

A CASE STUDY OF A DUAL DESIGN EDUCATION APPROACH TO IMPLEMENTING NEW PRODUCT DEVELOPMENT PROCESSES IN A SMALL TO MEDIUM-SIZED ENTERPRISE

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ABSTRACT

This paper is concerned with the implementation of new product development processes in a small to medium-sized enterprise. This implementation has been undertaken through the use of two company-university partnership mechanisms. Firstly, a two associate Knowledge Transfer Partnership model was implemented. This model placed two graduates within the company, supported by university and industrial supervisors to instigate change within the business. Secondly, the company's R&D manager and the two associates enrolled on the university's MSc in Rapid Product Development. The focus of this paper is on the effectiveness of this dual design education approach on implementing new design practices and overcoming barriers to change.

Keywords: New Product Development, Small to Medium-Sized Enterprise, Knowledge Transfer Partnership, Organisational Culture and Politics

1 INTRODUCTION

This paper reports on the efforts made by a small to medium-sized enterprise (SME) to improve the development functions within their company by embracing design education. For over twenty years the company has successfully supplied high volume injection moulded products to the medical industry both in the UK and overseas. However, as the products matured, the company recognised that they would benefit from a more customer led approach in developing new, competitive products. In order to advance design effectiveness, the Company entered into a Knowledge Transfer Partnership (KTP) programme with a local university department that specialised in New Product Development (NPD). This KTP model is based on placing a suitably qualified, recent graduate within the Company for two years. During this time, the graduate, known as a KTP associate, is supported by industrial and university supervisors to instigate change within the Company. In this particular company, an opportunity was recognised for developing a dual KTP, that is, the placement of two associates, each working on the NPD procedures associated with different families of products. During the period of the KTP programme, events indicated to the Research and Development (R&D) manager the potential benefits that could be gained from further design education. As a result, the R&D manager enrolled on the university's MSc in Rapid Product Development (RPD). In addition, as part of the support offered by the KTP programme, both associates also enrolled on the same MSc.

The main point of this paper is to discuss the effectiveness of this dual design education approach to instigating changes in the Company's NPD processes. In addition to detailing the method of implementing NPD procedures and the effect that this has had on the company's R&D department, this paper examines the cultural difficulties that were encountered during the programme.

2 BACKGROUND

The SME base within Wales is particularly important to the Welsh economy. The Federation of Small Businesses states that 71% of all Welsh private sector employment and 63% of business turnover in Wales is generated by SMEs [1]. Furthermore, manufacturing constitutes a significant proportion of the Welsh SME sector, in that manufacturing represents 15% of total Welsh employment [2]. In the light of increased, low-cost overseas competition, UK SMEs are being encouraged by the government to develop competitive advantages through the development of knowledge-intensive manufacturing [3]. Improving the processes associated with the development of new products can represent an area of such knowledge-intensive operations. In fact, studies have shown that successful new product development provides higher returns than practically any other type of similar investment [4]. However, SMEs frequently lack the stability and resources to take the risk of investing in new product opportunities [5].

One of the most frequently reported mechanisms for achieving significant improvements in new product development is to accelerate the time taken from initial idea to getting the product on the market [6]. This can be achieved by establishing a structured Product Development Process (PDP) in which NPD can be undertaken. A typical PDP consists of the following stages; design brief; product design specification (PDS); concept design; detail design; and, manufacture [7]. The design brief initially determines customer requirements, defining the need for a new product. This feeds into the creation of a PDS based on research that acts as a control document throughout the project. Concept design describes the initial translation of customer requirements into potential design solutions. Detail design refers to refinement of the concepts and commonly utilises 3D CAD and prototyping technologies, as well as test rigs to validate the design solutions. It is commonly considered best-practice to control progression between stages through evaluation of the output in a gated system that results in project end or proceed decisions [8].

3 METHOD

The KTP model has been shown to be an effective mechanism for improving NPD performance in a wide range of SMEs [9]. These government-backed knowledge and technology transfer programmes have been in operation for approximately 30 years, and represent a highly cost-effective use of government funds [6]. The aim of the KTP scheme is to strengthen the competitiveness and wealth creation of the UK by stimulating innovation in industry through structured collaborations with leading university research departments [10].

This KTP programme aims to provide the Company with both knowledge and the formal systems to be able to stimulate, conceptualise and evaluate new product ideas. This is achieved through developing robust validation and verification systems to enable viable new product ideas to be developed for the Company's primary market. In particular, it will move the Company from a position of dependency on two major product lines to one where it is able to support continuous innovation and development. The collaboration also provides the Company with enhanced knowledge of state-of-the-

art product development technology for potential exploitation in the new products that emerge as a result of this programme.

The second component to this dual design education approach is the two year, part-time postgraduate study of an MSc in RPD by the Company's R&D manager and the two associates at the University of Wales Institute, Cardiff. The course is designed to help candidates develop a successful career at middle and senior management level in the field of RPD in the manufacturing sector. It is intended to enable candidates to develop technological knowledge, strategic thinking and project management expertise within a product design environment. The course structure is designed to allow candidates to tailor their study to meet their own particular needs; this is effective in allowing the manipulation of the study modules to the circumstances within the KTP programme. This is aided by the fact that several modules use the industrial workplace as a basis for assignments, drawing on individuals' experiences as well as those of peers and managers in the workplace.

In order for the effectiveness of this dual education approach to be assessed, an interview was conducted with the Company's R&D manager fourteen months into the KTP programme and after completion of the first year of the MSc. The R&D manager was asked to describe how the Company identified the need for a dual KTP programme and why he chose to study an MSc in RPD. Open questions were asked regarding the effectiveness of the KTP and MSc, and the extent of their influence on recent Company changes. The outcome of this interview was used to inform the discussion section of this paper.

4 DISCUSSION

In the past the Company has been involved in providing work placements for undergraduates studying a BA Product Design sandwich degree at a local University. Undergraduates would work within the Company's R&D department together with the R&D manager, two Design Engineers and a Mould Tool Designer. This method, employed for four consecutive years, achieved some success as it provided the Company with low cost skills, often delivering high quality results. The nature of this programme meant that the undergraduates were employed for twelve months at a time. Of this time, the Company only considered six months to be properly productive due to periods of settling-in and overcoming the industrial learning-curve. The success of these placements was highly dependant upon the ability of the undergraduate, with different individuals requiring varying degrees of supervision from members of the department. This highlighted a need for further support from the University; however, with this sandwich model additional support was not provided.

The Company became aware of the KTP scheme through marketing activities of the university. The scheme proposed to place a high calibre graduate within an organisation for two years with guidance from an academic supervisory team. This proposition was attractive to the Company as it appeared to have the potential for combining the success of the sandwich course placements over an extended period, thereby increasing productivity and also supplying the external support the Company felt they required. The university encouraged the Company to expand the remit of the programme to include the implementation of systematic product development processes and not focus purely on concept design of new products, as the sandwich course had done. Initially, the Company felt that this addition to the programme would not yield any great benefit as the R&D department believed they had a proven track record with their current methods of working.

Project selection within the Company had not been structured in the past, which resulted in an accumulation of 'on hold' projects. The two product design graduates appointed as KTP associates analysed the strategic synergy, technical feasibility and key risk areas for each of the projects and prioritised future design tasks. For the first time this had proven that there were effective methods of approaching NPD that the R&D manager was not aware of, and that the KTP programme had far more potential than originally thought. The project selection exercise identified which design projects the associates should progress in order to yield the greatest Company benefits. The Company's approach to NPD meant there were few mechanisms in place for defining new developments, and capturing the needs and wants of the customer. This resulted in a lack of information on which to base design decisions, with work often being judged on the intuition of the R&D manager and directors. The two associates left the Company within six months of joining, to take up other design posts, but had been successful in reducing the amount of design projects pending. It was believed that the Company's existing design practices contributed towards the frustration and departure of the associates; and successful fulfilment of the KTP programme aims would have required the associates to overhaul the Company's design management strategy. However, the programme had enlightened the R&D manager to appreciate that NPD could be practiced more effectively if a systematic process was in place, and that the Board of Directors would be more responsive to R&D activity if information was presented in a similar way to the associates' project selection exercise. The success of the programme indicated to the R&D manager a personal need for further education, resulting in the enrolment of an MSc in RPD.

Two new associates were recruited and the programme was extended for a further two years. The framework of the KTP scheme entitles associates to a personal development and training budget, which was used to finance the enrolment of both associates on the MSc in RPD. The introductory Masters module addressed the purpose of product development; highlighting the need for creativity, understanding, quality and communication. It described design as a concurrent process and explained how it interacts with other departments within an organisation. This provided further evidence to the R&D manager that the Company's existing product design processes were '*ad hoc*' and would benefit from a more formal approach. The R&D manager and the associates mapped out a NPD process suitable to the Company's activities. This became an integral part of regular R&D meetings, reviewing projects by their placement in the process, and the information or decisions were required for progress. This new approach provided greater clarity to the wider Company purpose of each design project and created a heightened awareness of individuals' roles and responsibilities.

The R&D manager believed that the dual education approach was effective; with the MSc helping to identify weaknesses and suggest solutions for more conducive product design and the KTP programme demonstrating this in practice. Key to this combination was that this approach was being supported by the Company's R&D manager, allowing the knowledge of the KTP and MSc to be more credibly communicated to the directors. The learning experience of the associates was also enhanced through training alongside their manager. The situation often prompted conversation and debate regarding the content of the MSc and how it could be applied within the Company, improving the associates understanding of the impact of NPD at a managerial level.

Throughout the early stages of the KTP programme the case-study Company strategically restructured their management team. As part of this, the R&D department moved from the responsibility of the Engineering Director to the responsibility of the

Commercial Director, aligning R&D with the marketing function in an effort to improve responsiveness to customer needs. The Company appeared to be moving away from the autocratic management style in which it had operated for over twenty years. Under the previous management structure the R&D department had received a high level of daily direction from directors, with little explanation of market requirements. This may explain why product development had not seemed systematic in the past, and why the Company initially saw little value in the remit of the programme including the implementation of NPD processes.

In addition to the implementation of NPD processes, each associate managed a design project. The projects were undertaken in-line with the Company's new tailored process. One of the projects aimed to enter new markets, requiring extensive research to be undertaken in order to generate a clear brief and PDS. Although the desire to enter this new market had been communicated by Company directors, no formal examination of development constraints and user requirements had been undertaken. Within the newly adopted procedures such consideration was required. The purpose of such investigation being to ensure that investment and resources were only applied to projects that were likely to provide suitable economic return. During the period of research the directors became concerned that the KTP was proving ineffective due to a lack of tangible outputs. The directors were used to witnessing the R&D department quickly reaching the detail design phase of development. However, designs often struggled to progress to manufacture due to a lack of information regarding customer requirements, potential market share and target price. Although directors appeared frustrated at the perceived lack of progress, the results of the research indicated that two of a possible four planned developments were not economically viable. The associate introduced method of demonstrating project returns via discounted cash flow and risk analysis, convinced the directors of the merit of the PDP as it protected the Company from unsuitable investment. Other process developments introduced via the KTP programme included the creative thinking methods and the use of multi-functional team meetings with participants representing sales, marketing, R&D, production and quality assurance. These process developments assisted the Company in enhancing product quality by considering a greater variety of options; encouraging innovative thinking and developing inter-departmental communication. The implementation of the PDP had proved to be challenging to the organisational culture of the Company; however, the reduction of ambiguity at the front-end was shown to aid intelligent selection of projects and thereby reduce the risk of product failure.

5 CONCLUSIONS

This paper has examined the implementation of NPD processes in an SME through adoption of a dual education approach, that is, a two associate KTP model and the enrolment of both associates and the Company's R&D manager on an MSc in RPD. The method has improved the quality of MSc study and industrial experience for the associates as they have been exposed to the effects of implementing NPD in an industrial environment at managerial level. The premature departure of the original associates alerted the R&D manager to the need for professional development in product design, and to the potential such new understanding could achieve in terms of improving the impact of the KTP. The investment that the R&D manager placed in the dual education approach meant that the successes were recognised by the Board of Directors. The directors had previously measured project success based on time taken to reach a final concept design, rather than time taken to get a product into the market

place or a measurement of its likely market success. Engaging in both an MSc and KTP programme concurrently has ensured that the processes being implemented are established and well researched. As a result, the progressive environment that is being formed encourages a greater level of innovation. This is being utilised by the Company in the more focussed development of a smaller number of products that have undergone higher levels of research to more accurately meet market requirements. The new management structure is likely to cause further change within the organisation; however, the R&D department is now better equipped to be adaptive to these changes. Although the implementation of NPD processes has encountered some difficulties, the Company believes that positive impacts of this dual education approach is likely to be experienced over the coming years. The level of management involvement within the MSc and KTP programme has been vital to the success of educating the Company in NPD processes. The changes occurring at management level, has helped increase the likelihood of success of the dual education approach as a change culture within the Company is becoming more accepted.

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