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THE APPLICATION OF DESIGN MANAGEMENT THEORY TO A REAL DESIGN PROJECT

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1. Introduction

It is proposed that the theoretical models and recommended activities in design management have now moved from being too shallow to being too complex and thus, still impractical for the skilled practitioner to use. They do not include an appreciation that people who are experienced, or even expert, in a particular field do not need to pass through every stage of the process.
On the other hand, proposing 'fast-track' processes can also be 'dangerous'. The problem with a 'fast-track' processes is that these can be written for one set of people and then used by a different set of people with different experience from that available within an organisation. This could result in the omission of important stages in the process.
There needs to be a new approach that is flexible enough to capture particular experiential knowledge but also work when used by the less experienced. It must also be simple to use or it won't be used.
Theoretical design management processes were compared to those stages undertaken in a real design situation. Elements of a modified system that were found to work are described.

2. Background

Design management may be defined as 'the organisation of the process for developing new products and services' [Hollins & Hollins 1999]. Twelve years ago Wikstrom & Erichsen [1990] presented the results of a study of North Sea oil installations in which they concluded that none of the academic models of the design process worked in practice as they were all too shallow to be of practical use. Rohatynski [1990] deduced that it was the attempt to make these models universal that made them impractical.
Over these intervening years the understanding of design and it's management has grown. In the 1990's design management had a high profile. There are several British Standards that offer guidance in the process [BS 7000 Parts 2 and 3 and to a lesser extent, ISO 9000 2000] as well as several books [Baxter 1995, Hollins & Hollins 1999] that show the latest 'thinking' of this aspect of the product development process. Also this author has developed and implemented design management processes for organisations as part of consultancy. Some of these companies were later revisited to see how these processes were working. A typical comment was that the processes appeared to work all right. But on further questioning it was revealed that they were not always (sometimes rarely) used because they were difficult, often slow and this directly impinged on the product 'time to market'.
This led to the development of Stepped Specifications [Hurst & Hollins 1995]. With these, a small amount of information is identified and from this it is possible to make the decision as to whether it is worth making the investment to take the project to the next stage of product development. Thus the information grows in a series of steps. At any of these steps a decision may be taken to abandon the project, these are called 'bail-out points'. These are easier to use and go, some way, towards solving the problem.

In effect, this gives a front-end loading to product development and causes more projects to be (rightly) abandoned without much having been spent on them. The process is easier to use but there is a disadvantage. Although the overall time that a company may spend on the total number of design projects is reduced, as many more product ideas are abandoned at an early stage, the design team may spend more time on any one successful product developed through to market due to the many assessed stages involved.

3. The project

More recently this author has been involved, as a Non-Executive Director for a company called 'Cool Logistics'. This company supply shipping systems for the transportation of temperature sensitive products anywhere in the world at temperatures defined by the customers, typically, +2 degrees C to 8 degrees C. Although the methods adopted for testing and validation have become significantly more sophisticated, the products used in cool pharmaceutical distribution have remained, essentially, the same for the past twenty years - until now. That is, to package the pharmaceuticals into well insulated containers and keep the insides cool through the use of ice packs.

All this is about to change due to an exciting new product. Cool Logistics are developing a revolutionary new form of 'absorption cooling'. This product is still under development and will be protected by worldwide patents. Called NANOCOOL, it is a joint venture between Cool Logistics, of the UK and Nanopore of America. This is a world first and involves cooling through vacuum absorption and is operated as follows:- The cooling device is built into the lid of the insulated container. The cooling process is actuated by the press of a button on the pack and can provide up to several days of product cooling without the need for any form of electric power or precooling (as will be demonstrated in the conference presentation).

After initiation of the NanoCooler, the temperature inside the box falls and remains controlled until the absorption process is complete and then the temperature begins again to climb. The cool part of the packet is on the inside of the insulated container whereas the heat is ducted away to outside the container.

Part of the development has been funded through a SMART Award from the UK Department of Trade and Industry. Interest has also been shown by the UK Design Council, who would like to include the concept as one of their 'Innovation Stories' when the product is marketed September 2002.

4. Results

The development of this product has provided the opportunity to 'test' some aspects of the latest theoretical design management models and principles in a practical application to see if the theory is now practical.

Many of the existing doctrine regarding design management were found to hold true. This shows that we have progressed in our useful understanding and aid to the practitioner in recent years. One of the keys has been in the recent developments in our understanding of Product Design Specifications. The results also confirmed the effectiveness of the stepped approach for specification compilation. This can instil existing learning and experience into its compilation. The results also show the highly iterative nature of design management.

Prescribing an initial set of parameters inside which an organisation should base future developments did save a great deal of time as described in BS 7000 part 1 [1999] and Hollins & Hollins [1999]. In effect, it focused a potentially good product towards specified market niches that the company could usefully exploit. In this case it clearly showed the sequence of different markets that should be approached starting with the high value markets and down through to the low value high demand commodity markets. In this case the sequence of proposed whole life planning for market penetration has been planned for a period of five years. This was also similar to the mapping of both the length and width of the Innovation Highway [BS 7000 part 1 1999].

Another aspect that was prevalent throughout the design process was concurrency. The literature indicates that concurrency in developing new products tend to occur within certain stages of an overall design management process [Hollins & Hollins 1990]. That is, concurrency cannot (logically) occur in between, say, the market research stage and the detail stage of the design process. In practice, the design process of this highly innovative product was so iterative that aspects of all stages of the design

process were occurring at the same time. It is believed that the degree of innovation involved in this project has meant that it has been necessary to undertake some planning of the later stages (selling and manufacturing) as early as the initial market research stage. Perhaps this finding just indicates that iteration is far more extensive and detailed than is generally acknowledged in the literature.
It should be remembered that innovation can occur throughout the value chain [Topalian & Hollins 1998] including the marketing end of the process and all such opportunities need to be confronted and resolved early in the process. This could be considered as part of the concurrent engineering. In this case, the marketing side would not require a significant degree of innovation and so the existing knowledge that the directors held of the market could be used.

5. A new way?

An alternative, simplified, form of design management for new product development is proposed, based on what was found to work in this particular product development. It is suggested that existing experience can be incorporated into the process through the identification of areas where development is actually needed.
In this example, although this was a new start-up company, the three directors have more than 25 years of experience in providing solutions to this market. We chose to channel our effort into the particular known customer needs rather that spread our effort outside of chosen boundaries. The process builds on earlier work and has to be kept simple for it to be acceptable to practitioners.
It is now accepted that the main reason for new product failure is market failure. Bearing this in mind, the step was taken that designing the new product should be viewed mainly as an exercise in satisfying the market at all stages of the customer experience throughout the product life cycle (at a profit).
Research previously undertaken for the UK Department of Trade and Industry [Topalian & Hollins 1998] had already shown that successful companies that planned their new products well into the future (typically more than ten years) did not tend to look specifically at new technology. They were more likely to adopt one of two strategies. Either they would identify likely new markets and then seek the technology that would satisfy that market or they would find real potential markets that would use the technology that they had discovered and then 'aim' the development of that technology towards those markets. This development followed the second of these strategies. What they did not do was assume that customers existed for any bright new technological idea. If this was already widely accepted today then products would not appear on the market with many features that we, the customers, neither want nor subsequently use.
It was anticipated that this development would be closely related to the company strategic plan but though the strategic plan is important it did not allow for the serendipity in which this new high potential product came about. It was found that the product development programme tended to inform and alter the strategic plan. If this is a common occurrence it would appear that Product (and Service) development, especially in very small companies, leads the company strategy rather than following it. This is fundamentally different from most writing on strategic management. Further work is needed to identify if this is an isolated case or whether this is commonplace. If it is the latter then the importance of strategic design management has been understated in management literature. Furthermore, the common practice of considering strategic management without giving thought to product design may actually be wrong in all but large enterprises.

6. The process

The following outline of an experiential design process is proposed. Most of this will occur at the early stages (the first 15%) of the design process where the costs are low but 85% of the management decisions are made. Essentially, at the market research and product design specification compilation stages.

1. Understand the existing products (competition) that serve the market you are trying to reach (some may be your own products). Beware of Levitt's marketing myopia as this is likely to be wider than initially thought. Experienced product developers often know this competition if the new product is to meet their existing markets.
2. Then identify the advantages and disadvantages of the potential new product against that which already exists on the market. This stage is not new [Hollins & Hollins 1991].

3. Specify the minimum performance standards in each case for the new product to be able to compete with the competition in every case. Some will not matter and some will be essential and these must also be indicated. This reasoning here is made on the realisation that people do not buy technology, they buy the benefits that can be derived from that technology [Hollins & Hollins 1999].
4. As a result, it is also necessary to identify the technology that will provide this performance standard that customers require for the various design parameters. This stage is quite difficult in practice. Essentially, it means identifying the important aspects and then quantifying aspects of the product design specification, starting with the most important. It is putting numbers to the proposed design. Although experience helps it needs to be confirmed by potential customers through market research.
5. Specify the maximum performance in each case that is required by the potential customers. Deming's [1986] phrase that we should endeavour to 'delight the customer' is now common as a basis around which Total Quality programmes are built. More recently Huda [1997] has proposed that there is a service level beyond which customers do not require (or notice) a greater level of service at any point in time. Over time, expectations rise but this can be accommodated within subsequent design improvements.
   If it is accepted that there is a maximum (and therefore optimum) performance level for a service, then providing a product that exceeds these performance levels (usually at a higher development cost) is a waste of time, effort and money. This requires either well focused market research or a good understanding of the market that comes through experience (or both). Parallels can be drawn here with Quality Function Deployment where the 'voice of the customer' defines the subsequent design work that is to be undertaken. In practice, what is being proposed here is less structured and is configured around the identified important elements in the product design specification.
6. Identify the unique selling propositions (or benefits) that the new product idea could provide, over and above the competition, and identify if customers really want these U.S.P's.
7. Identify the minimum standards/performance that the customers want from each of these U.S.P's. The effect of this is shown on figure 1.
8. Identify what needs to be done to compete in each (important) area - to reach the minimum standard. Some of these may be achieved by engineering design. Others may be achieved through the design of the service.
9. Develop each of these sectors using stepped specifications. Knowing the important design problems that must be solved then these aspects will have greater resources devoted to them. If any one of these important features cannot be achieved then the project can be put on hold until a technical breakthrough is made (archived) or abandoned. In practice, most of these problems can be identified early in the process and thus do not appear after much time or money has been spent on the project.

As can be seen, the ease in which a design team will be able to achieve the above depends a great deal on their experience and understanding of the product market. Less experience will indicate more work but those with experience will need less research. All this is easier for developments made for industrial markets as was the case here. In industrial markets the customers are usually fewer and more easily identified, some are larger and known to be more important and their requirements tend to be more clearly defined. Furthermore, their purchases tend to be made in a more logical manner rather than by whim or impulse.

At first glance what is being proposed seems fairly obvious but it is not the way that many plan their new product development. The suggested process has been 'honed down' from more complicated systems rather than being originated in this simplistic form. It could be called Design Management by Objectives and mirrors aspects of Management By Objectives as prescribed in the 1980's. Particular objectives can be identified and the design team can concentrate on fulfilling these. Other areas are of less importance and, in some cases, can be ignored. Of course, all of this is highly iterative, more so than was anticipated, but most of this iteration will all take place before the detail stage of design, at the low cost end of design.

Performance Function							
			X				
maximum customer performance required	_____	_____	_____	_____	_____	_____	_____ –
	X						
		X					
							X
					X		
minimum customer performance required	_____	_____	_____	_____	_____	_____	_____ –
				X		X	
design parameter	1	2	3	4	5	6	7

Performance function '3' over designed. Performance function '4' & '6' unacceptable to customer

Figure 1. Minimum or maximum standards/performance that the customers want from each U.S.P's

It was found to be advantageous to break down the project into those parts that were known from experience to work and the 'new parts' of the product into sub-innovations. Each could approached as a separate target and prototypes and testing developed to prove each of these sub-innovations in turn (whilst not losing sight of the 'whole').

The theory implies one concept stage in the design process but practice showed that many beneficial 'off hand brainstorming sessions' [Lockwood 2000] took place throughout the design process to 'sort out' small difficulties as they occurred. These concerned marketing and operations as well as design. This is a confirmation, in fact, an expansion of, that proposed by Hollins & Hollins [1999], that a design process consists of many concept stages within the overall design process. A gestation period was in-built into the brainstorming sessions by revisiting various themes after a period of a few weeks [BS 7000 Part 2].

The project did benefit from having the active involvement of a director who acted as product champion (in both definitions of the term) [Hollins & Hollins 1991].

7. Conclusions

This paper has attempted to show some aspects of the theory that were found to work and how some other aspects needed modification to operate more effectively. The implication here is that some academic results are not working. The conclusion result of this paper suggests a dilemma for academics proposing complicated design management models. We academics have still some way to go in our research before we can be confident that our design management processes can be considered suitable for the practitioner, but we are getting there.

The spotlight in this development was put on developing those areas that are particularly needed to make the product competitive and express these in the product design specification. It also fully utilises the existing knowledge of the particular design team - which would be different in any new design project for a new market or new design team. Furthermore, it quickly shows if the potential product is achievable by focusing on specific design areas. This will encourage the necessary abandonment of potential failures early in the process.

In a large and established organisation with a large portfolio of products the strategy can lead and the

products follow to fulfil that strategy. In 'micro' organisations, where there are fewer products, a new product could have a fundamental effect on the entire organisation. This makes the product strategy lead the company strategy. This is fundamentally different from that stated in the strategy literature. This is, perhaps, the main finding of this paper.

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