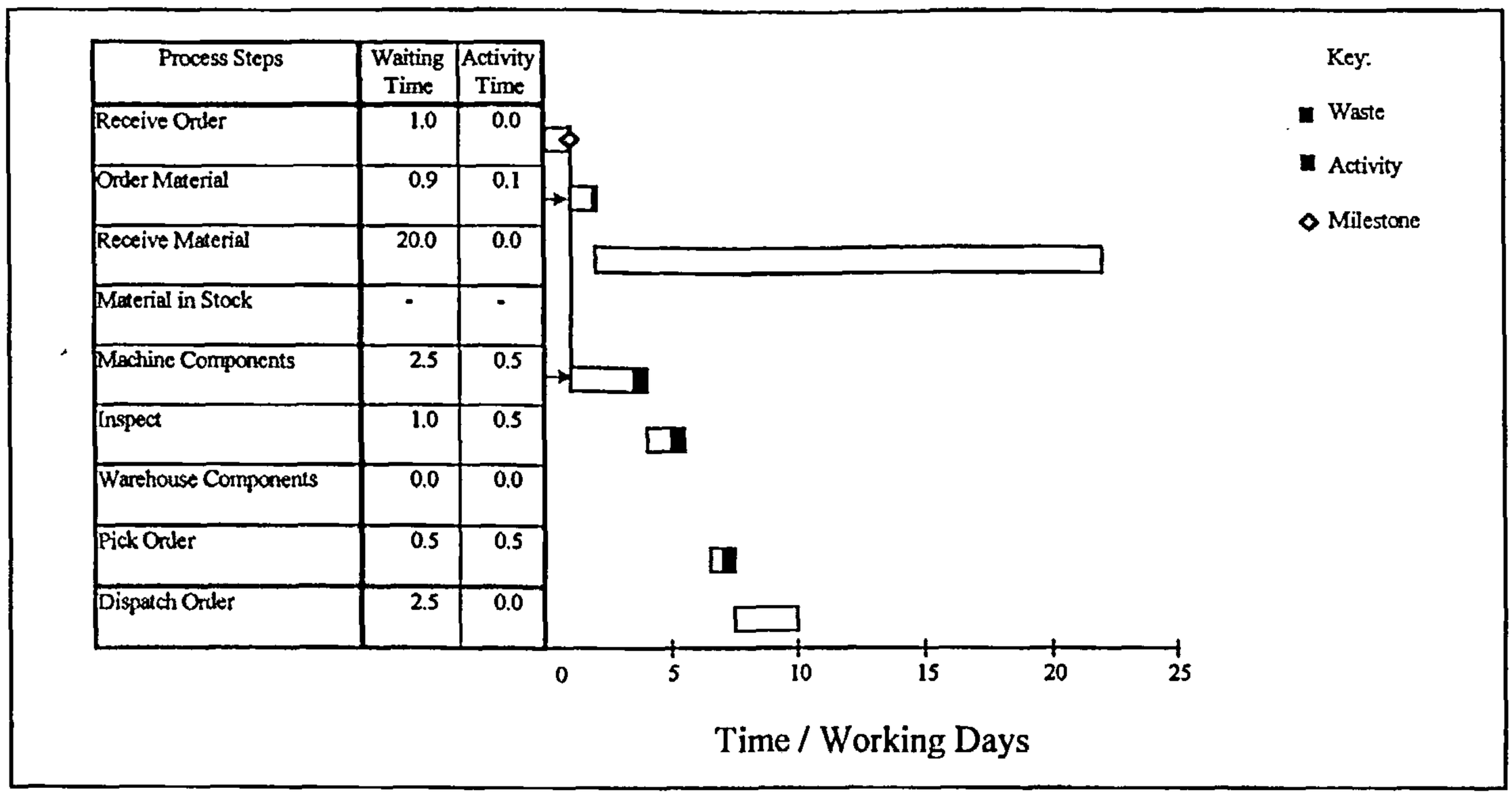


Figure 6. Scheduled Order to Receipt of Components -Time Based Process Map



Process Analysis.

The Order to Receipt of Components process has two possible routes. Where material is in stock, the process take around nine days, within which there is one and a half days of activity. When material must be ordered to satisfy an order than the lead time is increased by an extra twenty days

Opportunities for Improvement.

The AutoLean Programme aims to apply communication technologies to supply chain interactions in order to improve the effectiveness and efficiency of both the customer and the supplier. The following perceived Strengths and Challenges provide a context for identifying and assessing opportunities.

ASP Strengths	ASP Challenges
Strong vision of future position in the supply chain and how supply chain should function Keen to use IT to the fullest Good instinct for value added business opportunities Prepared to take the action needed to forge ahead	Overcoming poor record of on-time shipments

Near Term Opportunities.

Establishing internet communications with SME suppliers in the Midlands under aegis of Accelerate programme.

Long Term Opportunities.

This vision for long term radical improvement is presented based upon the opportunities and threats faced by the company. It requires significant upgrading of position in the supply chain supported by appropriate investment in training and technology. These look beyond the life of the AutoLean programme but will radically improve the effectiveness of the business in the long term, providing a vision of where the company could evolve to.

Opportunities	Threats
Building a dynamic, intelligent supply chain information system with strong emphasis on near real time response to changing conditions. ASP's major customer, Calsonic, is committed to the use of electronic commerce.	Organisational, getting everyone in the supply chain to buy into the "Vision" Promoting the benefits of supply chain coordination to customers and suppliers alike. Selecting vendors that can supply such a system Avoiding temptation for each company to do its own thing thus ending up with islands of automation linked together by E-mail and EDI.

ASP - Business Metrics

The following are categories of measurement which can be used for benchmarking purposes.

Table 2.

Metric	June 98	Nov 98
Lead Time Information Flow RFQ Production Call Off		
Finished Inventory Turnover (stockturns /yr)	25	
On-Time Shipments	pretty poor	
£ Spent on Premium Freight	a lot - many thousands	
Telephone/fax contact with Calsonic No per month Staff hours/month Charges per month		
Email messages per month Staff time/month	N/A	
Unplanned Changeovers: Number Cost	not much	
Inventory: Obsolete Excess	£ 50-60 K on distribution side	

Telephone use and fax use are the most reliable metrics to track since accurate data can be obtained from telephone company records. E-mail message creation and transmission can also be tracked.

Supplemental Background Information

Overseas business growing, USA, Taiwan, Israel
Office in St. Louis
Complex environment
Fast Growth due to move into value added fabrication
IT technology enthusiastic
Highly integrated information flow, want to look in on supplier's stock levels
Weekly call-off from Calsonic
Direct call-from SCHADE
Static build plan for month with daily variations
30 suppliers, 17 in Midlands 1/3 of product is value added, 2/3 is logistic clearing house (consolidator).
ASP picks up products from suppliers using its own truck.
Tight synchronization of supplier pickup and delivery to customers.

B Appendix B An example of an AutoLean II SOAT report Brookvale Manufacturing

AutoLean[4] Project

Brookvale Manufacturing Co. Ltd

Interview Date: September 22, 1999

Compiled by Robin McKenzie[5] & Michael Szczygiel[6]

[4] AutoLean is supported by ACCELERATE with funds from the European Regional Development Fund.
[5] Robin McKenzie is a Research Fellow with Warwick Manufacturing Group, University of Warwick.
[6] Mike Szczygiel is Information Services Director with the European Automotive Initiative Group.

1. Visit Context & Objectives

1.1 AutoLean Objective

The AutoLean programme aims to assist small and medium sized (SME) automotive suppliers in the West Midlands to apply the Internet to supply chain communications and improve the efficiency of key business process that involve communications with customer and suppliers.

1.2 What this report contains

In order to meet the AutoLean objective, the report details data gathered from the visit and is presented in the following order.
Section 2 Company Overview. This includes details on the company and the company's strengths, weaknesses and opportunities, together with the company's near and far term opportunities for the Internet.
Sections 3 Business Processes. The three key business processes are then mapped, detailing all the steps along them. Business processes map primarily the flow of information, but may map other areas for example material. The effectiveness of these processes is measured in terms of the wasted time they contain verses activity time. These three processes are:
The Quotation Process,
The New Product Introduction / Engineering Change Process,
The Orders to Customer Receipt of Components Process.
An analysis is given for each of the processes in turn together with specific internet opportunities for each process.

1.3 The benefits of assessing the company in these ways

An overview of the company is obtained. The AutoLean programme to date has interviewed 50 Small and Medium Sized Companies, so the strengths, weaknesses and opportunities of the company together with its opportunities to develop the use of the internet is judged not in isolation, but with reference to these SMEs as a whole.
The operations within the SME. This has been judged by one respected commentator[7] to be about 80% of the SME. These three processes form the core processes for the delivery of product to customers and that an understanding of these processes, however simplified and approximate, is seen as necessary as a starting point for increasing the effectiveness and efficiencies of the business.
The issue of time. Customers are expecting suppliers to continually respond quicker. The new communication technologies including the Internet are both an enabler for this to happen and a driving force demanding even faster response times. The use of process mapping techniques identifies the steps in each process, together with the time to complete that step. But by breaking the time down into time when nothing happens, 'waste time' and time when something does happen, 'activity time, the efficiency of each step and of the overall process can be seen. This simplified analysis does not even identify how effectively the step is being done, as activity time can be further divided into value-added time and non-value added time. This issue of value and no-value added time is for the SME to consider.
The need for innovation. A finding from the programme so far is that the SMEs which are seeking to look for new markets and/or opportunities to sell their existing competency, the more likely the company will continue and prosper. This is why the new product development process is mapped.

[7] Hill, T. (1987), *Small business, production/operations management*, Macmillan, p.12

One process, not three processes. The three processes outlined are in fact three parts of the same single process. This single process addresses in one coherent way the operations and innovations issues outlined.

2. Company overview

2.1 Company Details

All data will be treated as confidential!

Company Name	Brookvale Manufacturing Ltd.
Contact Name	Bob Crumpton
Position	
Address	15 Reddicap Trading Estate Sutton Coldfield West Midlands B75 7DQ
Telephone Fax E-mail	0121 378 0842 0121 31117 Brookvale@allcomm.co.uk
Ownership	
Basic Product Line/Service	Metal stampings
Product Service Category 1 plastic moldings 2 surface finishing 3 toolmakers 4 foundry 5 module assembly 6 machining/metal forming 7 light fabrication / assembly	6
Number of Employees	35
What level are you? Tier 1,2 3 4 or combo?	Tier 1 to Jag Tier 2
Turnover Total % bought in % Automotive related of total_____ Largest automotive customer VM, Tier 1 Tier 2 If VM: European, North American, Japanese Transplant	£1 Million 30% £700,000 (70%) Jaguar VM
% of Non-UK Business	(Now 2%) (Future ?)
Total Number of Part Numbers Supplied Total Number of Auto Part Nos. Supplied Total Number Largest Automotive Customer % of Runners within total supplied % of Strangers within total supplied	150 66 18 100%
Total Volume of parts supplied (# of units)	3 million
Total Number of Customers Number of Regular Customers	46 36

Number of significant to you automotive customers	18 ??
Is identity of vehicle known?	Yes
Chain #1 Major Customer > Their Customer Chain #2 Major Customer > Their customer Chain #3 Major Customer > Their customer	Jag IBC Saab
Total Number of Suppliers Number of Regular Suppliers	35 28
Supplier '#1 Supplier #2 Supplier #3	Griffiths Wire Thyssen Garfield Reyton
Request for Quotations (RFQs) per month How many are won? % that are major jobs (overall)	50 1-2%
New Product Introductions per year (automotive)	11
Unplanned Changeover in shop	3 per month
Finished Goods Obsolete/Excess Inventory	£ 5,000
On time shipments overall On-time shipments for largest automotive customer	98 % 100 %
Automotive Finished goods stocks turns	12 per year
Inventory Overall Inventory for largest automotive customer	£ _____ 4-6 wks £ _____ 4-6 wks
How many computers are there?	now 8 Planned 1
Is there a local area network?	yes
To what degree is computer used for production planning	(none) (some **(much)**
What system do you use? (vendor/brand)	Trojan
Do you have EDI?	No
If Yes how much did it cost? (installation) (annual)	
If not, why not?	Don't need it
Any plans to acquire EDI?	
What % of your business is handled via EDI	
With how many customers do you use it	
With how many suppliers do you use it?	
Telephone bill per annum	£3,000
Man days per month at customers/suppliers sites resolving technical issues	1-2
QS9000 Certified (now) (planned)	**(now)** (planned)
What are your foremost problems involving communications Customer related Supplier related In-house related	 Voice Mail No problem, use fax No

Communications with largest automotive customer	
Forecasts	
Mode	EDI, mail, fax, e-mail
Frequency	1 per year
Horizon	next 12 months
fixed	
advice	
Changes to fixed	_____per_____
Degree of change	2 %
Schedules	
Mode	EDI, mail, fax, e-mail
Frequency	4 weeks
Horizon	3 months
fixed	1 week
advice	
Changes to fixed	_____per_____
Degree of change	50%
Call-Offs	
Mode	EDI, mail, fax, e-mail
Frequency	1 week
Horizon	
fixed	
advice	
Changes to fixed	_____per_____
Degree of change	5%
Supplier Planning Data	
What data of the supplier would be useful in planning your production?	Reliable delivery dates

2.2 Opportunities for Improvement, Summary: Company and Internet

The AutoLean Programme aims to apply communication technologies to supply chain interactions in order to improve the effectiveness and efficiency of both the customer and the supplier. The following perceptions of strengths, weaknesses and challenges provide a context for identifying and assessing opportunities.

2.2.1 Company

Perceived Strengths

Well established in niche markets,
Solid production system, good use of planning tools for production,
Excellent delivery performance,
Quality,
Long relationship with Jaguar,
Own everything.

Perceived Weaknesses

Low win rate on quotations,
No CAD,
Limited vision for new business opportunities,
Lack of awareness of their competence and not cashing in on it (the Jaguar connection),
Low turnover per employee (£28.5K),
Lack of resources to improve product

Perceived Challenges

Finding partners for bigger jobs,
Broadening tier 1 relationships,
Meeting threat from other materials,
Upgrading technical resources,
Balance engineering Vs business interests,
Coming to terms with globalisation.

2.2.2 Opportunities Offered by the Internet

Short Term

The introduction of E-mail and Internet conferencing will allow the opportunity for:
Overall reduction in the cost of customer communications by reducing the need for use of fax, telephone and face-to-face meetings,
Structured management of customer communications providing a *consistent interface* with the customer,
Reduction in general time wasting "hassle" related to communications fax running out of paper, illegible fax pages, misplaced or lost fax pages lines engaged voice mail phone tag,
Customer call off schedules sent via e-mail and entered onto the in-house system without re-keying.

Web site for showcasing capabilities

Long Term

This vision for long term radical improvement is presented based upon the opportunities and threats faced by the company. These look beyond the life of the AutoLean programme but will radically improve the effectiveness of the business in the long term, providing a vision of where the company could evolve.

Electronic Commerce The growth of electronic commerce using the Internet will permeate industry offering new opportunities to develop new and improved relationships with customer staff facilitated by the Internet.

ANX/ENX. ANX, Automotive Network Exchange is a global communications system designed specifically for the automotive industry using Internet technology. Development was spearheaded by the North American Big 3 Vehicle Makers and several big name tier 1 suppliers. ENX, European Network Exchange, the European equivalent of ANX spearheaded by BMW is intended to support the European automotive community with the same approach. Both are very similar and together they will provide a safe, reliable and low cost way for automotive trading partners (at all levels in the supply chain) to communicate on a global basis using low cost Internet technology. A whole new grouping of trading relationships and virtual commercial groupings is most likely to emerge with a high degree of integration between trading partners. Both systems can be expected to make their appearance in the UK within the next 12 months. Brookvale Group Ltd should be alert to the opportunities they will provide for expanding business into new automotive markets. BMWs lead in pushing for the development of ENX should be noted with its implications for Rover and its supply chains.

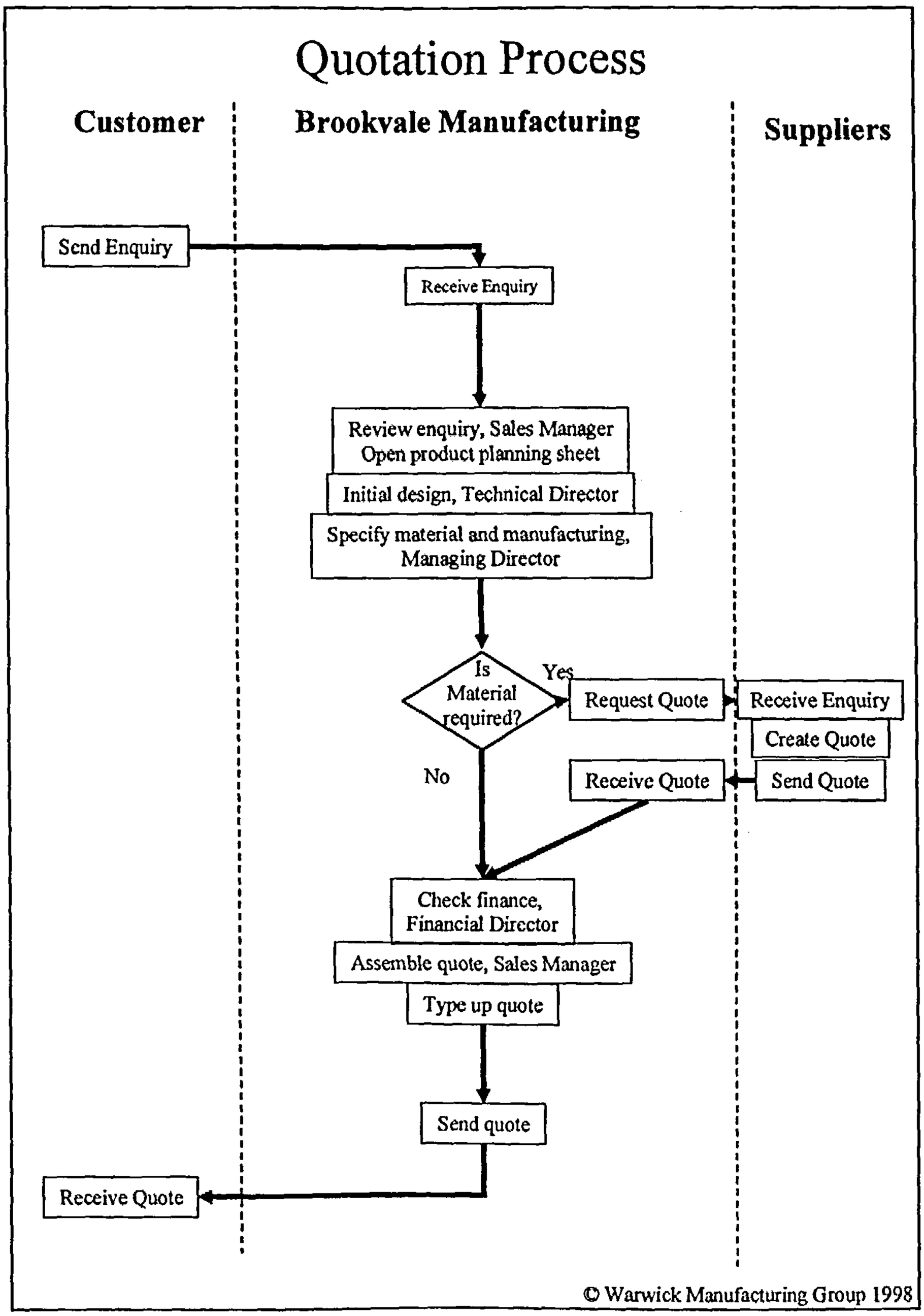
3. Process Mapping

Processes are used to convert inputs into outputs. In production processes, raw materials are converted into goods and products. In a similar way, the order management process uses customer orders and other data as its raw materials, converting them into the information necessary to produce the required products. Often this process is lengthy both in terms of the time it takes and the number of steps it contains.

3.1 Brookvale Manufacturing Co. Ltd Quotation Process

In order to understand the complexity found in the order management processes, the process needs to be mapped. The flow charts shown below simplify the processes allowing them to be understood through capturing all steps and illustrating how they relate to each other.

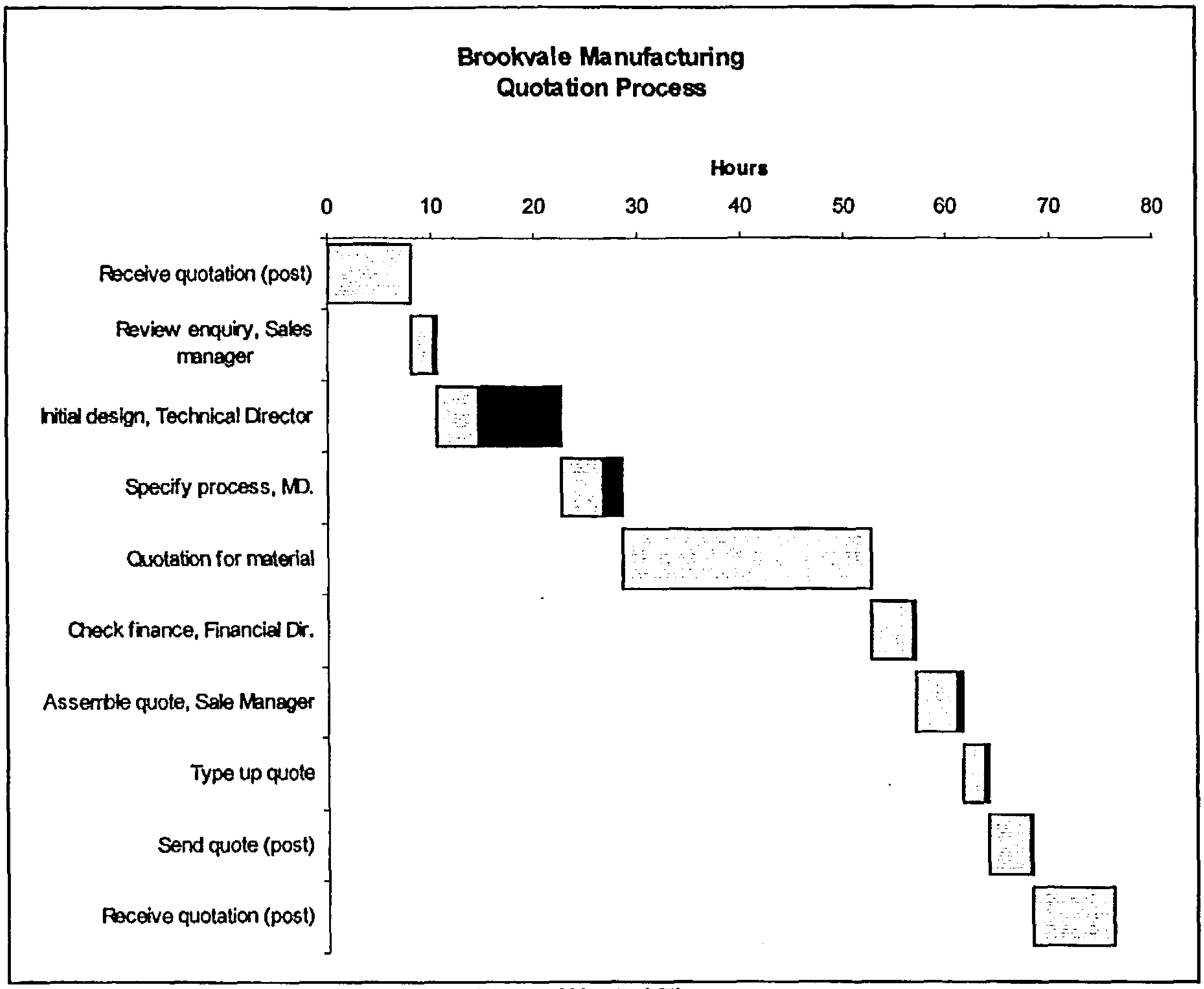
Figure 1. Brookvale Manufacturing Quotation Process



3.2 Time Based Process Analysis.

In order to establish the performance of the process shown in Figure 1, measurements are required. The key metric used in this exercise is time. Measuring the process in relation to time establishes a performance baseline. The data collected during this analysis is displayed here in the Time Based Process Map, Figure 2. Time Based Process Mapping is a technique for visually representing the steps in a process in relation to time.

Figure 2. Brookvale Manufacturing - Quotation Process Time Based Process Map



Grey Bars = Wasted Time
Black Bars = Activity Time

ID	Quote Process Steps Brookvale Manufacturing	Cum hours	W T hours	AT hours
1	Receive quotation (post)	0	8	0.1
2	Review enquiry, Sales manager	8.1	2	0.5
3	Initial design, Technical Director	10.6	4	8
4	Specify process, MD.	22.6	4	2
5	Quotation for material	28.6	24	0
6	Check finance, Financial Dir.	52.6	4	0.5
7	Assemble quote, Sale Manager	57.1	4	0.5
8	Type up quote	61.6	2	0.5
9	Send quote (post)	64.1	4	0.1
10	Receive quotation (post)	68.2	8	0
	Total	76.2	64	12.2

The measurement of time across the process has been categorised in two different ways:

Wasted Time
Activity Time

Here activity time is used as a measure as it provides an approximation for value added activity.

Time is considered to be truly value adding only when all three of the following rules are true:
The product/document/information was physically changed,
The customer cares about that change,
The change was done right first time.

Activity time only takes into account the first of these rules, i.e. that the thing in the process was physically worked upon. Whether this is actually Value Added depends upon the end customer cares about that change and that it was done right first time.

Non-value adding time is everything else and will include time where the thing going through the process stood idle, was being reworked or underwent a step the customer did not care about. Examples of this are waiting in queues, waiting for decisions, rework and unnecessary operations.

3.3 Brookvale Manufacturing Quotation Process, Analysis

3.3.1 Time Based Process Map

The quotation process begins when a customer sends Brookvale an enquiry. is process can be considered complete when the person generating that request receives Brookvale s quote in reply.

Examining the process in Figure 1, which creates this quote, it is clear that an extensive process exists. From the point of view of the quote passing the process, there are 10 seps it needs to go through before reaching the customer.

The performance of this process is revealed in Figure 2, the Time Based Process Map. It can be seen that much of the time the quote spends during this process is idle. In fact, the amount of time the quote was worked on was only 16% of the time that elapsed.

Given the importance most customers stress upon timely responses to their needs, it is clear that this process contains opportunities to improve.

3.3.2 Internet Opportunities

Short Term

E-mail with customers to resolve routine questions,
Receive drawings in digital form.

Long Term

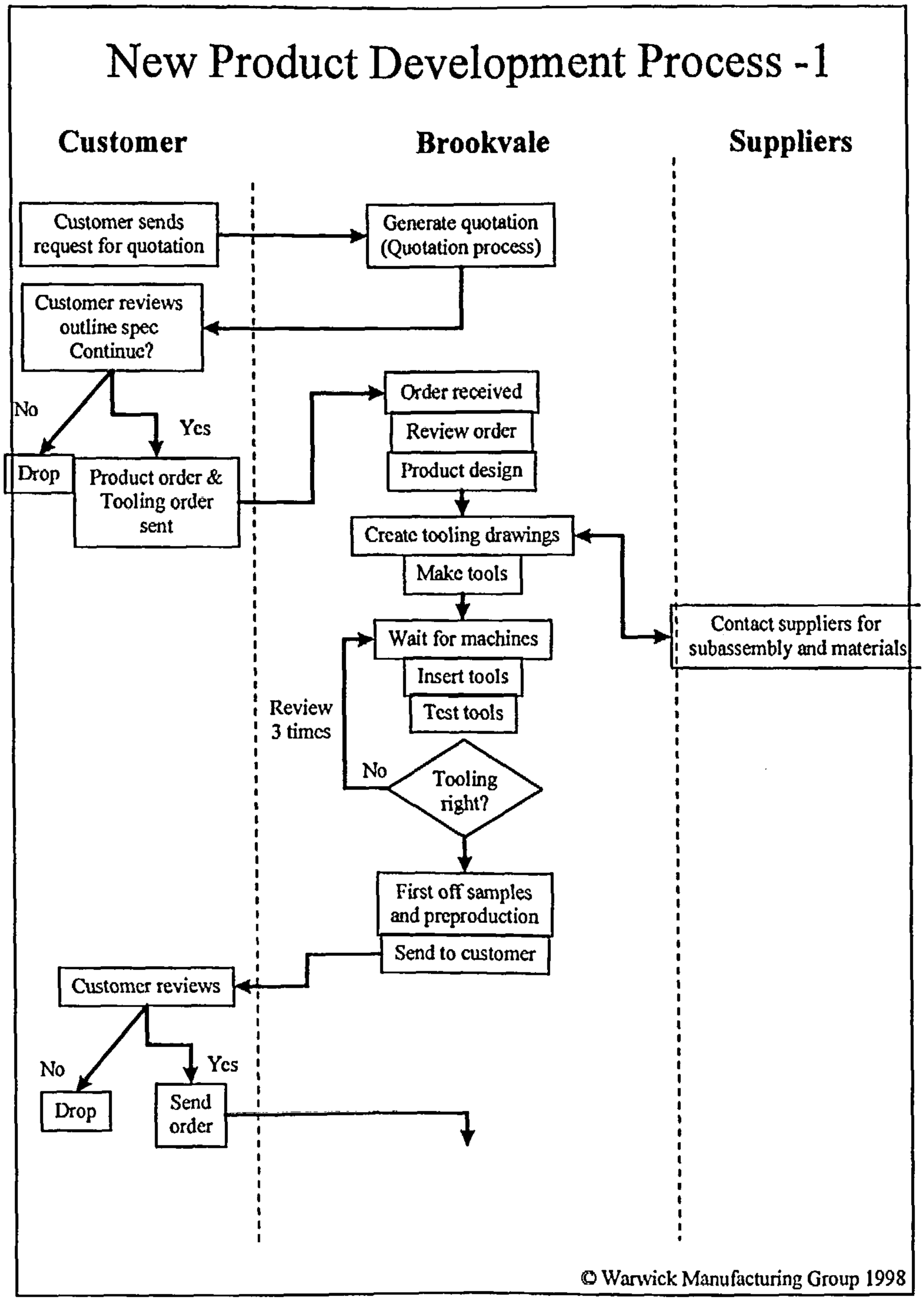
Accessing RFQ at the customer Web site obtaining all relevant documentation in digital form. Quote is submitted as one or more on-line forms provided by customer. This will be provided by customers to speed up the quotation process,

The Internet will facilitate the establishment of brokerage facilities making it easier for buyer and seller to find each other. This will evolve from simple one to one matching where a complete supply chain will be able to offer its services on an integrated basis to prospective customers. The Internet will be used to not only advertise such services but offer the means for a complete brokerage service to be established between buyers and sellers (integrated supply chain groupings).

3.4 The Brookvale New Product Development Process.

Once a customer accepts a quote for a new product from Brookvale, the customer creates an order for it. The New Product Introduction process is then followed until the customer accepts a first off production sample. This process is captured in Figure 3.

Figure 3. Brookvale Manufacturing - Product Development Process



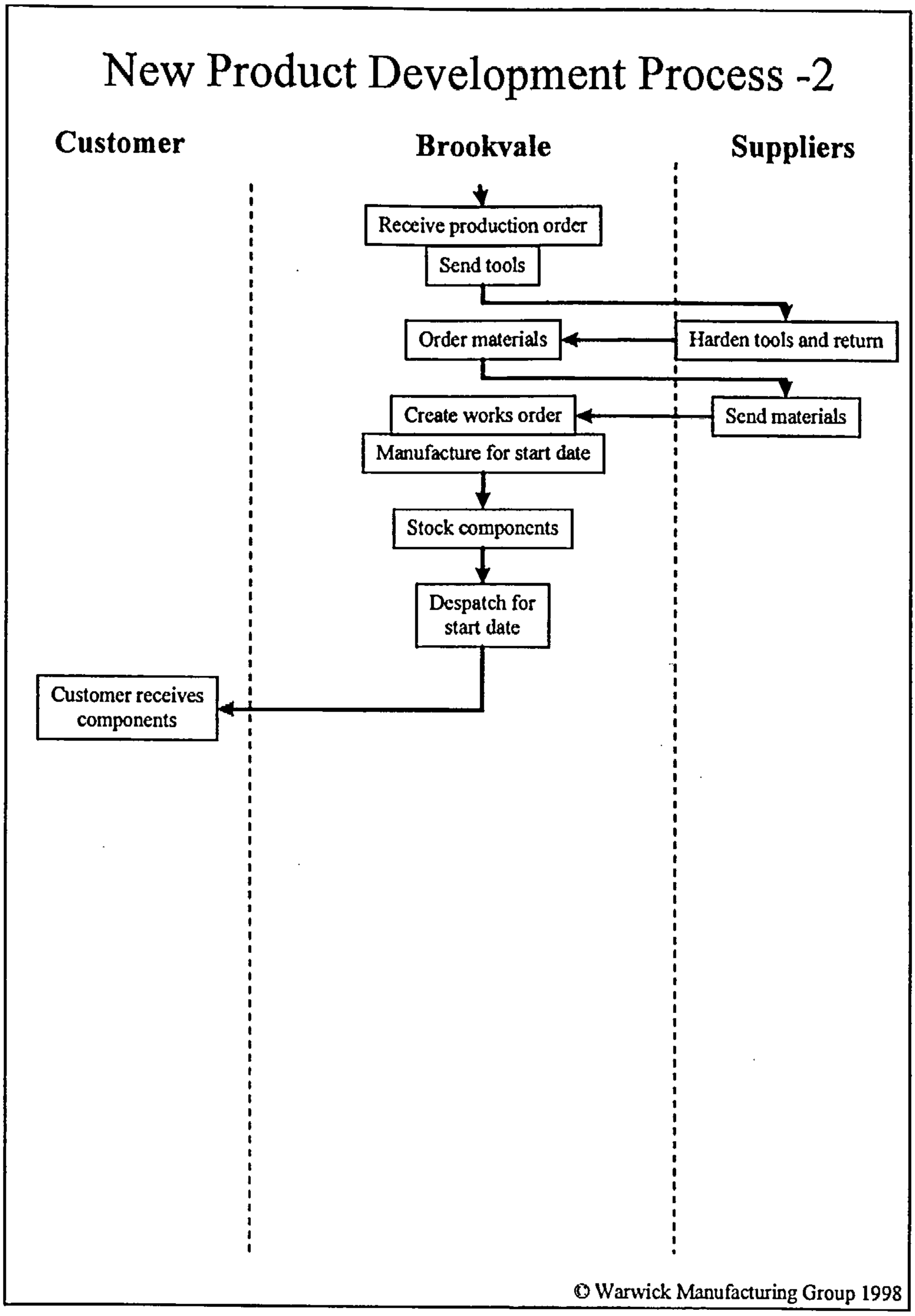
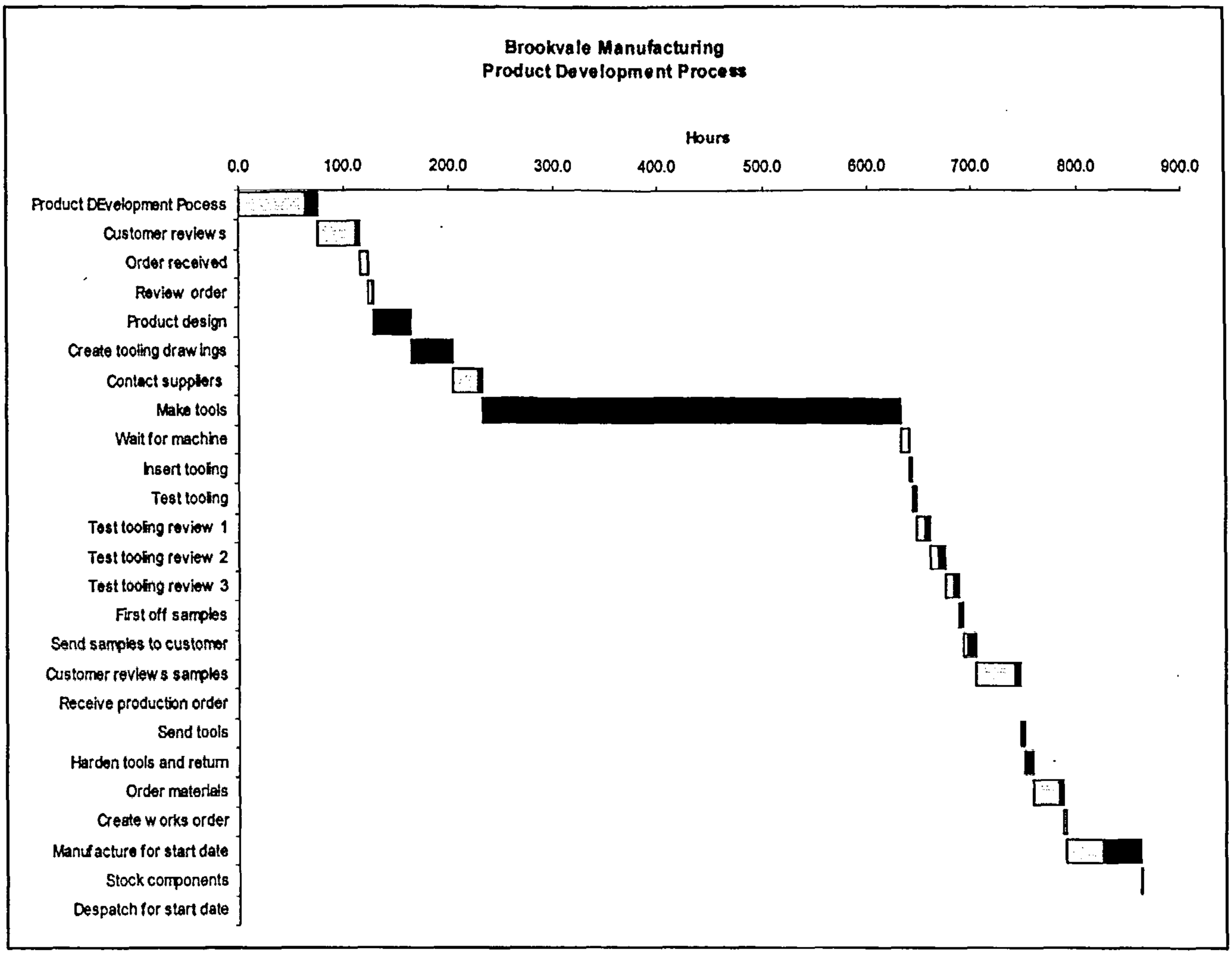

New Product Development Process -2
Customer
Brookvale
Suppliers
Receive production order
Send tools
Order materials
Harden tools and return
Create works order
Send materials
Manufacture for start date
Stock components
Despatch for start date
Customer receives components
© Warwick Manufacturing Group 1998

Figure 4. New Product Introduction Time Based Process Map



Grey Bars = Wasted time
Black Bars = Activity Time

ID	PD Process Steps Brookvale Manufacturing	Cum hours	W T hours	AT hours
1	Product DEvelopment Pocess	0.0	64.0	12.0
2	Customer reviews	76.0	36.0	4.0
3	Order received	116.0	8.0	0.1
4	Review order	124.1	3.5	0.5
5	Product design	128.1	0.0	36.0
6	Create tooling drawings	164.1	0.0	40.0
7	Contact suppliers	204.1	24.0	4.0
8	Make tools	232.1	0.0	400.0
9	Wait for machine	632.1	8.0	0.0
10	Insert tooling	640.1	0.0	2.0
11	Test tooling	642.1	0.0	4.0
12	Test tooling review 1	646.1	8.0	6.0
13	Test tooling review 2	660.1	8.0	6.0
14	Test tooling review 3	674.1	8.0	6.0
15	First off samples	688.1	0.0	4.0
16	Send samples to customer	692.1	4.0	8.0
17	Customer reviews samples	704.1	36.0	6.0
18	Receive production order	746.1	0.0	0.1
19	Send tools	746.2	0.0	4.0
20	Harden tools and return	750.2	0.0	8.0
21	Order materials	758.2	24.0	4.0
22	Create works order	786.2	2.0	0.2
23	Manufacture for start date	788.4	36.0	36.0
24	Stock components	860.4	0.5	0.5
25	Despatch for start date	861.4	0.0	0.0
	Total	861.4	270.0	591.4

3.5 New Product Development Process, Analysis

3.5.1 Time Based Process Map

Although the activity content of this process is 69%, the fact that the process is takes about 5 months means that there is still 6 weeks of wasted time. Most of this is time with the toolmakers (10 weeks). Given that the process is extended there are opportunities to remove the current wasted time, and with working together with the toolmakers and others to reduce the overall time.

3.5.2 Specific Internet Opportunities

Near Term

The exchange of CAD files with the customer.

Long Term

The use of 3D viewers to look at components and jigs in three dimensions and to conduct teleconferencing sessions with the customer using these viewers to resolve design problems.

3.6 The Brookvale Manufacturing Co. Ltd Order to Delivery Process

The final order management process undertaken at Brookvale Manufacturing is the ongoing supply of goods. This process begins with an order or a call-off against a blanket order and finishes with the receipt of goods by the customer. This is shown below in Figure 5. Figure 6 shows the corresponding Time Based Process Map.

Figure 5. – Brookvale Manufacturing Order to Delivery Process

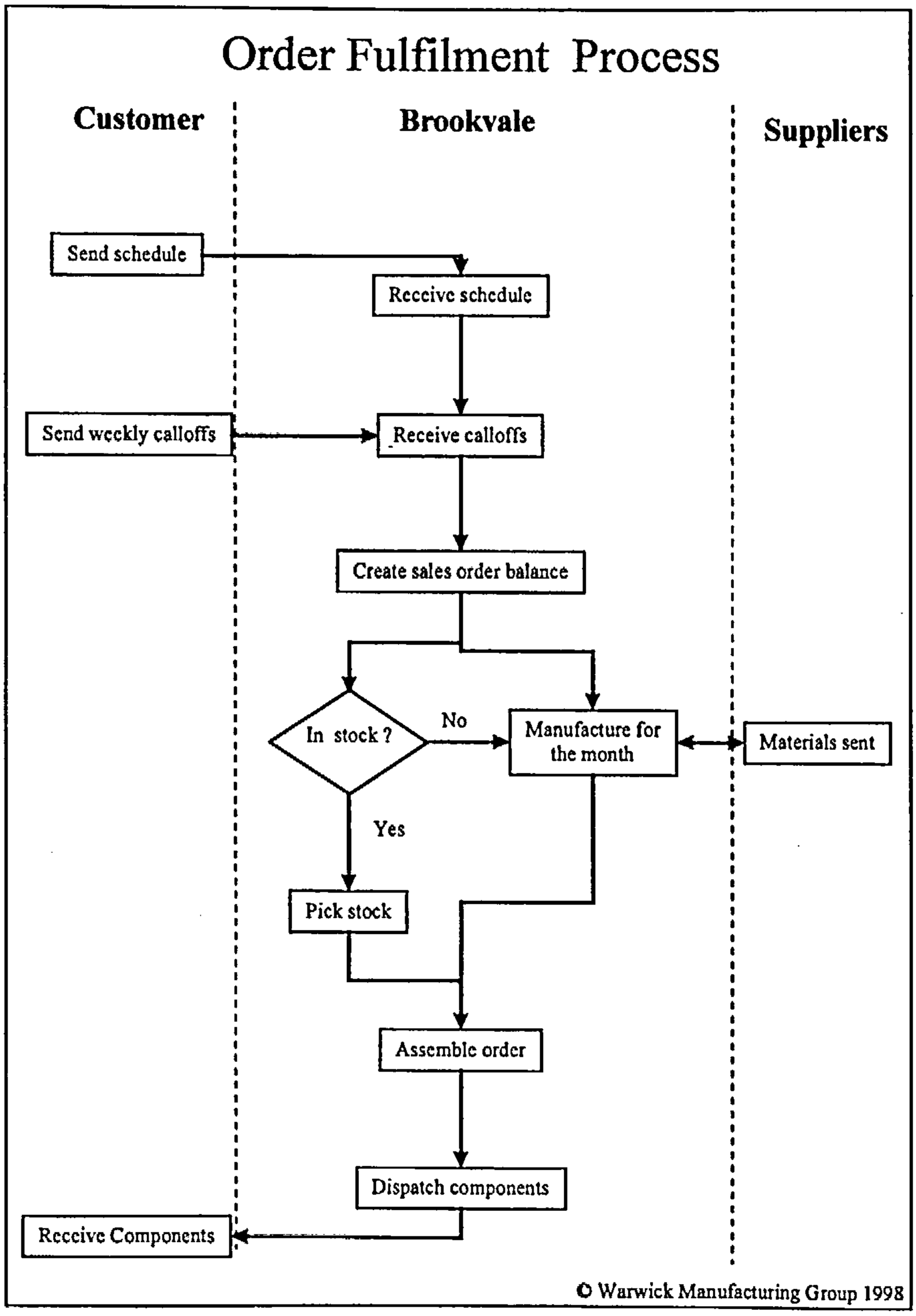
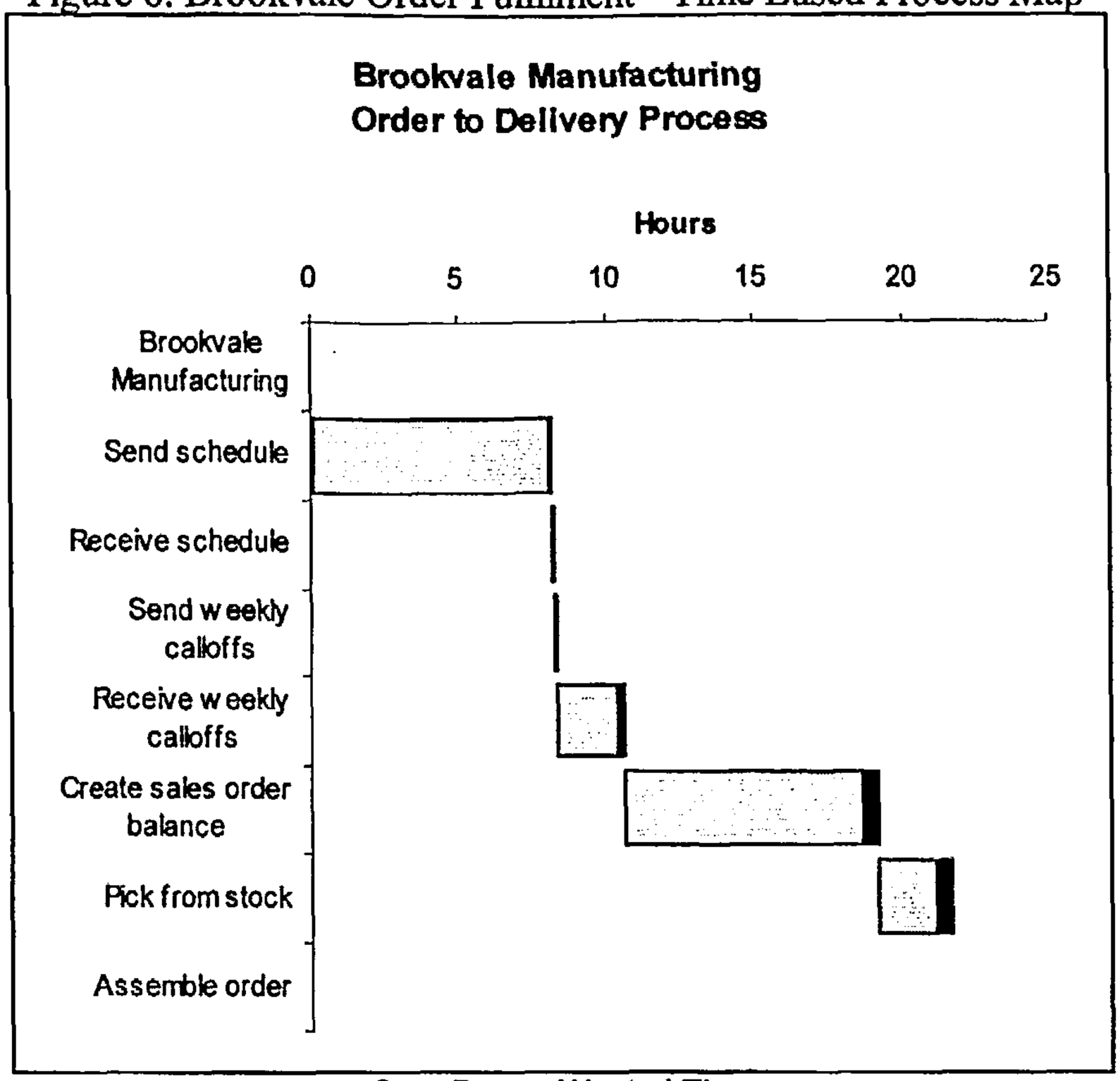


Figure 6. Brookvale Order Fulfilment -Time Based Process Map



Grey Bars = Wasted Time
Black Bars = Activity Time

ID	Order Process Steps Brookvale Manufacturing	Cum hours	WT hours	AT hours
1	Send schedule	0	0	0.1
2	Receive schedule	0.1	8	0.1
3	Send weekly calloffs	8.2	0	0.1
4	Receive weekly calloffs	8.3	0	0.1
5	Create sales order balance	8.4	2	0.25
6	Pick from stock	10.65	8	0.5
7	Assemble order	19.15	2	0.5
8	Dispatch components	21.65	8	0.25
	Total	29.9	20	1.65

3.7 Order Fulfilment Process, Analysis.

3.7.1 Time Based Process Maps

Figure 6 reveals that although is takes 3½ days for the order to be dispatched; only 6% of this is activity time (not including secondary processes). This allows considerable scope for reducing total time either proactively as a competitive advantage or reactively through customer requirements.

3.7.2 Internet Opportunities

Short Term

Receipt of orders via E-mail to replace fax/mail,
E mail communications with both customers and suppliers to resolve call-off issues.

Long Term

Fully integrating the production planning system with orders received over the internet,
Gaining access to forward plans of customers from their web sites.

C Appendix C: Brandenburg (UK)'s SOAT report: An Application SME

SME Assessment Questionnaire and Business Processes Mapping

Brandenburg (UK) Ltd

Interview Dates: 17 February and 2 May 2000

Compiled by Robin McKenzie[8] and Mairi Macintyre[9]

[8] Robin McKenzie is a Research Fellow with Warwick Manufacturing Group, University of Warwick.
[9] Mairi MacIntyre is a Senior Research Fellow with Warwick Manufacturing Group, University of Warwick

1. Visit Context & Objectives

1.1 Visit Objective

The Innovation Direct programme aims to assist small and medium sized (SME) suppliers in the West Midlands to develop new product development capability. As well as appropriate analysis of the product under discussion with the SME, I review of the SME and his capability to bring the product to market is discussed. This is done by reviewing the SME's key business processes to improve their effectiveness and efficiency and to review the possibilities for using Internet and electronic communications technologies to help both in the new product development process and also to improve communications with both suppliers and customers.

1.2 What this report contains

In order to meet the Innovation Direct objective, the report details data gathered from the visit and is presented in the following order.
Section 2 Company Overview. This includes details on the company and the company's strengths, weaknesses and opportunities, together with the company's near and far term opportunities for the Internet.
Sections 3 Business Processes. The three key business processes are then mapped, detailing all the steps along them. Business processes map primarily the flow of information, but may map other areas for example material. The effectiveness of these processes is measured in terms of the wasted time they contain verses activity time. These three processes are:
The Quotation Process,
The New Product Introduction / Engineering Change Process,
The Orders to Customer Receipt of Components Process.
An analysis is given for each of the processes in turn together with specific internet opportunities for each process.

1.3 The benefits of assessing the company in these ways

An overview of the company is obtained. This method for analysis the capability of SMEs has been used in over 50 Small and Medium Sized Companies by Warwick Manufacturing Group, and so is an effective way of assessing the SME In this method the strengths, weaknesses and opportunities of the company together with its opportunities to develop the product under review and the product introduction systems, together with a review of potential internet usage.
The operations within the SME. This has been judged by one respected commentator[10] to be about 80% of the SME. These three processes form the core processes for the delivery of product to customers and that an understanding of these processes, however simplified and approximate, is seen as necessary as a starting point for increasing the effectiveness and efficiencies of the business.
The issue of time. Customers are expecting suppliers to continually respond quicker. The new communication technologies including the Internet are both an enabler for this to happen and a driving force demanding even faster response times. The use of process mapping techniques identifies the steps in each process, together with the time to complete that step. But by breaking the time down into time when nothing happens, 'waste time' and time when something does happen, 'activity time, the efficiency of each step and of the overall process can be seen. This simplified analysis does not even identify how effectively the step is being done, as activity time can be further divided into value-added time and non-value added time. This issue of value and no-value added time is for the SME to consider.

---

[10] Hill, T. (1987), *Small business, production/operations management*, Macmillan, p.12

The need for innovation. A finding from the work done with SMEs is that the SMEs which are seeking to look for new markets and/or opportunities to sell their existing competency, the more likely the company will continue and prosper. This is another reason why this assessment method is appropriate for Innovation Direct as the new product development process is mapped.
One process, not three processes. The three processes outlined are in fact three parts of the same single process. This single process addresses in one coherent way the operations and innovations issues outlined.

2. Company overview

2.1 Company details

All data will be treated as confidential!

General	
Company Name	Brandenburg UK Ltd
Contact Name	John Burrows
Position	Managing Director
Address	24 Navigation Drive Hurst Business Park Bierley Hill West Midlands DY5 1UT
Telephone Direct Fax Mobile E-mail	01384 848 420 01384 843 224 01384 843 421 0771 505 3903 JohnBurrows@astec.co.uk
Ownership	Partnership. Managing Buyout from Astec in May 1999
Basic Product Line/Service	Flykiller products through OEMs
Product Service Category 1 plastic mouldings 2 surface finishing 3 toolmakers 4 foundry 5 module assembly 6 machining/metal forming 7 light fabrication / assembly	7
Number of Employees	50
What level are you? Tier 1,2 3 4 or combo?	Not discussed

Marketing Overview	The market is changing from HV type killing of flies back to an updated flypaper type approach. But here UV is still used as an attractor but the flies will be stuck onto an improved glue board which will withstand UV. The reason for this change is that sometimes when flies are HT electrocuted they 'fragment'. This is no longer acceptable in food processing establishments, and is being driven by HACCP, a technical approach to hygiene control similar in philosophy to TQM. The market was saturated but now this change is fuelling demand. Market could be approximately £200M worldwide.
Competitors	20 world wide All but 2 or 3 are small. One major Italian company is probably slightly larger than Brandenburg, called Cricri.

Turnover, customers and the supply chain	
Turnover Total	1999: £3.2M (8 months); 2000: £6.75M budget
Turnover per Employee	**£96000 pa (1999)**
% bought in	most 80% suggested seemed high
Largest industry sector	Fly catching equipment
% related to largest industry sector	100% to date
Largest industry sector customer	Rentokil
Is product to this industry	Yes
Largest well-known company in supply chain?	Rentokil and S.C. Johnson
European, North American, Japanese	UK and US respectly
% of Non-UK Business	Now: 50%, Future: increase substantially
Total Number of Customers Number of Regular Customers	 3
Number of significant major industry customers	3
Chain #1 Major Customer > Their Customer Chain #2 Major Customer > Their customer Chain #3 Major Customer > Their customer	
Total Number of Suppliers Number of Regular Suppliers	128 10
Supplier '#1 Supplier #2 Supplier #3	Silvanderson, Sweden (glueboards) SLI Lighting (brand name Sylvania), (UV lamps) John Hurley, (Injection Moulding)

Request for Quotations (RFQs) per month **How many are won?** **% that are major jobs (overall)**	N/A. Continuous discussions with major OEMs to suggest new products and to win the business.

New Product Introductions per year)	Continually upgrading of existing fly catch products to update and value engineer cost out. Two new products for 2000: Mosquito catch products and Aroma Dispersal Products

Order to Delivery Process	
Total Number of Part Numbers Supplied Total Number of Industry Part Nos. Supplied Total Number Largest Customer % of Runners within total supplied % of Strangers within total supplied	Estimated about 20 50% 50%
Total Volume of parts supplied (# of units)	Approx. 40000 units now

ISO 9000 Certified (now) (planned)	Was ISO 9001 in the Astec group, but they are being forced to register.
Other standards	Safety testing done at NEMCO for European and Japanese markets and UK for American and Canadian markets

Finished Goods Obsolete/Excess Inventory	£_____
On time shipments overall On-time shipments for largest customer	100% 100%
Finished goods stocks turns	per year
Inventory Overall Inventory for largest automotive customer	£230K Days_____ £_____ Days_____
Unplanned Changeover in shop	many per month

Forecasts	Annual forecasts from Whitmire and SC Johnson
Mode	EDI, mail, fax, e-mail
Frequency	
Horizon	
fixed	
advice	
Changes to fixed	_____per_____
Degree of change	%

Schedules	Rentokil: individual orders for several months ahead Track inventory and sales at Whitmire to ensure supply to US
Mode	EDI, mail, fax, e-mail
Frequency	Every week
Horizon	12 weeks
fixed	8 weeks
advice	3 weeks
Changes to fixed	_____per_____
Degree of change	_____%
Call-Offs	
Mode	EDI, mail, fax, e-mail
Frequency	
Horizon	
fixed	
advice	
Changes to fixed	_____per_____
Degree of change	_____%
Supplier Planning Data	
What data of the supplier would be useful in planning your production?	

Technology for commerce	
How many computers are there?	now Planned
Is there a local area network?	Yes, but is still on Aztec's LAN
To what degree is computer used for production planning	(none) (some) (much)✓
What system do you use? (vendor/brand)	Calicah, West Drayton
Do you have EDI?	N/A
If Yes how much did it cost? (installation) (annual)	
If not, why not?	
Any plans to acquire EDI?	
What % of your business is handled via EDI	
With how many customers do you use it	
With how many suppliers do you use it?	
Telephone bill per annum	£ ?
Website?	Had to give one up on Management buyout. Looking to develop one.

Other issues	
Man days per month at customers/suppliers sites resolving technical issues	

What are your foremost problems involving communications Customer related Supplier related In-house related	 Will put all literature onto website To be on line: need to find suitable vendors online
What do you see as your Strengths? Weakness? Challenges?	Business core competence is in design and manufacture Good technology in products Good value for money Flexible to customer Integrating and using new IT systems Need more expertise, or access to expertise To be able to meet and cope with expects future growth.

2.2 Opportunities for Improvement, Summary: Company New Product Development and Internet

The Innovation Direct Programme aims to apply communication technologies to supply chain interactions in order to improve the effectiveness and efficiency of both the customer and the supplier. The following perceptions of strengths, weaknesses and challenges provide a context for identifying and assessing opportunities.

2.2.1 Company

Perceived Strengths

Quality,
On-time performance,
Flexibility,
Forward thinking mentality which includes a particular flare for product innovation
A willingness to learn,

A collaboration mentality with other small businesses to provide release funds and time to enable Brandenburg to play to its strengths,
A clear understanding and management of the existing production system,

Perceived Weaknesses

A six to eight week production culture,
Appropriate management of the new product introduction process,
The need to increase engineering expertise given the desire of Brandenburg to become an 'innovation warehouse'. This could be acted upon in the short term by the acquisition of a graduate with some experience (2-3 years) who could perhaps be taken on under a Teaching Company Scheme. The aim would be that this person would be recruited full time at the end of the scheme period.

Perceived Challenges

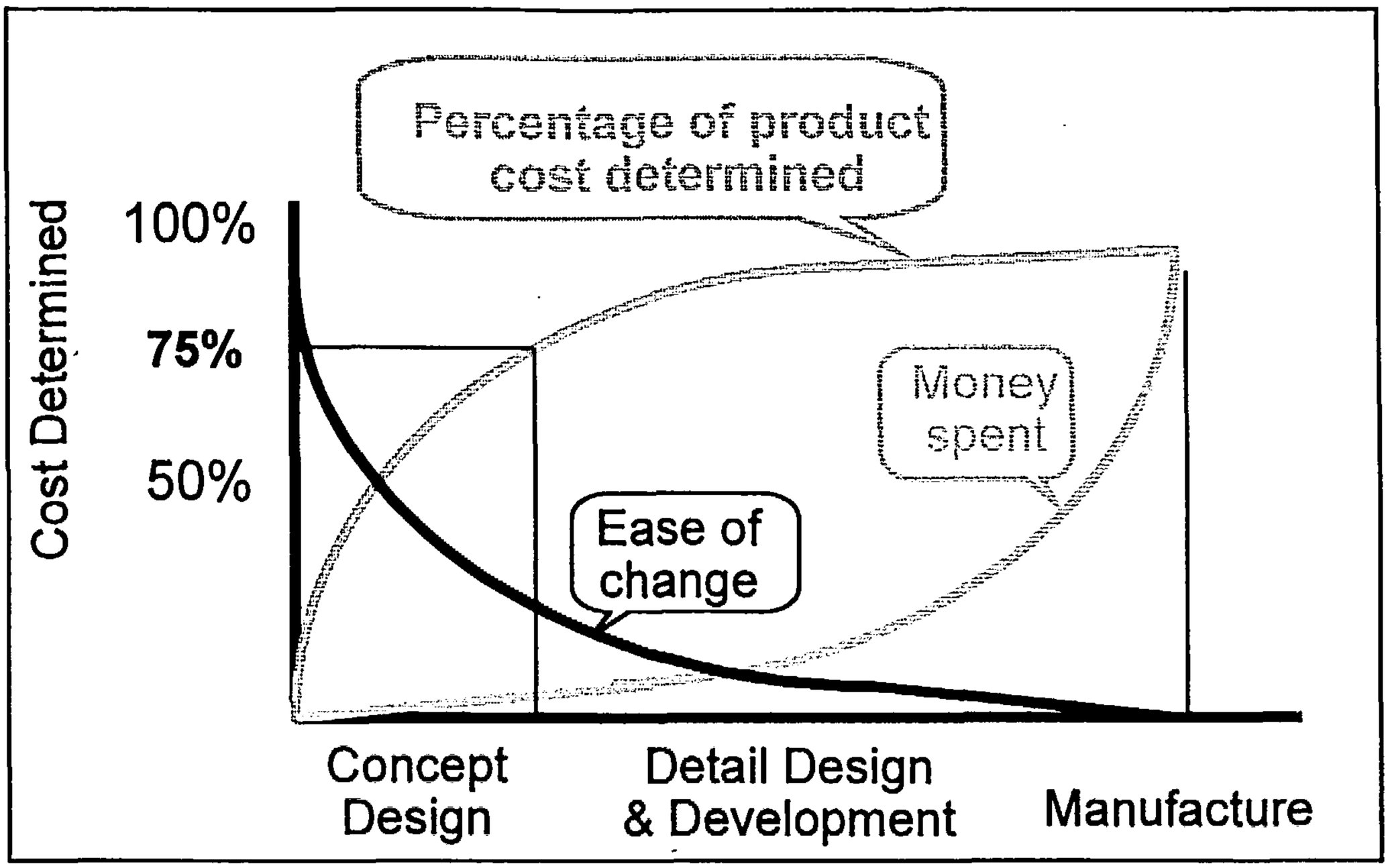
To change the culture of Brandenburg so that production times reflect time spent adding value alone. This would provide Brandenburg with an opportunity to provide a better service if required without having to add cost in order to meet any new customer driven reduced delivery times. It would also provide a competitive advantage in the acquisition of new business,
Production times could only be reduced by making the product flow more efficiently. This would be done through reduction in supplier lead time and a detailed analysis of existing production processes, If supplier lead times could be reduced to a two to three days then what was the customer orders could drive supplier orders. The aim would be to assign specific supplier orders to customer orders. By reducing supplier delivery times, the existing space for inventory would be almost completely reduced, freeing factory area for production and allowing better work flow, and also given a one off cash injection into the business by the reduction of stock. It is suggested that an analysis be done to determine the cost of perhaps flying in the glue board and paper in small batches against the cost of inventory overall.
Reduce the changeover times in the sheetmetal area to increase work flow
To create a position of new product introduction manager to take ownership of the various product introduction processes. This could be either an existing senior person, or having a 'middle management' type person, called perhaps Product Manager. This product management post could be filled by promoting an existing person to manage the process and training up, someone for example like Tracey Brooks, or bringing in someone from outside the business. The problem with bringing someone in is that the salary levels required might be beyond what is thought appropriate to commit to at this stage.

2.2.2 New Product Development

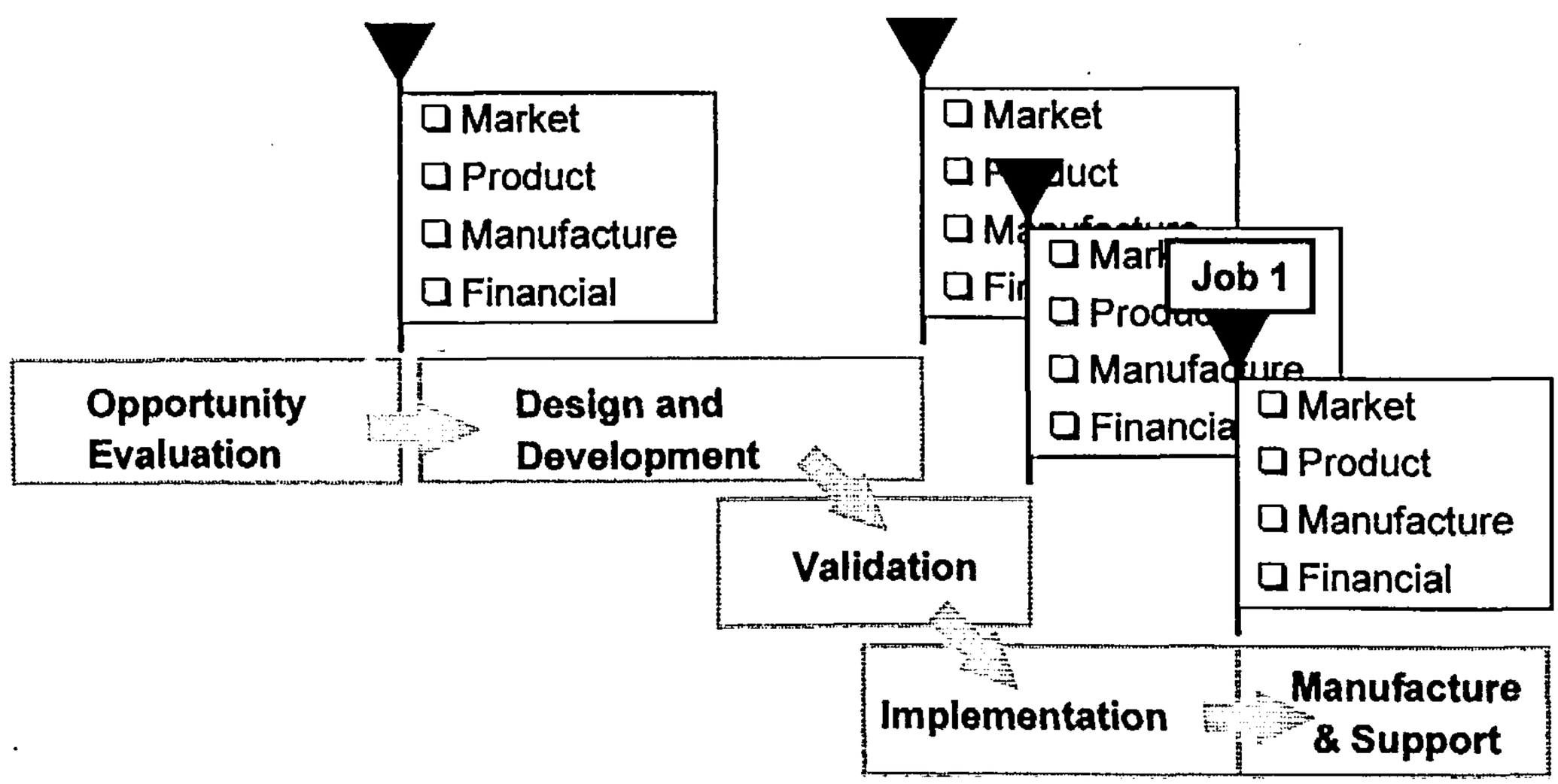
There is a need to recognise New Product Development as a process that needs managed. Apart from addressing price and quality, there is also a need to effectively develop and introduce new products on time.

The following diagram shows how 75% of cost is determined at the initial concept design stage where only a fraction of the "money spent" has been used. If the concept design is managed well there is an opportunity for savings to be made. Also shown on the graph is the ease of change to a design. This means if a change is to be made to a design it is much easier to do this in the early stages

of the development work.



New Product Introduction is a process which needs managed. The following diagram outlines the general principles that need managed in any New Product Introduction.



Brandenburg Ltd introduces many new products frequently into the market place without any formal management of the New Product Introduction Process. As the company grows this may become more and more difficult to handle.

2.2.3 Opportunities Offered by the Internet

Short Term

The introduction of E-mail and Internet conferencing will allow the opportunity for:
Overall reduction in the cost of customer communications by reducing the need for use of fax, telephone and face-to-face meetings,
Structured management of customer communications providing a *consistent interface* with the customer,
Reduction in general time wasting "hassle" related to communications fax running out of paper, illegible fax pages, misplaced or lost fax pages lines engaged voice mail phone tag,
Increase the production flow by changing communication from post to email.

Long Term

This vision for long term radical improvement is presented based upon the opportunities and threats faced by the company. These look beyond the life of the Innovation Direct programme but will radically improve the effectiveness of the business in the long term, providing a vision of where the company could evolve.

Electronic Commerce The growth of electronic commerce using the Internet will permeate industry offering new opportunities to develop new and improved relationships with customer staff facilitated by the Internet.
Centre of Excellence - Extending web site into a virtual centre of excellence on all aspects of flock coating. This could support a consultancy activity perhaps in conjunction with a third party like a university.
Internet groupings. There is a move for industries to have their own specific internet areas. This is being driven by the automotive and is called Automotive Network Exchange (ANX). ANX is a global communications system designed specifically for the automotive industry using Internet technology and it will be had to work because it is being developed jointly by the North American Big 3 Vehicle Makers, General Motors, Ford and DaimlerChrysler and several big name tier 1 suppliers. ANX will be the primary means by which these automotive companies will communicate with their suppliers on a global basis. ENX European Network Exchange is a European version and is being committed to by the majority of the European automotive manufacturers.
The reason for pointing this out is that the automotive industry is a leader in the use of new technology and is often used as a model for other industries. So it is important that all suppliers are conversant with internet technologies in the medium to long term, even if their existing customers and suppliers are not using such technologies. We have seen for example, the first bid for supply into an automotive tier 1 supplier by internet alone (no paper or other media).

3. Process Mapping

Processes are used to convert inputs into outputs. In production processes, raw materials are converted into goods and products. In a similar way, the order management process uses customer

orders and other data as its raw materials, converting them into the information necessary to produce the required products. Often this process is lengthy both in terms of the time it takes and the number of steps it contains.

3.1 The Brandenburg Quotation Process

In order to understand the complexity found in the order management processes, the process needs to be mapped. The flow charts shown simplify the processes allowing them to be understood through capturing all steps and illustrating how they relate to each other.
The quotation process in Brandenburg was not mapped because most of the business is with three major customer who are dealt with by negotiation.

3.2 Time Based Process Analysis.

In order to establish the performance of the process, seen in detail in figure 2, measurements are required. The key metric used in this exercise is time. Measuring the process in relation to time establishes a performance baseline. The data collected during this analysis is displayed here in the Time Based Process Map, Figures 3 and 4.Time Based Process Mapping is a technique for visually representing the steps in a process in relation to time.

The measurement of time across the process has been categorised in two different ways:

Wasted Time

Activity Time
Here activity time is used as a measure as it provides an approximation for value added activity. Time is considered to be truly value adding only when all three of the following rules are true:

The product/document/information was physically changed,

The customer cares about that change,

The change was done right first time.

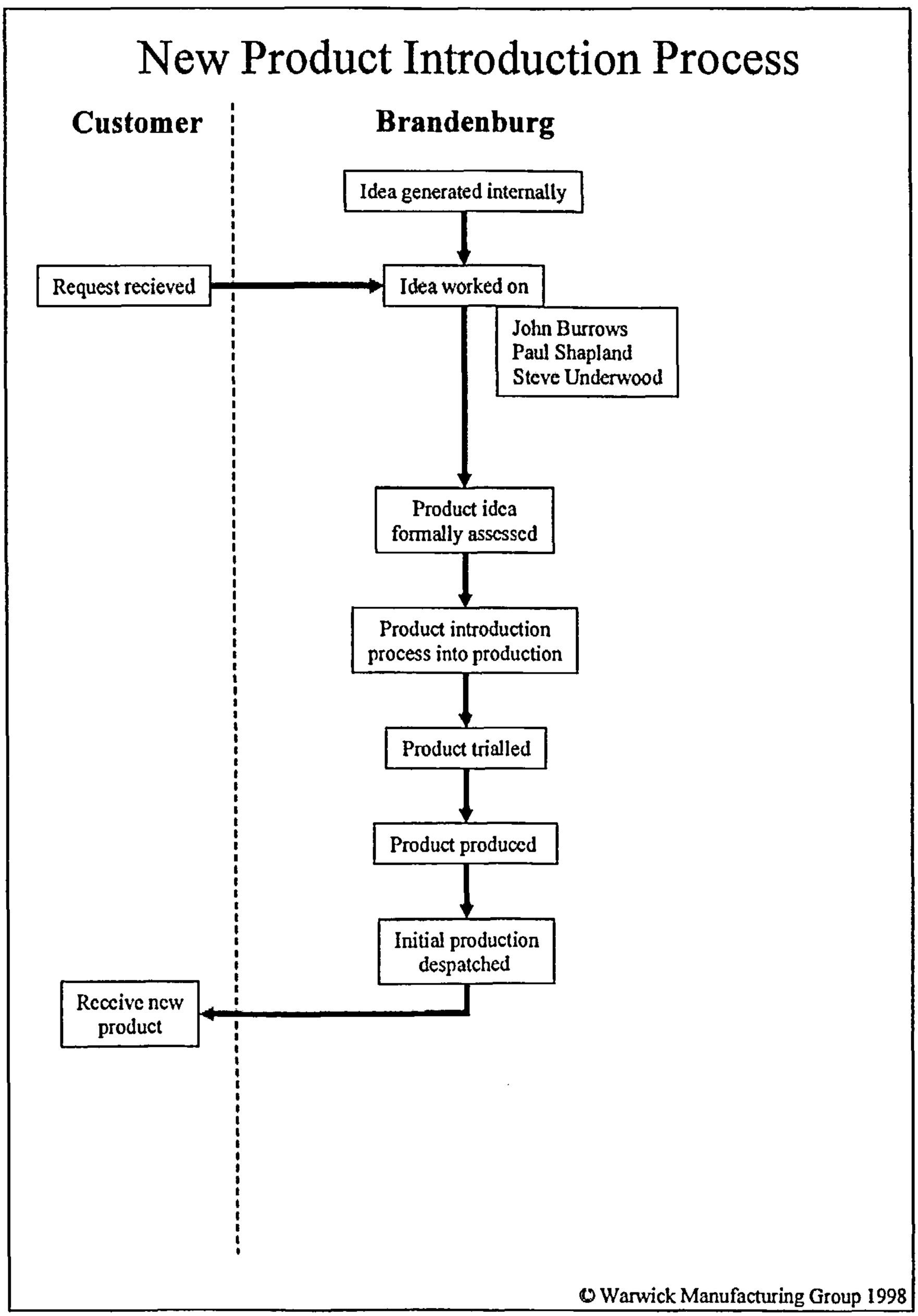
Activity time only takes into account the first of these rules, i.e. that the thing in the process was physically worked upon. Whether this is actually Value Added depends upon the end customer cares about that change and that it was done right first time.

Non-value adding time is everything else and will include time where the thing going through the process stood idle, was being reworked or underwent a step the customer did not care about. Examples of this are waiting in queues, waiting for decisions, rework and unnecessary operations.

3.4 The Brandenburg New Product Development Process.

In a simple process, once a customer accepts a quote for a new product, the customer creates an order for it. However given that most of the new products developed come from new technological developments and are subject to extensive negotiation, the New Product Introduction is then key to the Brandenburg's medium term development as a business. The NPI process is normally followed until the customer accepts a first off production sample. This process is captured in Figure 1. However, it was clear that this understanding of how to capture this process was still being discussed and implemented within Brandenburg.

Figure 1. Brandenburg Product Development Process



3.5 New Product Development Process, Analysis

3.5.1 Time Based Process Map

It was not thought important at this stage to do a time based process map as the processes were only just being considered. Brandenburg has just started developing a process for the latter stages of the NPI process, to enable the product to be put into production. The example given was a six week plan which in practice on slipped a week, which seemed good. It was found that other similar projects could also be put into this procedure.
It was thought that ownership of the NPI process was important. It was suggested that a person be appointed with responsibility for this area. This importance if this is expanded in section 2.2.1
This process should be given the same importance as the quotation and delivery process.
Brandenburg are strong in their ability to create new products and have many product ranges that are constantly evolving. As the company grows, formalising the process and managing it effectively will become of increasing importance.

Brandenburg may wish to consider a Teaching Company Scheme Associate for the role of formalising and managing New Product Introduction. The benefits of this would be the associate would be an employee of the University for a two-year period, when the two years are up Brandenburg might want to take the associate on full time. The associate would be a graduate with 2-3 years experience. The manpower at Brandenburg is such that there is already a stretch on the time available to management and the design team and most of the product knowledge lies with the management. Our experience of Teaching companies Schemes is that the company is able to progress more rapidly as the associate has the full support of the University. This a DTI part funded scheme.

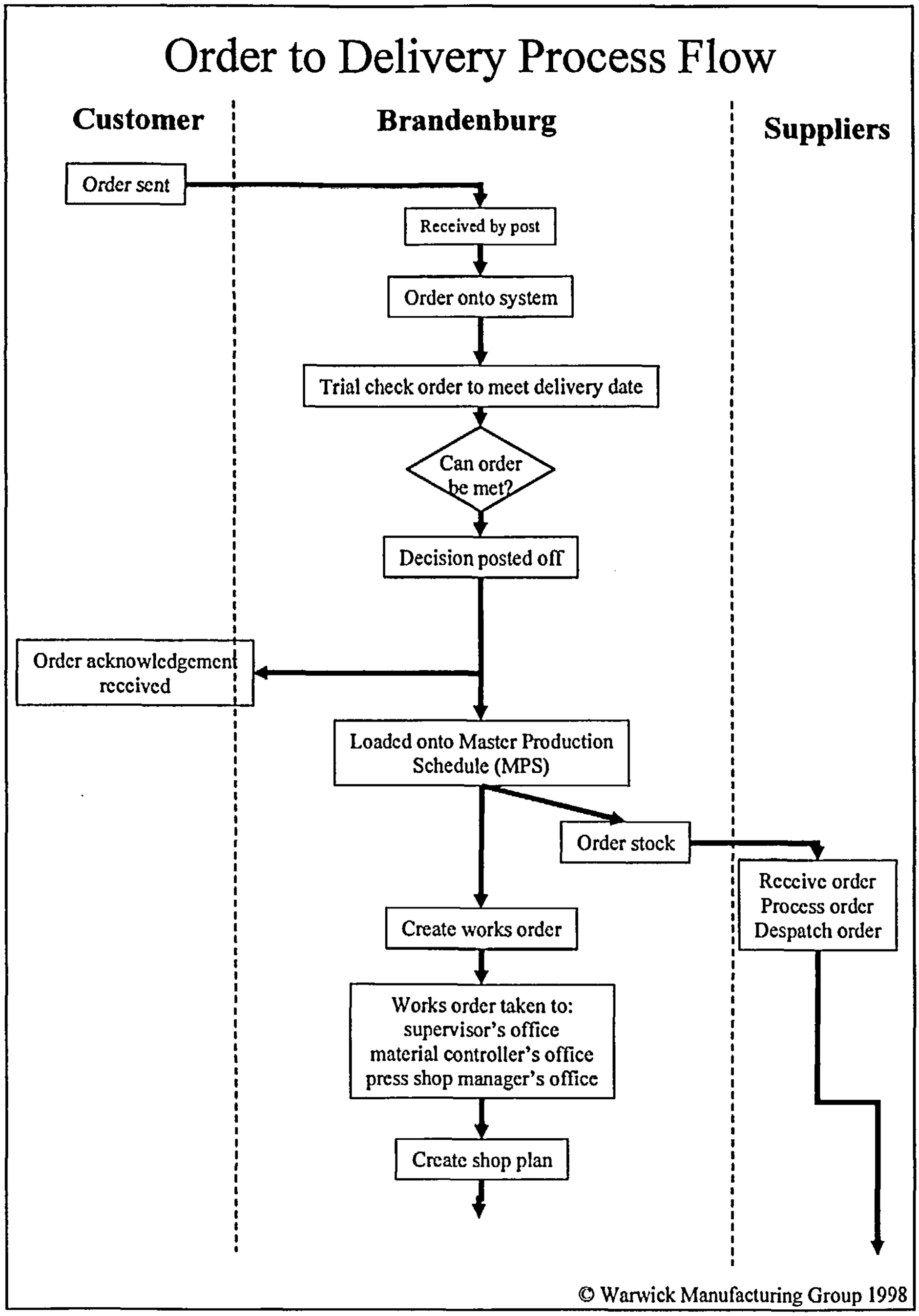
3.5.2 Specific Internet Opportunities

Use of email for communications and transfer of CAD drawings,
The use of video conferencing, given that one of the major customers is in the United States,
The establishment of web site to show the innovation capability of Brandenburg.

3.6 The Brandenburg Order Fulfilment Process

The final order management process undertaken at Brandenburg is the ongoing supply of goods. This process begins with an order or a call-off against a blanket order and finishes with the receipt of goods by the customer. This is shown below in Figure 3. Figure 4 shows the corresponding Time Based Process Map.

Figure 2. – Brandenburg Order Fulfilment Process



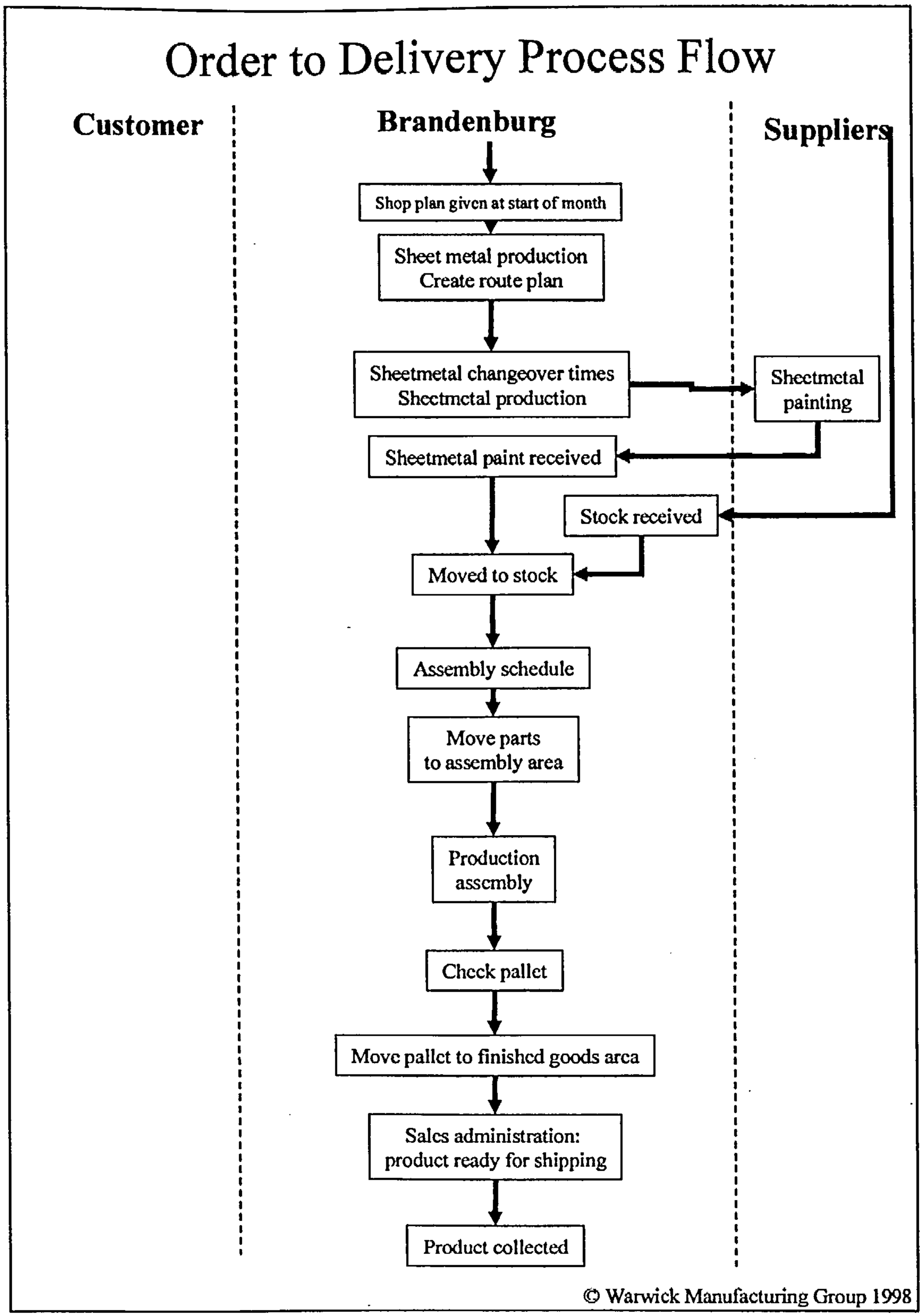
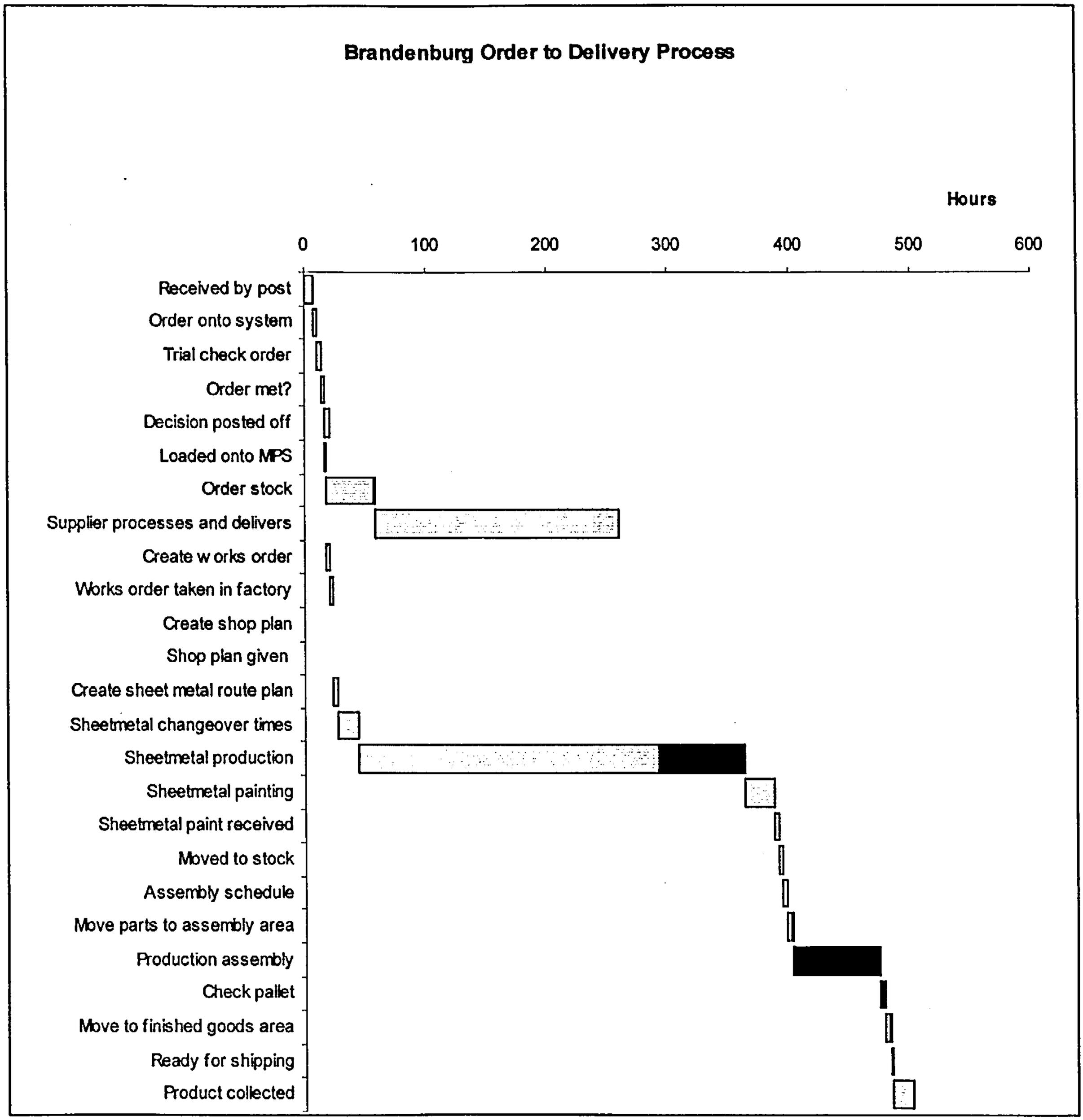

Order to Delivery Process Flow
Customer
Brandenburg
Suppliers
Shop plan given at start of month
Sheet metal production
Create route plan
Sheetmetal changeover times
Sheetmetal production
Sheetmetal painting
Sheetmetal paint received
Stock received
Moved to stock
Assembly schedule
Move parts
to assembly area
Production
assembly
Check pallet
Move pallet to finished goods area
Sales administration:
product ready for shipping
Product collected
© Warwick Manufacturing Group 1998

Figure 3. Brandenburg Order Fulfilment -Time Based Process Map

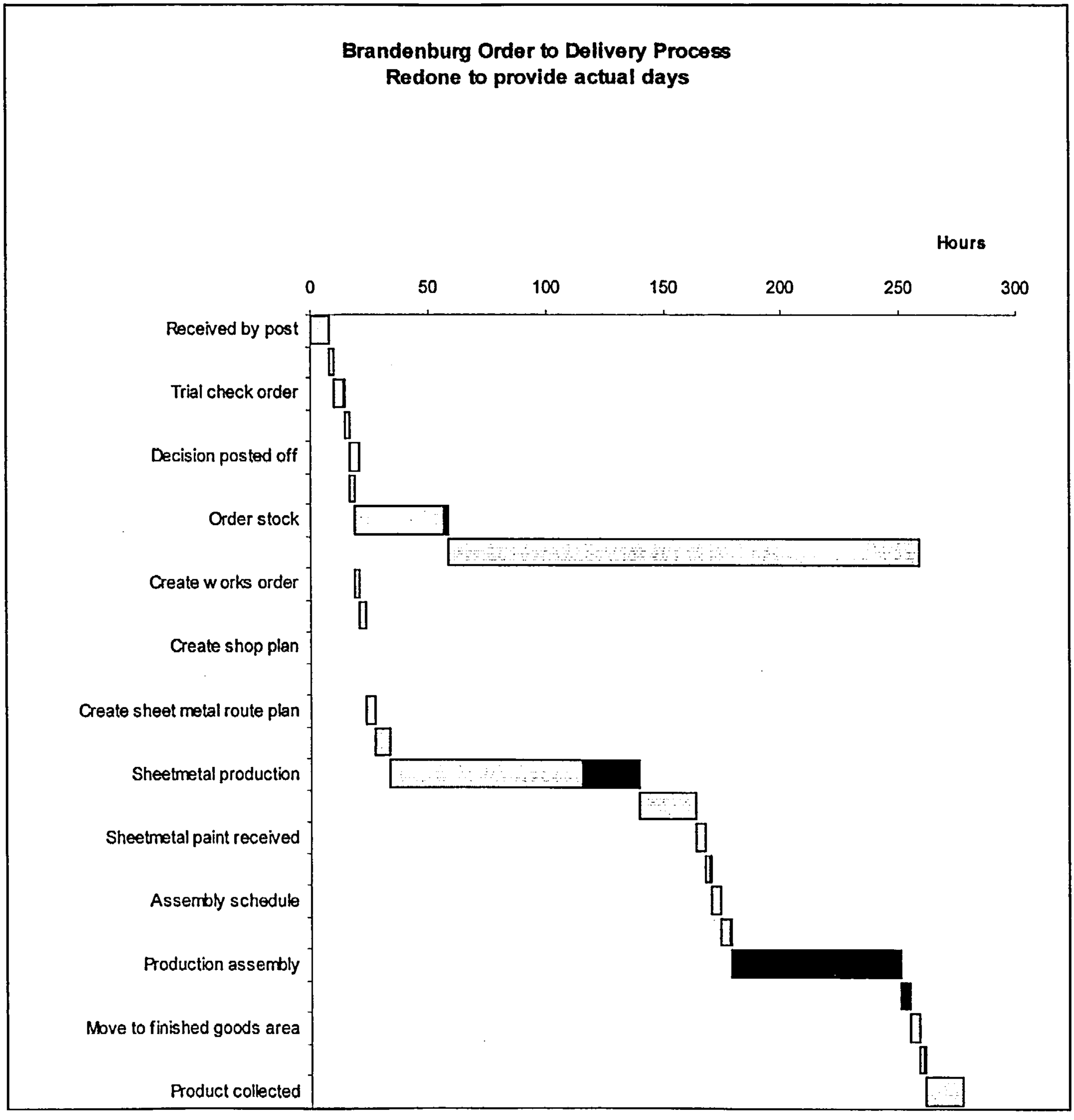


Grey Bars = Wasted Time
Black Bars = Activity Time

	Order Process Steps	Cum	W T	AT
ID	Brandenburg	hours	hours	hours
1	Received by post	0	8	0
2	Order onto system	8	2	0.2
3	Trial check order	10.2	4	0.3
4	Order met?	14.45	2	0.2
5	Decision posted off	16.6	4	0.1
6	Loaded onto MPS	16.6	2	0.1
7	Order stock	18.7	38	2
8	Supplier processes and delivers	58.7	200	0
9	Create works order	58.7	2	0.2
10	Works order taken in factory	60.9	2	0.3
11	Create shop plan	63.15	0	0.2
12	Shop plan given	63.3	0	0.2
13	Create sheet metal route plan	63.15	4	0.2
14	Sheetmetal changeover times	67.35	17	0
15	Sheetmetal production	84.35	247	72
16	Sheetmetal painting	403.4	24	0
17	Sheetmetal paint received	427.4	4	0
18	Moved to stock	431.4	2	0.5
19	Assembly schedule	433.9	4	0.3
20	Move parts to assembly area	438.1	4	0.5
21	Production assembly	442.6	0	72
22	Check pallet	514.6	0	4
23	Move to finished goods area	518.6	4	0.5
24	Ready for shipping	523.1	2	0.1
25	Product collected	525.2	16	0.5
	Total	541.7	392	152

The problem with this analysis is that the sheetmetal production area is on 24 hour working. To give a picture of overall flow, the sheetmetal steps have been reduced by a third to give an actual elapsed time overall. This is redone is figures

Figure 4. – Brandenburg Order Fulfilment Process: Redone



Grey Bars = Wasted Time
Black Bars = Activity Time

ID	Order Process Steps Brandenburg	Cum hours	W T hours	AT hours
1	Received by post	0	8	0
2	Order onto system	8	2	0.2
3	Trial check order	10.2	4	0.3
4	Order met?	14.45	2	0.2
5	Decision posted off	16.6	4	0.1
6	Loaded onto MPS	16.6	2	0.1
7	Order stock	18.7	38	2
8	Supplier processes and delivers	58.7	200	0
9	Create works order	58.7	2	0.2
10	Works order taken in factory	60.9	2	0.3
11	Create shop plan	63.15	0	0.2
12	Shop plan given	63.3	0	0.2
13	Create sheet metal route plan	63.15	4	0.2
14	Sheetmetal changeover times	67.35	6	0
15	Sheetmetal production	73.35	82	24
16	Sheetmetal painting	179.4	24	0
17	Sheetmetal paint received	203.4	4	0
18	Moved to stock	207.4	2	0.5
19	Assembly schedule	209.9	4	0.3
20	Move parts to assembly area	214.1	4	0.5
21	Production assembly	218.6	0	72
22	Check pallet	290.6	0	4
23	Move to finished goods area	294.6	4	0.5
24	Ready for shipping	299.1	2	0.1
25	Product collected	301.2	16	0.5
	Total	317.7	216	106

3.7 Order Fulfilment Process, Analysis.

3.7.1 Time Based Process Maps

Figure 2 reveals a complex order to delivery process with 25 steps identified. Figure 3 reveals that the time taken for the process is 541 hours of which 152 hours are activity hours, 28% of the total. The stock replenishment time has been excluded as it runs in parallel and at present product ordered go into stock. This can be seen by reviewing Figure 4 where the sheetmetal times have been reduced by a third to make plain the actual number of days worked. It can be seen that the process time for the whole process is actually 40 days, or 8 weeks, of which only just over 2½ is directly related to activity. By better organisation and work flow, this is probably the initial target for production throughput times.

The company has from a culture of 6 to 8 week delivery. Recognising that this forms a comfort cushion, it perhaps does not allow the company to think about positively using drastic reductions in lead time as a competitive advantage. At present for example, suppliers orders go to stock, not to production.

3.7.2 Internet Opportunities

Short Term

Receipt of orders via E-mail to replace fax/mail
E mail communications with both customers and suppliers to resolve call-off issues

Long Term

Fully integrating the production planning system with orders received over the internet
Gaining access to forward plans of customers from their web sites.

D Appendix D ECLOS Memorandum of Understanding and Intent

Introduction

This memorandum of understanding and intent, provides a general description of the attitudes by which individuals, companies and organisations come together to collaborate. Its aim is to provide a framework for the initial contact and workings within a new and prospective relationship or project, a set of values by which the participants can move forwards with commitment and respect for each other, at a time when other ways of governing the relationships are not yet established, such as historical understanding or contract.

The headings have been taken from Womack and Jones' *Lean Thinking Model* (1996), Lamming's *Lean Supply Model* (1993) and McKenzie and Brennan's (1999) *Additional Factors*. Lamming's and McKenzie and Brennan's factors specifically address issues within the relationship between supplier and customer, whilst Womack and Jones' factors originally provided a context for such "*leanness*", and so have been used in this context.

1. Definition of Value

All participants within the relationship shall work towards an understanding of value in terms of what is seen by the end customer or consumer.

2. Identification of Value Streams

All participants shall identify the most appropriate value streams, to provide the value so defined for the end customer. Within this identification will be a determination to identify and remove all unnecessary *muda*, waste or non-value adding activities.

3. Organising around flow

Participants will organise all relevant activities such that activities, information, products and people *flow* unimpeded through the value chain as appropriate. This will mean organising people and activities which enable the flow rather than constrained by any normal understanding of the boundaries of any of the organisations involved. This may mean employees from one participant working alongside participants from another organisation in the same geographical location. It may also mean financial openness such as open book accounting.

Within these structures so created there will be a recognition that the requirements of individual organisations is still important. This means there will be profit guarantees, a sharing of risks and a working for mutual gain.

4. Responding to Pull through the value chain

Participants are to organise their activities so that only what the customer requires is done. This though should be what might be called an active anticipation, where issues that may arise can be brought to the forums for discussing such issues. It also recognises that *pull* is sometimes difficult to achieve for logistical and other reasons. In such circumstances, a case for creating inventories is to be made to a joint forum. Participants are to be open to other participants reviewing the their operations in order to learn from each other and to reduce waste. This is to be done in an atmosphere of mutual respect and support, and where know-how and intellectual property issues are not compromised.

5. Cooperation, trust and relationship management

Companies and organisations are to come together on the basis of trust and cooperation. This means that promises agreed are kept, and that there is a recognition that one individual or company or organisation will need to make the first move, and so thereby become vulnerable to potential exploitation. All other participants within the proposed relationship are to support this first mover, and are not to take advantage. Where any organisation or company so does take advantage, other participants shall see if sanctions are appropriate.

6. Commitment of individuals to the relationship: The psychology of sharing

It is the responsibilities of all individuals within the project to be committed to the project. This means contributing and willing to contribute more than the bare minimum. Each individual and party will contribute what they have at their disposal. For larger companies, this may mean money; for small companies this may mean their time or their facilities; for governmental organisations this may mean teaching and seminars on the relevant parts of the law or regulations.

7. Supplier associations and networks

The ability to trust and continue with the relationship is shown through the willingness to continue the relationship with others, in either a formal or informal way. This will mean collaborating with other suppliers (who may be competitors) to ensure the best overall ongoing solutions to issues and concerns.

8. The acknowledgement and use of power

It is acknowledged that there will be discrepancies in the power and influence of the different companies and organisations working together. In this case it is the responsibility of the more powerful, often larger companies and organisations, to ensure that all the relevant parties are on board and up to speed.

9. Team working structures

All projects and work shall be started and continued within a sprit of teamworking and consensus, even where the understanding and practical outcome of leadership may constrain this desire. It is recognised that such working brings about tensions, and a clear method and procedure for resolving such tensions as and when they arise.
This teamworking may be formally constituted by the setting up of Integrated Project Teams, or informally constituted through regular meetings of the appropriate individuals of appropriate seniority and standing. Deputies should only be sent in the last resort.

10. Time based competition

All individuals and parties should structure their processes and operations in order to reflect the actual time taken for activities within their organisations, rather than relying on a rule of thumb or formal time comfort zone. This means for example that delivery times quoted for what could be normally achieved, rather than an organisational culture of a standard delivery time.

11. End customer

All parties shall give sight to the requirements of the end customer or consumer as far up the supply chain as it practically possible. This provides a reasoning for why decisions are made by those closest to the consumer, and also provides visibility of future requirements and trends to the whole supply chain. The emphasis will be for those within the supply chain to be proactive in putting forward initiatives which will contribute to the changes in requirements of the end consumer.

12. The impact of new technology

All individuals and organisations shall be committed to understanding and using new technologies where they provide added customer value and reduce cost. Where there is an imbalance of resources in this area, larger companies will enable less able companies with this type of understanding. In return, less able companies shall be willing to be helped in this manner.

13. Knowledge management

All companies and organisations shall set up informal or formal processes and procedures for capturing and retaining such information and knowledge which ensures their continuing participation within the group of consenting companies and organisations. Sanctions will be considered where such a company or an organisation does not so do.

14. Intellectual Property Rights

It is understood that the development of know-how and intellectual property forms the basis for any individual company's well being and growth. It is recognises that all initial knowhow and intellectual property brought to the discussions will remain the property of that organisation, unless the know-how or intellectual property is shared, bought or given away without pressure and with consent. Any such developments generated by the parties from the work shared together as the property of those so working together. It is again recognised that tensions may be generated within this environment, and a procedure to deal with these tensions is to be set up at the beginning and regularly reviewed thought the time of the collaborations.

15. Nature of competition

The structure of the participants within any collaboration is dependent on the industry, geographical issues and concerns, changes in the market, regulation and the desires and aspirations of those within the collaboration. Whilst it is not possible to foresee every eventuality, all participants are to agree to continue with the collaboration for the intended duration of the collaboration. This means it is very important to discuss the nature of the collaboration, thus ensuring all parties will have knowledge of the conditions where-by the collaboration is no longer appropriate or relevant.

16. Basis of sourcing decisions

Sourcing decisions shall be based on a range of so-called hard and soft indicators, including environmental concerns.

17. Role and mode of data, information exchange

The practical issues of information and data exchange shall be discussed in an open manner.

18. Management of capacity and delivery practice

Practical issues of production and delivery shall be brought to a forum for discussion, to ensure ongoing best implementation for all parties, and provide the participants with a competitive edge in supplying the end consumer. Tensions here shall again be brought to a forum for discussion and resolution.

19. Dealing with price changes

Pricing shall be conducted in a spirit of openness and informed discussion. Ideally pricing shall be a part of the ongoing relationship, and not an issue, of itself, to discontinue the relationship.

20. Attitude to quality

All participants shall strive to have the highest quality standards within the industry, and the participants as a whole shall benchmark their work with other industries, to ensure continuing improvement.

21. Level of pressure

Working closely together provides both a sense of security and also generates tensions. The participating companies and organisations shall provide a forum for such tensions to be aired and shared, and procedures set up to resolve such issues.

22. Perfection

Participants are to continually strive for enhanced performance, both from their own operations, organisations, systems and people, but are also to encourage the same from participants within the relationship.

References

Lamming, R. (1993), *Beyond Partnerships*, Prentice-Hall
McKenzie, R. and Brennan, N. (1999), "Lean Supply in the Automotive Industry - Factors Identified for successful customer-supplier relationships", Logistics Research Network Annual Conference, University of Northumbria, September, 1999
Womack, J. and Jones, D. (1996), *Lean Thinking*, Simon & Schuster