The Transfer of 'Best Practice' Knowledge into Manufacturing Companies

Engineering Doctorate

Executive Summary

Ian C. Gregory

September 1997

Table of Contents

ACKNOWLEDGEMENTS 4

DECLARATION 4

1. INTRODUCTION 5

2. OBJECTIVES OF THIS PORTFOLIO 8

3. STRUCTURE OF THE PORTFOLIO 9

4. SUMMARY OF THE PORTFOLIO 13

4.1 The Nature of 'Best Practice' 13

4.2 Methods for the Transfer of 'Best Practice' 15
4.2.1 The Written Word 15
4.2.2 External Change Agent 16
4.2.3 Transfer of Knowledge Through the DTI Study 16

4.3 Successful transfer of 'Best Practice' 17
4.3.1 The Change Framework 17
4.3.2 Success Criteria for a Change Model 19

4.4 Description of the Case Studies 20
4.4.1 Success of the Case Study Projects 23

4.5 Description of the Change Model 29
4.5.1 Change Team Roles 30
4.5.2 Change Process Archetype 34
4.5.3 Role of the Change Team Within the Change Process Archetype 39
4.5.4 Overall Description of Model 40

5. CONCLUSIONS 45

5.1 Constituents of 'Best Practice' 45

5.2 Successful Transfer of 'Best Practice' 45

5.3 The Change Model 46

6. REFERENCES 48

List of Figures

FIGURE 1 - EVOLUTION OF THE CHANGE FRAMEWORK TO THE CHANGE MODEL 17

FIGURE 2 - CAUSAL LOOP DIAGRAM SHOWING RELATIONSHIPS IN THE CHANGE PROCESS 42

List of Tables

TABLE 1 - ITEMS IN SECTION 1 OF THE PORTFOLIO 9

TABLE 2 - ITEMS IN SECTION 2 OF THE PORTFOLIO 10

TABLE 3 - ITEMS IN SECTION 3 OF THE PORTFOLIO 11

TABLE 4 - ISSUES IN COMPANY 1 20

TABLE 5 - ISSUES IN COMPANY 2 21

TABLE 6 - ISSUES IN COMPANY 3 22

TABLE 7 - ISSUES IN COMPANY 4 23

TABLE 8 - EFFECT OF PROJECT AT COMPANY NO. 1 25

TABLE 9 - EFFECT OF PROJECT AT COMPANY NO. 2 26

TABLE 10 - EFFECT OF PROJECT AT COMPANY NO. 3 27

TABLE 11 - EFFECT OF PROJECT AT COMPANY NO. 4 28

TABLE 12 - SUMMARY OF SUCCESS IN THE CASE STUDIES 29

TABLE 13 - CHANGE MODEL RELATING TEAM ROLES WITH SUCCESS CRITERIA 33

TABLE 14 - CHANGE MODEL RELATING CHANGE PROCESS TO SUCCESS CRITERIA 38

TABLE 15 - CHANGE MODEL RELATIONSHIP BETWEEN TEAM ROLES AND CHANGE PROCESS ARCHETYPE 40

TABLE 16 - MAJOR PERFORMANCE IMPROVEMENTS 46

ACKNOWLEDGEMENTS

This Engineering Doctorate has had many contributors in one way or another. I would like to thank all of those people for making the EngD an effective and enjoyable learning experience for me. In particular I would like to thank:

- Dr. Stan Manton, Dr. Dan Park, and Mrs. Karen Bradbury for acting as my mentors during the doctorate and for providing support and constructive criticism.
- My colleagues on the Time Compression Programme for their help and guidance.
- The Engineering Doctorate Executive, Warwick Manufacturing Group staff and my fellow Research Engineers for their support and interest.
- All of the employees of the organisations and companies with which I have worked for their assistance and for making life interesting.
- The EPSRC for funding this Engineering Doctorate.

DECLARATION

The work contained in this report is entirely my own and has not been previously submitted for consideration for any qualification.

1. INTRODUCTION

The objective of the Engineering Doctorate is to demonstrate innovation in the application of knowledge to the engineering business environment. The theme of this portfolio is to understand the mechanisms for the transfer of 'best practice' knowledge into manufacturing industry and its successful application.

This topic is of vital importance to the future competitiveness of UK industry. It is widely accepted within the management literature that the pace of change within the business world has increased and will continue to do so at an ever accelerating rate. This has been fuelled by the globalisation of markets, by the increased involvement of huge and developing nations like China and India into international trade and by the possibilities provided by new technologies. In such an environment it will be increasingly difficult for companies with mediocre performance to survive. For example, one study (Strategic Planning Society et al, 1996) ranked 30.1% of UK companies as 'punchbags' and a further 9.5% as 'won't go the distance'. Thus they expect 39.6% of UK industry to experience difficulty in surviving in the future.

The best hope for UK manufacturing industry is to raise the performance of these companies to that near to 'best in class' in their particular market. This cannot be achieved by isolated evolution. There isn't time. It requires an input of knowledge developed from companies who have tried different ways of doing things and regained their competitive position. By learning from the successes and failures of others the

process of company regeneration can be accelerated. This way companies stand a better chance of survival.

The success of the organisational learning process for these companies is dependent upon the process of transferring this knowledge. If the knowledge is transferred effectively it will be used quickly to benefit the company. If it is transferred poorly it may slow down the change process as managers and employees become cynical and turn back to "the way we've always done things".

Understanding the best way to transfer 'best practice' knowledge is a key element in understanding how to accelerate the regeneration of UK manufacturing industry and provides the theme for this portfolio. The portfolio's starting point is the definition for innovation provided by the UK Department of Trade and Industry, "the successful exploitation of new ideas", which allows the demonstration of innovation in the application of knowledge in two ways:

- Through innovative approaches to successful transfer and use of knowledge by companies.
- Identification and application of 'Best Practice' techniques to companies where they had not been considered before.

Having identified the nature of and opportunities to test 'best practice', the umbrella of tools and techniques known as 'Time Compression' was taken as an academic and practical framework for the transfer of 'best practice' into four companies. The learning generated by these interventions has been combined with the results of survey

research and literature review to develop the theme for the portfolio, the transfer of 'best practice' knowledge into manufacturing industry.

2. OBJECTIVES OF THIS PORTFOLIO

The objective of this portfolio is to understand the process of transferring 'best practice', to further knowledge in this area and to demonstrate innovation in the application of knowledge. This was done by carrying out the following activities:

1. Understand what constitutes 'best practice'.
2. Critically examine how 'best practice' is currently transferred.
3. Attempt to transfer 'best practice' to new environments.
4. Learn.
5. Innovate.
6. Iterate.
7. Draw conclusions.

The above process was structured in this way in order to generate:

- Measurable performance improvements at the company level.
- An understanding of the mechanisms for successful transfer of 'best practice' at the conceptual level.

3. STRUCTURE OF THE PORTFOLIO

The portfolio is split into four main sections. Each of these is split into a number of items. The portfolio should be read in the order indicated by the section numbering. The findings of the portfolio as a whole are discussed in Section 4.

Section 1 - What is 'Best Practice'?

This section investigates the constituents of 'best practice'. In doing so it provides the basis of content for the application of 'best practice' knowledge into companies.

Table 1 - Items in Section 1 of the Portfolio

No.	TITLE	DESCRIPTION
1.0	**Introduction**	
1.1	**What is 'Best Practice' - Introduction**	Discusses the nature of 'best practice' as it has been identified in the past, and the development of management thinking and practice.
1.2	**Description and Results of Two Studies**	Describes two studies undertaken for the Department of Trade and Industry to investigate 'best practice' in some of the UK's better companies.
1.3	**Discussion and Conclusions**	The two studies are discussed in the context provided by the literature and conclusions on the constituents of 'best practice' drawn.
1.4	**A Retrospective Look at the Studies**	Assesses how the two studies affected the DTI's approach to the transfer of 'best practice' knowledge.

Section 2 - How is 'Best Practice' Currently Transferred?

This section investigates the way in which 'best practice' is currently transferred into manufacturing industry. In doing so it provides the basis for the process of transferring 'best practice' knowledge. The mechanisms for transfer focused on are those easily available to the Researcher in a collaborative research environment.

Table 2 - Items in Section 2 of the Portfolio

No.	TITLE	DESCRIPTION
2.0	**Introduction**	
2.1	**Change Management Literature Review**	Reviews the management literature on change management and the types of intervention available to an 'external change agent'.
2.2	**Transfer of 'Best Practice' - The Written Word**	Literature review on the use of the written word to transfer 'best practice'. Includes a study of the use of 'Interactive Self-Help Packages'.
2.3	**Transfer of 'Best Practice' Through Management Consultants**	Postal survey undertaken to assess the approaches to 'best practice' transfer used by management consultants.

Section 3 - A Practical Investigation Into the Transfer of 'Best Practice'.

To demonstrate the transfer of 'best practice' knowledge, the idea of Time Compression was used within four companies to whom it was new. Early contact with the companies showed that, in each case, the techniques would contribute to their performance The methodology used was based on that of 'Action Research'

(Cummings & Worley, 1993). The conclusions of Section 2.3 indicated that this was the archetype for the transfer of knowledge, most likely to result in success.

Table 3 - Items in Section 3 of the Portfolio

No.	TITLE	DESCRIPTION
3.0	**Introduction and Methodology**	
3.1	**Time Compression - A Review of Major Approaches**	Reviews key literature on Time Compression in new product development and manufacturing.
3.2	**Case Study 1**	Focused on the use of Time Compression within the product development process of a consumer ceramics manufacturer.
3.3	**Case Study 2**	Focused on the identification of opportunities for Time Compression on a product enhancement in an aerospace company.
3.4	**Case Study 3**	Focused on the use of Time Compression to improve the manufacturing performance of a jewellery company.
3.5	**Case Study 4**	Focused on the use of Time Compression to improve the engineering change process within an aerospace company.
3.6	**Summary of the Case Studies**	Summarises the four case studies and compares the levels of success in the transfer and application of 'best practice' knowledge.

Section 4 - Synthesis and Conclusions

This single item discusses in detail the findings of the different case studies with respect to the transfer of 'best practice' knowledge and puts them into the context

provided by the literature reviews and survey research. It uses this discussion to develop a model for the successful transfer of 'best practice' knowledge into a manufacturing company.

4. SUMMARY OF THE PORTFOLIO

4.1 The Nature of 'Best Practice'

Section 1 of the portfolio led to the conclusion that 'best practice' is that which is appropriate to the market conditions and customers of a particular company.

Therefore it is not necessarily state of the art practice. 'Best practice' is that which allows a company to achieve and sustain excellent performance related to its competition.

In effect, 'Practice' refers to use of any tools, techniques, cultural styles, technologies or systems to gain operational improvements tied to strategic thinking. 'Best' refers to the configuration and reconfiguration of a company's practices which enable it to improve its performance and capabilities relative to other players in its current and prospective markets.

The constituents of 'best practice' are likely to be unique to a given company, albeit a number of generally applicable principles of 'best practice' were identified. These were split into two categories, phenomena which were seen to be generic and those which were seen to be specific to the business climate in the UK in 1994. These were:

Generic

- There is a good strategic fit between the company's external environment, its strategy, the processes underpinning that strategy and the practices used in those processes.

- The strategy is continually updated to match changes in the external environment taking into account the company's core competences. The remaining part of the fit is updated in accordance.
- There is continuous removal of waste from the system in the form of material, cost or time. This infers a clear understanding of the business processes.
- People within the system are managed for maximum effectiveness.
- There is a clear focus on the customers and/or markets.

1994 and UK Specific

- The company uses a differentiation type strategy.
- There is a focus on innovation, product development and supply chain issues for competitive advantage.
- The human resource management issues are based on the ideas of teamwork and using employee's abilities to their full potential.
- There is a strong focus on a culture supportive of the human resource management practices used.

The nature of the generic phenomena of 'best practice' means that in the constantly changing competitive environment of modern business, new practices must continually evolve or be transferred into a company in order to maintain the fit between the external environment, strategy, and business process performance. This dictates to a company the need for constant change, both at the strategic level and at the operational level. The ability to manage the processes of knowledge transfer and change are therefore a critical competence of a successful company.

4.2 Methods for the Transfer of 'Best Practice'

There are a number of ways to transfer knowledge including books, articles, management consultants, supplier development initiatives, educational programmes and government activity. This portfolio focuses on the written word and on external change agents, for example management consultants and the work of this Researcher. These were chosen as they were the mechanisms available to this Researcher in the collaborative research environment in which this research took place.

In section 2 of the portfolio a number of mechanisms for knowledge transfer are considered. The first task was to review the existing literature on the subject area as a whole (Submission 2.1) to provide a basis for the survey and case study research.

4.2.1 The Written Word

The use of books and journals was discussed (Submission 2.2, part 2), It was concluded that journal articles are infrequently read and commonly felt to be irrelevant, and books suffer from lack of practical detail and sheer volume of material, which discourages managers from reading them.

The idea of interactive self-help packages was discussed (Submission 2.2parts 4.8-4.9). These were found to be suitable for explaining 'hard' systems type subjects such as BS5750, but unsuitable for less structured subjects. In these types of subjects the use of a change agent, for example a management consultant, to transfer appropriate knowledge would be the most likely method to succeed.

4.2.2 External Change Agent

A literature review (Submission 2.1) was undertaken and was used as the basis for survey research looking at the transfer of 'best practice' by management consultants (Submission 2.3). This shows that it is possible for 'best practice' to be successfully transferred by an external change agent and that the best model for success is that of 'Action Research' (Submission 2.3, part 6.1).

4.2.3 Transfer of Knowledge Through the DTI Study

The contrast between the written and change agent approaches to transfer of 'best practice' was illustrated by the 'DTI/CBI 100 of the best companies' study (Submission 1.4). This study was published as the report 'Competitiveness: How the best companies are winning' (DTI, 1994). Traditionally reports on 'best practice' had been compiled by management consultants and given to the DTI. These had been turned into booklets and sent to industrialists. In contrast, the approach used for this study was to involve the civil servants in collecting information and gaining their involvement in writing the report for publication (DTI, 1994). The message of the report was transferred mainly by peer contact between industrialists and industrialists seconded to the DTI. This approach generated considerable ownership and enthusiasm for the findings of the study within DTI, resulting in a change in their approach to promoting the competitiveness message (Submission 1.4, part 4.2). Their enthusiasm and understanding also helped to sell their message to industry, as illustrated by the 75,000 copies of the report distributed. The traditional method resulted in 15-20,000 copies being distributed (Submission 1.4, part 3.1).

4.3 Successful transfer of 'Best Practice'

As an example of the transfer of 'best practice', Time Compression practices were transferred to four companies using the change framework described. Each of these companies gained benefit in terms of performance improvements and organisational learning.

4.3.1 The Change Framework

The framework used for the transfer of 'best practice' knowledge within the case studies had two elements:

- **The Change Team** - the roles of the key people involved in facilitating and carrying out the change process.
- **The Change Process Archetype** - the steps taken during the change intervention.

This change framework is used to provide the basis for a detailed and validated change model which is developed from the research in this portfolio. This transition is illustrated in Figure 1.

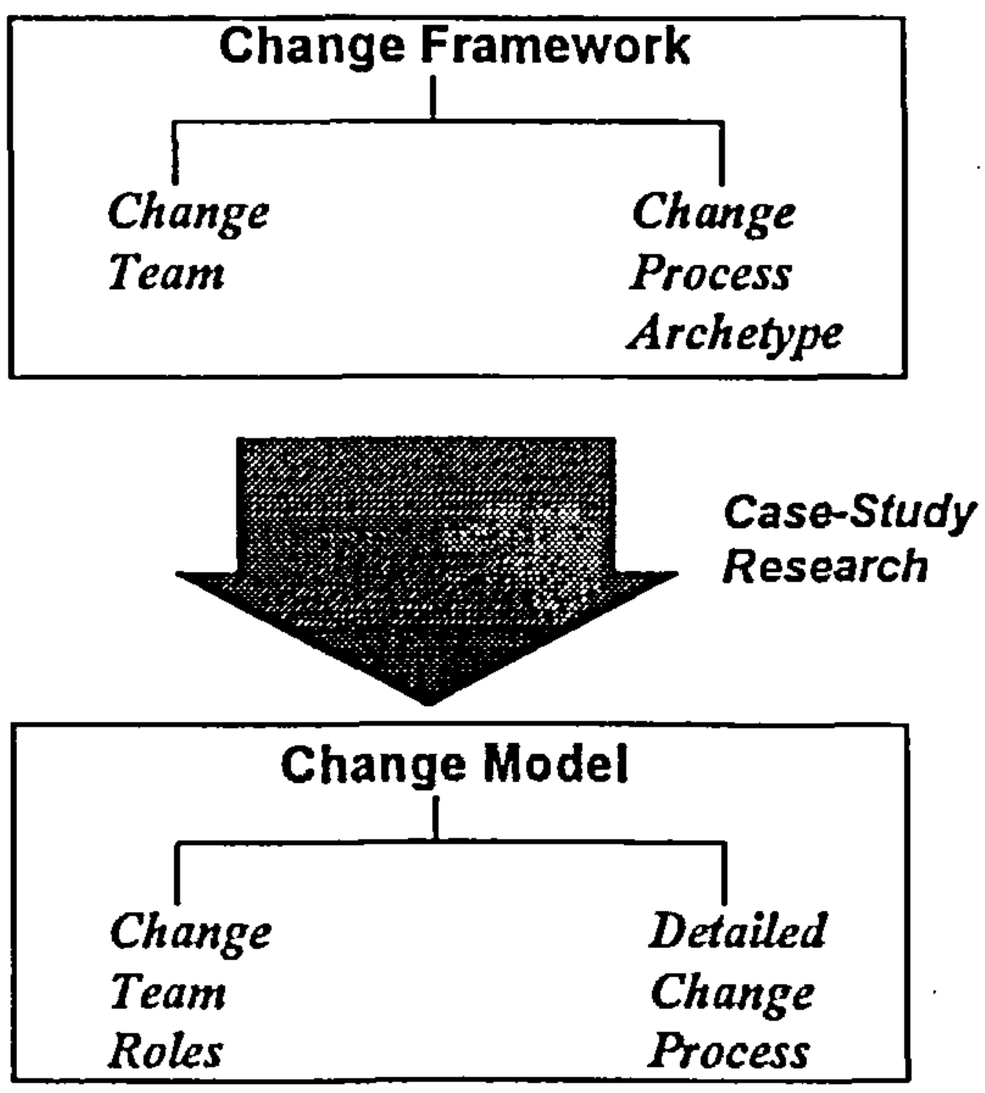

Figure 1 - Evolution of the Change Framework to the Change Model

4.3.1.1 The Change Team

There were three key roles within the change team. These were:

- **Project Sponsor** - a senior manager chosen to manage the strategic level of the change process and ensure that operational and strategic change were linked together.
- **Principal Contact** - a manager closely related to the area of the business being investigated chosen to manage the operational level of the change process.
- **External Change Agent** - the Research Engineer whose main role was facilitation and knowledge transfer (Hereafter referred to as the **'Researcher'**).

4.3.1.2 Change Process Archetype

The survey on the transfer of 'best practice' through management consultants (Submission 2.3, part 6.1) identified that the consulting model which most closely resembled that required for success was that of 'Action Research' as described by Cummings & Worley (1993). This was used in the four case studies in section 3 of the portfolio. The 'Action Research' model is described in detail in part 6.2.4 of submission 2.1 of the portfolio. In summary it consists of:

1. Problem identification.
2. Problem definition.
3. Data collection.
4. Feedback of data.
5. Joint problem diagnosis.
6. Solution generation.
7. Implementation.

8. Performance change is measured.

9. The change process begins again.

4.3.2 Success Criteria for a Change Model

The literature review on Change Management (Submission 2.1, part 7) identified a number of criteria which a change model must take account of if change is to occur successfully. These were that a successful change model must:

- be linked to the strategic requirements of the company,
- provide consistent goals,
- provide a coherence of purpose and belief amongst the senior management team,
- provide inter-organisational coherence between, customers, suppliers, distributors and partner companies,
- balance long and short term needs,
- not overload existing resources,
- not create unsolvable problems,
- balance technology, process and human changes,
- balance the needs of different functional expertise,
- provide a knowledge base to support the change,

These provided a basis for the analysis of the framework for change used and the development of a refined model for the change process.

4.4 Description of the Case Studies

The issues in the companies and the knowledge applied are summarised in Tables 4, 5, 6 and 7. For reasons of confidentiality the companies investigated remain anonymous within this Executive Summary.

Table 4 - Issues in Company 1

COMPANY No. 1	
Business	Consumer Ceramics
Business Process	New Product Development
Objective	Reduce the Lead-Time of the New Product Development process.
Issues	Poor filtering and prioritisation of projects resulted in conflicting priorities and project overload. Poor communication. Unrealistic commitments made to customers. Low priority of new products in production led to long delays and rework. Poor specification of product concepts resulted in delays and rework.
Knowledge Transferred	'Project Overload' and the use of effective filtering and prioritisation. The need for collaboration in setting reliable delivery dates. The effect of poor specification
Case Study	Submission 3.2
Discussion	Submission 4.1, Part 2.1

Table 5 - Issues in Company 2

COMPANY No. 2	
Business	Aerospace
Business Process	New Product Development
Objective	Time Compress project plan for major modification at feasibility stage
Issues	Lack of co-ordination between different phases of the project and functional roles resulted in specification and design changes, redundant work and cost Poor management of uncertainty led to lack of urgency to change. Problems with group dynamics and communication reduced the effectiveness of the multi-functional team and project. Organisational issues between the team and functional departments. Potential for project overload.
Knowledge Transferred	Value adding time. Thinking in terms of information flows between decisions. Introduction of a formal process planning framework. Issues relating to teamworking. The effect of late involvement of marketing and procurement functions in a study. 'Project overload'
Case Study	Submission 3.3
Discussion	Submission 4.1, Part 2.2

Table 6 - Issues in Company 3

COMPANY No. 3	
Business	Jewellery
Business Process	Manufacturing
Objective	Reduce lead-time, overdues and quality problems .
Issues	Uneven demand on the factory due to no understanding of capacity. No co-ordination of production resulting in long lead times and poor delivery reliability. Large product range resulting in excessive complexity, cost and quality problems. Poor quality due to large product range, poor design for manufacture, excessive handling and poor specification of manufacturing parameters. No understanding of product cost. Inexperienced management.
Knowledge Transferred	Value adding and non-value adding time. The effect of unstable demand on lead times and work in progress. The need to ensure constant movement of work. The introduction of a finite capacity scheduler to cope with controlling factory demand. The use of computer databases to identify and monitor quality problems. Taguchi methodology for experimental design. Cellular manufacturing design and structure.
Case Study	Submission 3.4
Discussion	Submission 4.1, Part 2.3

Table 7 - Issues in Company 4

COMPANY No. 4	
Business	Aerospace
Business Process	New Product Development
Objective	Improve effectiveness of engineering change process for existing product.
Issues	Poor fit between projects, resources and company strategy resulting in 'project overload' and a sub-optimal mix of development projects. Unrealistic targets for projects. Lack of early involvement of downstream departments, resulting in delays and missed targets. Poorly co-ordinated multiple processes causes confusion.
Knowledge Transferred	'Project overload' and managing projects as a portfolio. Analysing processes in terms of decisions. The importance of effective filtering and clear prioritisation of projects in enacting company strategy effectively. The need to consider the needs of all departments when setting targets. The use of teams. Setting performance measures.
Case Study	Submission 3.5
Discussion	Submission 4.1, Part 2.4

4.4.1 Success of the Case Study Projects

It is important to be able to measure the relative success of the projects, such that the success or otherwise of the different elements of the change framework may be assessed in their contribution to the meeting of the success criteria for a change model described in part 4.3.2. Therefore, the relative degree of success of the case study projects was measured against two criteria:

- Evidence of transfer of key elements of Time Compression and other 'best practice' knowledge to employees of the companies. This includes any increase in understanding of the processes within the company.
- The observation of performance improvements as a result of the project, which show that the knowledge transferred was used. These were split into improvements relating to process control, movement towards a process orientation, improvements in communication and tangible performance measures.

The improvements facilitated within each company are described in tables 8, 9, 10 and 11 (Submission 3.6). These improvements were measured through existing or new performance measures where possible. In subjective areas, for example to ascertain the degree of knowledge transfer or to analyse the causes of implementation difficulty, semi-structured interviews were used. The evidence to validate the improvements identified is contained within submissions 3.2, 3.3, 3.4 and 3.5.

Table 8 - Effect of project at Company No. 1

Criterion	Before	After
Understanding of Existing Process	Little understanding of NPD process as a whole.	Core team understood entire process and its problems and strengths. Other staff understood more of process and the role of their function. Performance of process was quantified. Clearer understanding of elements of marketing strategy. Value adding times of design identified.
Time Compression Techniques	No understanding at outset	Understanding of potential of time based strategy. Understanding of value adding and non-value adding time. Understanding of 'project overload'.
Other New Concepts	-	None appropriate in this case.
Staff Development	Had not considered NPI as a process	Key managers had internalised issues and developed process.
Process Control	Too many projects in system. Many unjustifiable in cost terms.	Justification process improved but still ignored at times. This reduced number of projects, though there were still too many. Better targets set, resulting in improved performance in meeting them.
Functional vs Process Orientation	Heavily functionally oriented structure with strong cultural differences between functions.	Functionally oriented structure with meetings to co-ordinate activities. Still cultural differences. Awareness of need for process increased. Board understood importance of functional differences in improving process performance.
Communication	Poor and on an ad-hoc basis. Poor specification.	Weekly meetings improved interfunctional communication. Specifications still poor. More realistic delivery dates given to customers.
Results	Long and unpredictable lead-times. Overdue projects.	Improved performance in delivery of new products on time.

Table 9 - Effect of Project at Company No. 2

Criterion	Before	After
Understanding of Existing Process	Good understanding of engineering process. Poor understanding of overall process.	Some improvement in understanding.
Time Compression Techniques	Some understanding amongst programme management	Engineers less sceptical of possibility of reducing lead-times through process changes. Understanding of value adding and non-value adding time. Understanding of 'fuzzy front end'. Understanding of 'project overload'.
Other New Concepts	-	Awareness of thinking in terms of decisions.
Staff Development	Management understood potential for Time Compression.	Management understood and showed they could use techniques
Process Control	Planning process under control.	Planning process under control.
Functional vs Process Orientation	Multi-functional development team set up but with functional heads relatively strong compared to team leader. No buy-in from some functions. Strong cultural differences between engineering and commercial departments. Many issues between team and functions unresolved.	Acceptance of heavyweight team structure as the way forward. Further teams set up. Cultural differences remain. Understanding of need for team resource to be full-time and dedicated.
Communication	Limited communication between commercial and technical functions.	Promoted through teamworking and planning proforma developed.
Results	Estimated cost of study £1.5m Estimated Duration of feasibility phase 6 months. Estimated project duration 3.5 years.	Cost £0.9m Duration of feasibility phase 4 months. Estimated project duration 2.5 years.

Table 10 - Effect of Project at Company No. 3

Criterion	Before	After
Understanding of Existing Process	Understanding of individual activities. Little understanding of the flow of work, process times, quality problems. Little understanding of product cost.	Understanding of process times for most products. Understanding of quality problems. Understanding of the relationship between capacity, product flow, lead-time and delivery reliability. Better understanding of product costs.
Time Compression Techniques	No understanding	Understanding of Time Based Process Mapping and of Value and Non-value adding time.
Other New Concepts	Limited understanding of any manufacturing 'best practice'.	Quality databases, Taguchi methods, Cause and effect diagrams, Finite capacity scheduling, Understanding of materials flow.
Staff Development	Many inexperienced managers at all levels.	Continuous improvement projects helped to introduce techniques to identify and manage projects at supervisory level. One project resulted in significant quality benefits and showed clear management development. Managers view of operations increased, confidence increased and awareness of opportunities increased.
Process Control	Poor understanding of capacity, poor forecasting and large number of products led to extremely uneven demand. No production control except for expediting. Quality problems.	Finite capacity scheduling implemented in lockets cell and targeted at other areas. Measures and standard times provided in factory to enhance product flow and ensure some control. Some quality problems solved.
Functional vs Process Orientation	Functionally oriented, including process departments within manufacturing. Strong cultural differences between manufacturing and commercial departments.	Commercial - Manufacturing functionalism increased by move to head office. Manufacturing functionalism decreased by organisation into cells and business units including purchasing, material control and production functions.
Communication	Poor understanding of overall factory limited interdepartmental communication.	Cellular manufacturing increases understanding between different manufacturing areas. Move to head office decreased ties with commercial departments. New performance measures help communication of targets.
Results	Specials cell lead time 5 days Cell 1 overdues 60% Factory rejects 13.9% Casting rejects 14% Casting volume unsustainable 75 cans	Specials cell lead time 3.5 days Factory overdue orders down 37% Cell 1 overdues 3% Cell 2 overdues down by 50% Factory rejects 10% Casting rejects 5.6% Casting volume sustainable 120 cans

Table 11 - Effect of Project at Company No. 4

Criterion	Before	After
Understanding of Existing Process	Tendency to focus on technical improvements. Design time often underestimated. Overall process and its objectives poorly understood.	Balance between improvement types obtained. More complete estimates of design time. Objectives of process widely communicated.
Time Compression Techniques	No understanding	Understanding of 'project overload', product strategy and value adding time. Looked at process and project portfolio as a whole.
Other New Concepts	-	Understanding of Decision Node Analysis
Staff Development	Principal Contact inexperienced in new role.	Knowledge and confidence of Principal Contact developed.
Process Control	Too many projects in process for resource available. Unjustifiable projects in system. Different change processes caused confusion. Poor embodiment targets imposed. Many variances to Variable Build Standard. No prioritisation of projects and cherrypicking. Projects not linked to company strategy.	Projects reduced from 470 to 147 with 65 active. New modifications justified and controlled. Single change process resulted in co-ordination of all modifications. Realistic targets set by consensus. Modifications embodied to plan. New prioritisation mechanism linked to company strategy.
Functional vs Process Orientation	Heavy functional orientation. Culture differences between engineering, manufacturing and commercial functions.	Widened and consistent attendance at key decision making meetings allowed co-ordination of functions. Change from 'Engineering' to 'Product' change process changed image. Multi-functional teams successfully set up to look at specific types of product change. Functionalism between commercial and engineering functions increased by move of commercial.
Communication	Many departments absent at meetings. Unreadable minutes.	Complete attendance at meetings. Prose minutes
Results	Process lead-time 23.5 weeks Targeting accuracy <50%	Process lead-time 4 weeks. Targeting Accuracy 94% Improvement in productivity.

The relative success of these projects is summarised in table 12 (Submission 3.6).

Table 12 - Summary of Success in the Case Studies

	Company 1	Company 2	Company 3	Company 4
Success (Results)	Slight improvement	Some untested improvement	Pockets of good improvement. Some improvement in other areas	Very significant
Success (Knowledge transfer)	Key issues and solutions transferred	Key ideas of Time Compression transferred and used	Substantial transfer of knowledge	All key issues and approaches to solution transferred

The way in which the success criteria were, or were not, met was analysed for each case study. There was a strong correlation between meeting the success criteria and the degree of improvement seen within the companies. Thus the success criteria were validated.

4.5 Description of the Change Model

The case studies were analysed to establish how the different members of the change team and the different steps of the change process archetype had contributed to their success in terms of the success criteria described in part 4.3.2 (Submission 4.1). This analysis was used to develop a detailed change model which identifies the responsibilities of the different team members and the emphasis to be given to the different elements of the change process. This model is summarised below.

4.5.1 Change Team Roles

The roles of the change team were described in terms of different types of power as described by Handy (1993). The likelihood of success of a project is increased by the availability of all of the following sources of power (Submission 4.1, Part 6.1):

- position power at the strategic level of change,
- resource power at the strategic level of change,
- position power of control or influence over process to be improved,
- resource power within process to be improved,
- expert power of process to be improved,
- expert power of techniques to improve process (provided by Researcher in these case studies),

In each of these cases the source of power must be either possessed by the Project Sponsor or Principal Contact, or the Project Sponsor, Principal Contact or Researcher must be able to effectively influence the holder of those sources of power, typically through persuasion or exchange. It is notable that only one of these essential sources of power is in the hands of the Researcher. Thus, the ability to successfully transfer 'best practice' knowledge and see it implemented is thus almost entirely outside of the hands of the Researcher as the external change agent. His effectiveness is entirely based on his ability to persuade, and upon the willingness of company employees to be persuaded. This conclusion correlates with the findings of the study on transfer of 'best practice' by management consultants (Submission 2.3, part 6.1) which suggested that the closeness of the relationship between consultant and client was related to, but not a guarantee, of success. It was suggested that the client consultant relationship

was a two way process and that it could be the willingness of the client to co-operate which was responsible for determining the outcome of the assignment.

The ideal characteristics of the Principal Contact were determined (Submission 4.1 part 6.1) to be that he should:

- Be bought into the need for the project and be willing to champion it.
- Have a detailed understanding of the context of the company.
- Have a detailed understanding of current processes and procedures.
- Have the ability to gain the respect of peers through his experience and knowledge.
- Have time available to focus on the project. If required he should have access to other resources, perhaps through control of them.
- Have good interpersonal skills to allow him to work closely with the Researcher and help persuade his colleagues of the course of action.

The characteristics of the ideal Project Sponsor were determined (Submission 4.1, part 6.1) to be that he should:

- Be bought into the project, have a clear understanding of its objectives and be willing to champion it.
- Have a detailed understanding of the context of the company.
- Be able to influence or control resources available to carry out the project.
- Be able to influence or control other projects which may have an effect on the project in question.
- Have good interpersonal skills to allow him to work closely with the Researcher and Principal Contact.

The key attributes of the Researcher (external change agent) were (Submission 4.1, part 6.1) that he should:

- Have a thorough understanding of the techniques for process improvement in order to provide a basis for expert power.
- Have good interpersonal skills in order for him to be able to use his expert power in order to be able to influence any person involved in the project.
- Have the ability to pull together the information collected from the diagnostic stage in order to be able to balance the needs of different functional departments and elements of the project through effective project planning and communication.

The purpose of Table 13 is to synthesise the model, through relating the contribution of the three change team members to the success criteria for a change model.

Table 13 - Change Model Relating Team Roles with Success Criteria

Success Criterion	Principal Contact	Researcher	Project Sponsor
Linked to strategic requirements	Ensure project is linked to strategy as defined by sponsor	Ensure project is linked to strategy as defined by sponsor	Provide strategic requirement for project
Consistent goals	Acts to reach the goals	Acts to reach the goals	Provide goals, and ensure their consistency by managing the internal and external context
Coherence of senior management purpose & belief	Encourage understanding and commitment of all senior managers.	Help senior managers to understand the key issues through the presentation of valid information and options.	Ensure commitment of all senior managers, and balance conflicting issues.
Inter-organisational coherence	*Unknown*	*Unknown*	*Provide framework for co-operation*
Balance long and short-term needs	Use gaps in short term workloads to work on longer term issues.	Highlight need to work on longer term issues	Ensure adequate resourcing of longer-term projects
Not overload resources	Provide resource or manage workload. Provides dedicated resource for project management.	Provides additional resource and coaching to make best use of the time available.	Ensure adequate level of resourcing for projects underway.
Not create unsolvable problems	Helps Researcher to anticipate problems.	Anticipates problems and solves or avoids them.	Helps Researcher to anticipate problems.
Balance technology, process and human changes	Helps to identify stakeholders and key issues. Work with Researcher to manage project.	Careful project management to ensure that all stakeholders become involved as soon as possible and to avoid important perspectives being missed.	Help to identify stakeholders and key issues. Takes a balanced view of the problem.
Balance functional needs	Help to identify stakeholders and issues. Acts as broker between functions and project manager.	Careful project management to ensure that all stakeholders become involved as soon as possible and to avoid important perspectives being missed. Facilitates relationship between functions.	Help to identify stakeholders and key issues.
Provide knowledge base.	Principal recipient of knowledge. Acts to disseminate knowledge within company.	Provides new knowledge and perspectives.	Provides strategic perspective.

Areas requiring more validation are shown in italics.

4.5.2 Change Process Archetype

The change process archetype was analysed for its contribution to the satisfaction of the success criteria (Submission 4.1, part 6.2).

Problem Identification and Definition

Initial problem identification was carried out by the Project Sponsor who directed the Researcher to that area. Problem definition was carried out by the Researcher and Project Sponsor (Submission 4.1, part 6.2). It was clearly shown that accurate problem definition was essential so as to avoid creep of project scope. Accurate definition was shown to be enhanced through some initial diagnostic interviews which identified the key opportunities. Since the problem definition is used to identify a suitable Principal Contact and project team it is important to ensure that the human elements of the project are included in the definition.

The problem definition stage is the key point in the process where the strategic level of change is considered. It is at this point in the process where the role of the Project Sponsor is critical. The success of the company is influenced by the link between the project and company strategy. The success of the project is influenced by the consistency of its goals and the coherence of senior management in pursuing them. The likelihood of achieving these is closely related to the definition of the problem, and influence of the Project Sponsor (Submission 4.1, part 6.2)

Data Collection

The data collection process was seen to provide the following (Submission 4.1, part 6.2):

- It allowed the Researcher to gain an understanding of the process, company culture and language used within the company.
- It allowed the Researcher to generate valid data for use in influencing company employees of the need to change the process and of the direction that that should take. Interviewing all key people built up credibility for the data collected and thereby helped to gain internalisation of it.
- It allowed the Researcher to identify key people in the process and build up relationships with them, thereby beginning to build commitment to the change process.
- It allowed the company employees to learn about the principles behind what was being examined and the reasons the project was being undertaken, thereby beginning to gain commitment to the change process. This also helped to begin to create a common language and a new perspective amongst the stakeholders.

The tools used for data collection provided the following (Submission 4.1, part 6.2):

- They helped people to think of the process from a different point of view to that which commonly prevailed.
- They provided a means of capturing data.
- They provided a mechanism to start talking to company employees about the process.
- If visually simple they could be extremely powerful in influencing company employees of the need for and direction of change.

The data collection process proved important in that it was the first time the Researcher, Principal Contact and other stakeholders had worked together. Thus it was key to the relationship building required during the later phases of the project. The power of this stage of the process was shown at company 4 where the success of the data collection process and associated analysis and feedback, provided the company with enough to implement the changes with little further intervention (Submission 4.1, part 6.2).

Data Feedback, Analysis and Solution Generation

This stage of the process was heavily influenced by the success or otherwise of the steps in the process before it. It was concluded that this stage of the process should be an integrated end to the data collection process. The stakeholders will already be involved in the project through the data collection stage, have an understanding of the process and be committed to the project outcome. This stage of the process builds further relationships and consensus. This shared understanding provides a solid foundation for the creation of realistic and feasible plans and commitment to their achievement through availability of suitable resources. If a workshop is held then its objective is to identify possible solutions, decide on the most appropriate and plan the framework for their implementation (Submission 4.1, part 6.2).

Implementation

The success of the implementation phase is dependent entirely on the stages of the process before it. The problems of resourcing experienced at companies 1 (Submission 3.2, part 5.2) and 3 (Submission 3.2, part 4.3) can be traced back to lack of consideration of all factors at the problem definition stage, partly due to

inappropriate choice of Project Sponsor. The successful implementation of solutions by the Principal Contacts at company 1 (Submission 3.2, part 5.2) and particularly at company 4 (Submission 3.5, part 5.2) can be traced back to the relationships built up during the data collection and data feedback, analysis and solution generation stages (Submission 4.1, part 6.2).

Performance Measurement

Measures were set up at the implementation stage. The perceived success of the project in senior management's eyes determined whether or not measures were maintained. At company 3 the measures were used to reinforce the successes and build confidence for further changes (Submission 3.4, part 4.1).

The purpose of Table 14 is to synthesise the model, through relating the contribution of each element of the change process archetype to the success criteria for a change model.

Table 14 - Change Model relating Change Process to Success Criteria

Success Criterion	Problem Ident. and Definition	Data Collection	Feedback, Analysis & Solution	Implementation	Performance Measurement
Linked to strategic requirements	Ensure link in problem definition	Check relevance of problem	Ensure solutions fit with strategy	Monitor fit of solution to strategy	Ensure fit with strategy.
Consistent goals	Set suitable goals for consistent application	Maintain and communicate goals	Set objectives for individual project elements	Communicate goals	Match measures and goals
Coherence of senior management purpose & belief	Ensure coherence through suitable choice of problem definition and negotiation	Maintain coherent message	Maintain coherent message	Maintain coherent message	Use to reinforce purpose and belief
Inter-organisational coherence	*Set framework*	*Follow framework*	*Follow framework*	*Follow framework*	*Use to reinforce framework*
Balance long and short-term needs	Identify possible conflicts	Identify all issues and collect valid information.	Ensure balance through choice of solutions	Manage balance	Use to monitor balance
Not overload resources	Look at problem definition in overall context and ensure adequate resource. Choose Principal Contact	Understand stakeholders and issues requiring resourcing.	Match project needs, timing and resources.	Monitor use of resources and replan if necessary	*Highlight overdue projects*
Not create unsolvable problems	Choose appropriate problem	Identify problems and solve.	Identify problems and solve	Monitor to ensure all problems resolved.	*Use to highlight problems*
Balance technology, process and human changes	Identify issues and stakeholders	Identify issues and cover all appropriate perspectives during data collection. Bring stakeholders into project. Provide valid information to gain shared understanding	Ensure solutions chosen balance issues	Monitor and project manage	*Use to monitor balance*

Success Criterion	Problem Ident. and Definition	Data Collection	Feedback, Analysis & Solution	Implementation	Performance Measurement
		and solve conflict.			
Balance functional needs	Identify stakeholders and issues	Identify further issues and stakeholders. Bring all stakeholders into project through involving them in data collection. Collect valid information.	Build on commitment and understanding of stakeholders to identify suitable solutions using valid information.	Monitor and project manage	Use to monitor balance.
Provide knowledge base.	Provide knowledge base to senior management	Provide knowledge base to all stakeholders.	Reinforce knowledge base	Reinforce knowledge base and disseminate throughout organisation.	Test success, thereby building knowledge base.

Areas requiring further validation are shown in italics.

4.5.3 Role of the Change Team Within the Change Process Archetype

The two elements of the change model are both essential to meeting the success criteria required of a model. The different change team members were most important at different stages of the change process. These relationships are summarised in Table 15.

Table 15 - Change Model Relationship Between Team Roles and Change Process Archetype

Model Element	Principal Contact	Researcher	Project Sponsor
Problem Identification and Definition	Is selected according to nature of problem.	Helps Project Sponsor to define problem. May carry out overview diagnosis.	Defines problem and ensures its fit with strategy and its coherence with internal context.
Data Collection	Works with Researcher on data collection	Carries out data collection	Helps gain access to key stakeholders
Feedback, Analysis & Solution Generation	Works with Researcher to analyse data. Works with project team to identify and plan solutions	Feeds back data and works on analysis. Facilitates solution generation.	Receives feedback and ensures strategic fit of solutions.
Implementation	Manages project at operational level	May assist management of project at operational level. Coaches team.	Manages strategic level of change
Performance Measurement	Maintains performance measures.	Monitors performance measures	Monitors performance measures.

4.5.4 Overall Description of Model

The model developed can be described in terms of the role and attributes of the members of the change team, the role of the change process and the contribution each of these makes in ensuring that the criteria for success of a change project are met. These are shown in tables 13, 14 and 15. The model is dynamic and complex. It is summarised in the Causal Loop Diagram in Figure 2. This allows the dynamic relationships to be seen more easily. The different factors within the model are written on the diagram. Relationships between them are represented by arrows. A '+' sign by the arrow means that as the factor at the blunt end of the arrow goes up, so

does that at the pointed end. A '-' sign means that as the factor at the blunt end of the arrow goes up, the factor at the pointed end goes down. The model has been split into those elements which occur at the operational level of change and those at the strategic level of change. It can be seen that both elements have an important input to the success of a change project.

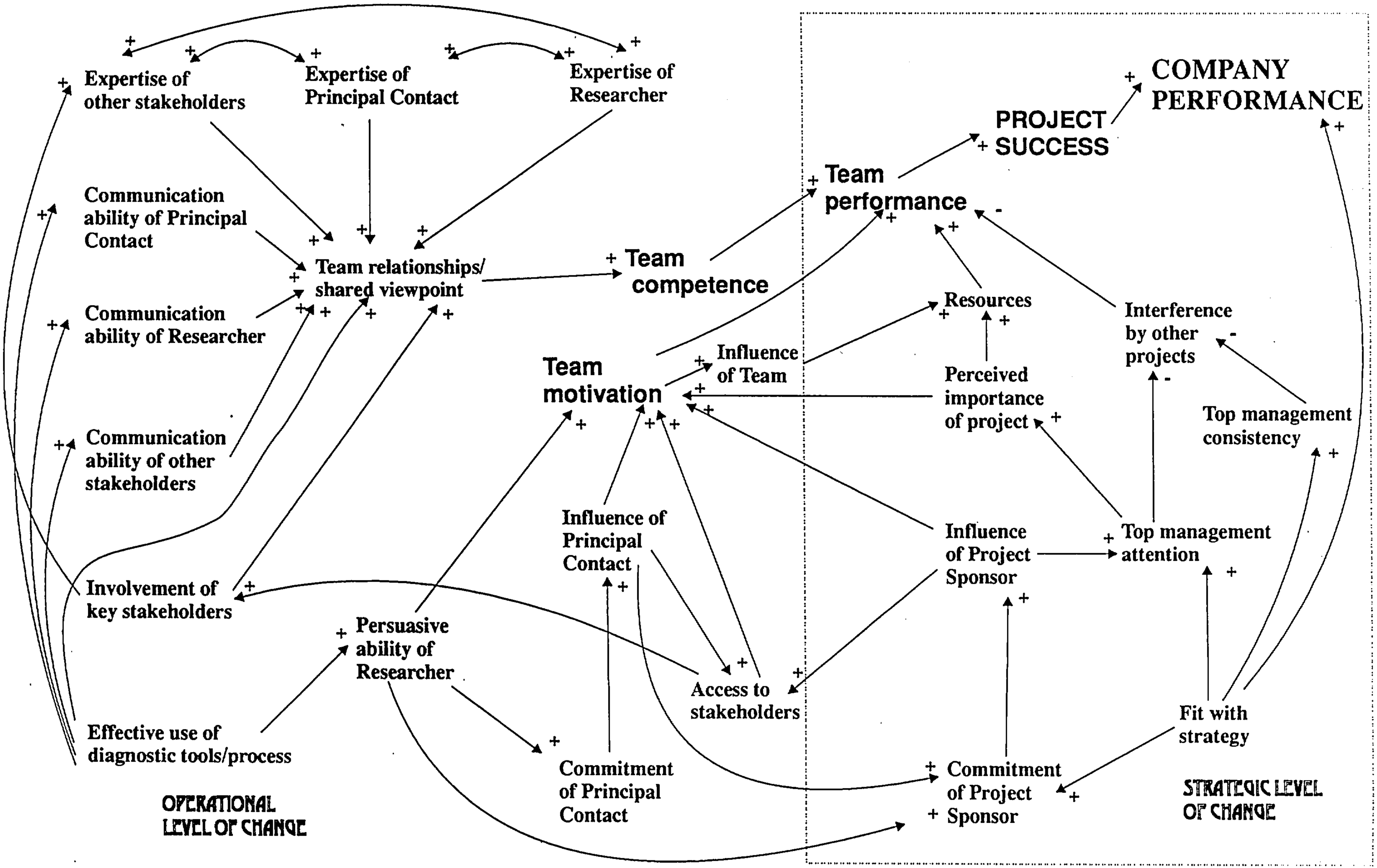

Figure 2 - Causal Loop Diagram Showing Relationships in the Change Process

4.5.4.1 Other Issues

It was recognised that a major issue facing the companies studied was the situation of 'change project overload' where a large number of projects were being carried out by a small number of managers, resulting in projects with very long elapsed times. This was felt to be a result of poor prioritisation and targeting of changes to a business. A number of strategies for gaining maximum benefit from an investment in change are proposed for further validation (Submission 4.1, part 5).

- Focusing resource on fewer projects.
- Targeting change at points of leverage - by definition, a point of leverage is a place where a little effort provides a large result (Senge, 1990, p64)..
- Using Time Based Process Mapping to target efforts at the areas of a business with the most non-value adding time.
- Focusing change on pressing business problems to ensure line management commitment to improvement.
- Using a strategy with a large number of sequential and co-ordinated small projects to ensure that the business benefits from improvements as quickly as possible.

Three points of leverage were identified (Submission 4.1, part 5.2). They were:

- Effective filtering and prioritisation of new product projects/product changes.
- Planning of the product change process.
- Product specification and conceptual design.

It was concluded that these points of leverage have a number of characteristics which may be used to help identify others (Submission 4.1, part 5.3):

- They are all decision making points.
- They are near functional boundaries.
- They have a significant effect on those activities occurring subsequent to them in a business process.
- It is relatively easy and inexpensive to change the practice occurring at the point.

The identification of points of leverage is a valuable means to maximise the return on the investment of both capital and human resources. By identifying the points of leverage and targeting change in those areas, it is possible to improve the performance of the organisation on a wider scale, often without any major change taking place outside of the point of leverage area. This occurred in the project at company 4 (Submission 3.5).

5. CONCLUSIONS

There are many conclusions which have been drawn from this Executive Summary.

There are, however, a number of key conclusions:

5.1 Constituents of 'Best Practice'

The constituents of 'best practice' are not state of the art, they are appropriate to the competitive conditions experienced by a company, its culture and strategy. There are a number of generally applicable elements of 'best practice':

- Clear focus on customers and markets.
- Continual update of strategy in line with changes in the competitive environment of the company,
- Strategic fit,
- Continuous removal of waste,
- Maximisation of people's effectiveness.

There are also elements of 'best practice' which vary with time and geography. They follow the generally applicable elements, but are transient in nature.

5.2 Successful Transfer of 'Best Practice'

The change model developed has been successfully used to transfer 'best practice' knowledge into manufacturing companies with tangible performance improvements, including the following:

Table 16 - Major Performance Improvements

	IMPROVEMENT SEEN
Company 1	Improved performance in on-time delivery of new products.
Company 2	Reduction in estimated project duration from 3.5 years to 2.5 years.
Company 3	Overdue orders down 37% on average. Specials lead-time reduced from 5 to 3.5 days. Rejects reduced by 4%. Virtual elimination of overdues in two cells
Company 4	Process lead-time down from 23.5 to 4 weeks On-time delivery of product changes improved from under 50% to 94%.

5.3 The Change Model

The role of the external change agent in the transfer of 'best practice' knowledge is based on his ability to use his expert and personal power to influence those in the client company to use their resources to implement change, and the willingness of the client to be influenced. This dependant relationship means that the process followed to implement change is crucial. It was concluded that the problem identification and definition stage was crucial to the success of the later stages of a project. It was at this stage that the fit of the project with the strategic objectives of the company was made, the goals set and the relationship with an appropriate Project Sponsor developed. The data collection phase which follows provides the opportunity for the external change agent to build relationships with employees at the operational level of the company, and for the employees to build relationships between one another. It also provides the opportunity for the development of data to support the analysis and solution generation phase. The research led to the conclusion that, where there were

problems in the relationship building in these two phases, the project was liable to be less successful. It also led to the conclusion that the project was less likely to be successful if the fit with the immediate strategic objectives of the company were poor, indicating a mismatch between changes occurring at the strategic and operational levels of change within the company.

6. REFERENCES

- Cummings T G, Worley C G, "Organization Development and Change" 5th Edn. West Publishing Co., St. Paul, MN, (1993)
- Department of Trade and Industry (DTI), Confederation of British Industry, "Competitiveness: How the best companies are winning", London (1994)
- Handy C, "Understanding Organisations", Penguin Books, London (1993)
- Senge P M, "The Fifth Discipline", Doubleday, USA, (1990)
- The Strategic Planning Society, London Business School and IBM, "Made in Europe", Conference Proceedings, 25th January 1996.