New Product Development to Achieve Customer Values: A Case Study Approach

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Abstract

Experimental evidence on the strategic management of new product development is presented in four case studies. The cases are analysed to elucidate the procedures used to capture and preserve customer values. A generic network is constructed to represent strategic flows of information in product development.

Keywords

New product development, quality assurance, strategic management

1 INTRODUCTION

We consider the batch manufacture of discrete products by companies which are small to medium size enterprises (SME's) in their own right or, if members of larger groups, function essentially as autonomous units of medium size in those larger groups. The aim is to identify the information processing characteristics of the strategic management of new product development (NPD as revealed by analysis of a diverse set of four case studies, designated A, B, C, D. In what follows we summarise the case studies, characterise leading features in terms of the companies, their products and customers, and review the means adopted for capturing and preserving customer values.

The original version of this chapter was revised: The copyright line was incorrect. This has been corrected. The Erratum to this chapter is available at DOI: 10.1007/978-0-387-35321-0_72

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2 CASE STUDIES

Case Study (A) - Turbomachinery (Lewis, 1996)

Company: Small specialist firm established in Melbourne in 1989 by an engineering entrepreneur who set up a network of suppliers and arranged for hire of manufacturing and test facilities.

Product: 400 kW dredge pump for dredging the harbour at the port of Newcastle, New South Wales, major contract for new company, product is a one-off special purpose item of a medium degree of complexity, engineered to order, ETO in the classification of Maffin et al. (1995).

Customer Relations / Value Capture: Company founder had well established reputation as pump designer but many face-to-face discussions with customer's senior engineers required to establish trust in capacity to deliver the goods. Value capture : dialogues with customer's engineers led to entrepreneurial insight, company founder. He saw the need for a constant speed pump and convinced the customer of the advantages of such a device, a significant departure from conventional variable speed technology.

Quality Assurance / Value Preservation: Company has ISO 9000 accreditation. Critical dimensions of patterns and castings supplied by sub-contractors were checked by design staff. The pump was assembled by design staff in rented factory space. Laboratory facilities were hired and the pump tested to prove its hydraulic performance, before being shipped to the customer.

Case Study (B) - Medical Instrumentation (Hauser, 1992)

Company: Medical instrumentation company, located in Boston, well established, medium size firm with widely accepted products but experiencing declining market share as competitors introduce new, attractively priced products.

Product: Spirometer, a medical instrument for measurement of lung capacity. Production in large batches, products made to stock, MTS in Maffin et al. (1995). Customers are physicians and medical technicians in hospitals and general practice, level of expertise of users is variable. Product complexity at user interface: high; complexity of product configuration: medium. (See Burns et al. (1996) for elaboration of these concepts of product complexity.)

Customer Relations / Value Capture: Extensive use of Quality Function Deployment procedures to identify customer needs, explicit and implicit, interviews with typical customers and focus group discussions. Cross-functional team formed from marketing, engineering and manufacturing to handle product development from market research to product launch. A QFD matrix was drawn up containing 56 engineering design attributes associated with 25 customer needs.

Quality Assurance / Value Preservation: Testing and evaluation at the end of key stages of the product development process by groups of typical customers, asking them to review in turn written specifications of the spirometer proposed, visual models, and working prototypes. The final step was approval of the new spirometry system by the U.S. Food and Drug Administration.

Case Study (C) - Rural Water Supply (Lewis and Liu, 1997)

Company: A well established, small to medium size enterprise employing about 100 people, member of larger manufacturing group. Founded by local entrepreneur who later sold out his interest.

Product: Domestic water pressure systems. Product provides pressurised water in rural areas where there is no reticulated supply. Production in large batches, products made to stock (MTS). Complexity at user interface: high, because users usually responsible for operation and maintenance of equipment. Complexity of product configuration: low.

Customer Relations / Value Capture: There are a large number of technically naive customers drawn from the general adult population. Cross functional team formed from marketing, engineering and manufacturing to undertake development of product. Customer needs translated into engineering specifications via a tabulation similar to that for QFD matrix but modified to include a column entitled "Customer Experience" . By referring everything back to and recording explicit customer experience it was intended to exclude implicit assumptions about customer behaviour being accepted when those assumptions, if made explicit, would be rejected.

Quality Assurance / Value Preservation: Customers' need for trouble-free operation led to (a) a series of failure modes and effects analyses each of which corresponded to a potential mode of failure identified in the modified QFD table, and (b) life and durability testing of key components subject to fatigue and wear, followed by performance testing of prototypes in the field before product launch.

Case Study (D) - Urban Transport (Lewis and Crump, 1997)

Company: Began life as Commonwealth Engineering, a company formed after the Second World War to supply transport equipment to local rail authorities, is now a subsidiary of a global engineering group. 250 employees at the time of this study.

Product: Railcars for urban transport system in U.S.A. - bodyshells and bogies for 200 mass transit vehicles. Small batch production on assembly line. Product is engineered to order, ETO.

Customer Relations / Value Capture: Public call for tenders by U.S. transit authority. Company D bid successfully for supply (design and manufacture) of bodyshells and bogies of railcars. There had been progressive incremental development of product specifications by customer with decades of experience in the operation of urban transport systems. These specifications incorporated into contract with Company D.

Quality Assurance / Value Preservation: The contract stipulated reviews and inspections carried out by the customer's engineers and consultants after each major phase of product design and development, as follows - Concept Design Review, Final Design Review (of design scheme representing embodiment of previously agreed concepts), Detailed Design Review of working drawings, then type test of prototype to validate performance under the stipulated loading regimes, and finally inspection and dimensional checking of the first railcar manufactured.

3 ANALYSIS

3.1 Independent variables

Comparisons between the case studies enables us to identify points of similarity and points of difference and hence the variables affecting the outcomes of the NPD processes adopted by the different companies. We classify these variables as (i) independent variables - the givens not under the control of strategic management of the company concerned, and (ii) control variables - the subject of decisions by strategic management. The independent variables are shown in Tables 1 and 2.

Table 1 Independent variables - companies

Case	*Age*	*Size*	*Product R&D (% turnover)*	*Comment re data on Product R&D*	*Characteristics of Customer*
A	1 year	Small	7.0	Advice from founder	Experienced, but lack knowledge
B	Mature	Medium	(8.0 - 10.0)	Published data for similar companies	Practitioners with varying skills
C	Mature	SME	2.0		Adults, with practical skills
D	Mature	Medium	n.a.	Data confidential to company	Considerable experience

Table 2 Independent variables - products

Case	*Type of Product*	*Production*	*Complexity - User Interface*	*Complexity - Configuration*
A	ETO	One-off	Low	Medium
B	MTS	Large batch	High	Medium
C	MTS	Large batch	High	Low
D	ETO	Assembly line	Medium	High

3.2 Control Variables

Value Capture

Company A is a young, entrepreneurial, niche company, manufacturing specialised products engineered to order. Value capture is the result of extensive face-to-face dialogues between the entrepreneur (the founder of the company) and the customer's engineers. The remaining companies are well-established, their entrepreneurial founders have long since departed: the organisation people have taken over, competent but lacking the founder's insights. Their products, either because of the range of their interactions with the user or because of their physical form, are relatively complex. Companies B and C have customers possessing some product knowledge but nevertheless widely varying levels of skill in product operation and maintenance. They carefully organise their approach to product design, in their case by QFD-based procedures. Company D on the other hand had one very experienced customer who had developed a set of detailed specifications.

Value Preservation

The procedures for value preservation in the case studies are set out in Table 3 .

Table 3 Control variables - procedures for preservation of customer values

Procedure	*Company*	*Comments*
Design review - concept	B, D	Direct involvement of customer
- details	D	Product D much more complex than B
Design review - indirect	C	Indirect customer input via QFD
Failure modes and effects analysis	A, C	A - operating reliability a top priority C - derived from QFD table
Physical model, mock up	A, B	A - assisted visualisation of pump B - response to product aesthetics
Rig tests of key components, sub-assemblies	C	C - critical modes of failure are fatigue and wear of complex parts
Performance testing of prototype(s)	B, C, D	B, C - field tests with customers D - proof of strength under all loadings
Certification testing	A, B, D	A - proof of hydraulic performance B - acceptance by F.D.A. D - Inspection of first product off line

4 IMPLICATIONS FOR STRATEGIC MANAGEMENT

Successful management of value capture and value preservation in the NPD process requires a deep knowledge of the flows of information which are of strategic importance. Such knowledge is demonstrated by the construction of a flow chart or Strategic Information Network (SIN) of which Figure 1 is an example. In the figure rectangles with square corners represent the information processing characteristics of manufacturing operations in the value adding chain of new product development. The interlinking lines or arcs represent flows of information - flows between operations, between operations and customers, and to the company database system. This system is represented by rectangles with radiused corners. The diamonds represent control or review points in the NPD process, points at which decisions are made to proceed, to end the project, or to backtrack and revise previous work.

Figure 1 is based on Case Study (A), an ETO product; it has been extended to cover cases (B) and (C), MTS products, by inclusion of a formal procedure for recording customer experiences and product responses, and feeding this information into the company's product design database, to be available for subsequent design projects. The SIN for case (D) would be similar to that for (A), as both are ETO products, but with more control points introduced because of the greater complexity of the product.

There is a box in Figure 1 labelled PPFA and FMEA. The latter refers to failure modes and effects analysis and needs no further explication. The former - potential problem formulation and analysis - is a generalisation of FMEA in which any inability to meet targeted levels of product quality represents a potential barrier to successful product design, and therefore a problem to be solved in advance of product launch. The solution of such problems is an integral part of the design process. See Marshall et al. (1996) for an example of how one company organises its database of the problems encountered and solved in its product design and development programme.

In the context of information processing, strategic management of the NPD process consists of decisions on

(a) the nature of the dialogue with customers and the capture and transmission of information from this dialogue;
(b) the positioning of control points in the SIN's, the nature and timing of review procedures;
(c) information storage, the construction of company databases and the means of access to them.

The case studies have demonstrated successful strategic decision making in a diverse set of companies manufacturing a variety of products.

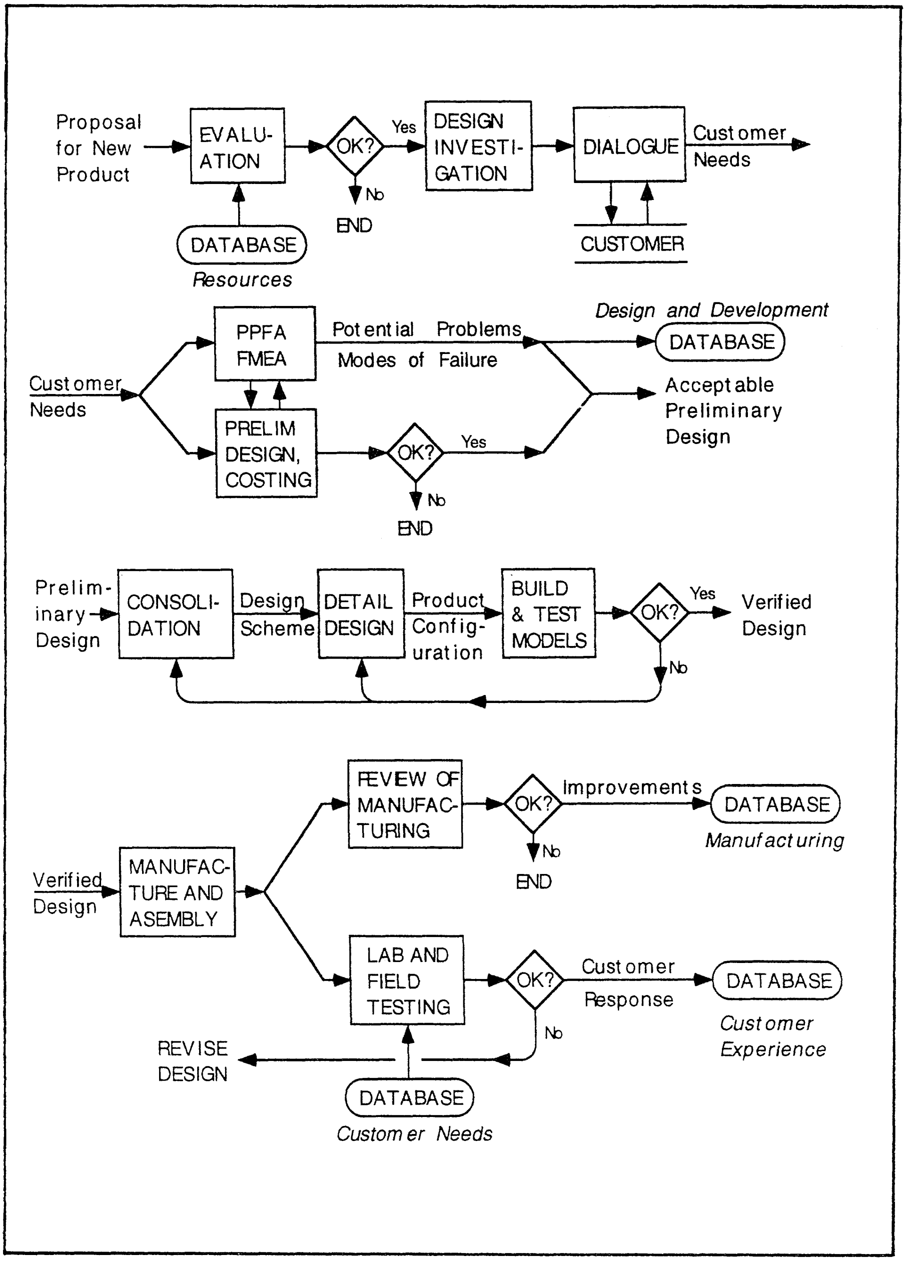

Figure 1 Strategic information network.

5 CONCLUSION

We have considered four case studies of new product development. Classifications of the companies and their products have been presented in Tables 1 and 2 in Section 2 of the paper, and the corresponding procedures used for value capture and preservation in Section 3. The tabulations facilitate extrapolation from the case studies to other applications of practical interest. The systematic application of these procedures is conveniently shown on a Strategic Information Network. The importance of an adequate and accessible company database of potential and current problems in product design and development is apparent.

REFERENCES

Burns, J., Barclay, I. and Poolton, J. (1996) A Structured Methodology for Implementing Concurrent Engineering, in *Concurrent Engineering: What's Working Where* (ed. C.J. Backhouse and N.J. Brookes), Gower Publishing, Aldershot.

Hauser, J.R. (1992) Puritan-Bennet - The Renaissance Spirometry System: Listening to the Voice of the Customer. Working Paper No. 67-92, I.C.R.M.O.T., Massachusetts Institute of Technology, Cambridge, Massachusetts.

Lewis, W.P. (1996) Case studies of engineering design in small to medium size enterprises. Design Report No. DR 1/96, University of Melbourne.

Lewis, W.P. and Liu C. (1997) The timely allocation of resources in the concurrent design of new products. *Journal of Engineering Design,* **8**, 3-17.

Lewis, W.P. and Crump, I.R. (1997) Design of urban transport vehicles for global markets, in *Proceedings of the International Conference on Engineering Design,* Tampere, Finland, 713-722.

Maffin, D., Alderman, N., Braiden, P., Hills, B. and Thwaites, A. (1995) Company classification: a new perspective on modelling the engineering design and product development process. *Journal of Engineering Design,* **6**, 275-289.

Marshall, S., Medhat, S., Pratt, G. and Rook, J. (1996) Tools and Techniques for Efficient Product Development, in *Concurrent Engineering: What's Working Where* (ed. C.J. Backhouse and N.J. Brookes), Gower Publishing, Aldershot.

BIOGRAPHY

Dr. W. P. Lewis is a senior research associate, University of Melbourne. Together with colleagues he has established a structured course stream in Engineering Design and Manufacturing at that University. He has led continuing education courses on Strategic Product Development, and has special responsibilities for university liaison with industry. Dr. Lewis's research and consultancy interests include: manufacturing systems, innovation and public policy, design theory, quality assurance. He is the author or co-author of two books and fifty papers.