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AN ASSESSMENT OF NEW PRODUCT DEVELOPMENT IN THE IRISH PHARMACEUTICAL INDUSTRY

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ABSTRACT

In today's competitive drug development environment, Irish pharmaceutical companies are moving towards more knowledge base activities. These companies must focus on new product development (NPD) firstly to remain competitive and ultimately to survive. This work assesses the current NPD process in the Irish pharmaceutical industry by examining models from literature and quantitative research in the form of a survey. Integration and communication of project management and NPD systems is critical. The requirement for improvements in information flow, performance management, risk management and the development of a cohesive costing system is highlighted.

INTRODUCTION & AIM

General: Pharmaceutical Industry in Ireland

The Irish Development Authority (IDA) identified the pharmaceutical sectors as providing potential for wealth and employment creation 25 years ago [1]. This industry has been a very significant provider of economic growth and industrial employment to Ireland over the past two decades in particular. Ireland has low corporation tax relative to other European countries, competence and capability in the industry and ease of access to the European market. In total 17 of the world's top 20 pharmaceutical companies are present in Ireland employing 23,000 [1].

According to the Irish Central Statistics Office the total value of all pharmaceutical exports during 1998 was in excess of 18 billion euro. This amounts to 31.7% of Ireland's total exports. Table 1 shows the growth in value in the sector during the past 30 years. The growth of this industry between 1973 and 1995 in terms of exports alone is an astonishing 6,373% from 100 million euro to 6.4 billion euro. This is equivalent to an average year-on-year growth of 20.8% per annum.

Year	Exports, euro
1973	100 million
1995	6.4 billion
1998	18.03 billion
2000	27.22 billion

Table 1 Economic growth in the Irish pharmaceutical industry [2]

Employment in the chemical sector has also seen strong growth, due in part to the pharmaceutical sector's surge in employment figures in recent years, as illustrated in table 2. The future of pharmaceutical companies in Ireland also looks promising. In 2001 a total of nine Irish based pharmaceutical companies pledged to invest 1.47 billion euro in plant expansion, thus creating 1460 new jobs [2].

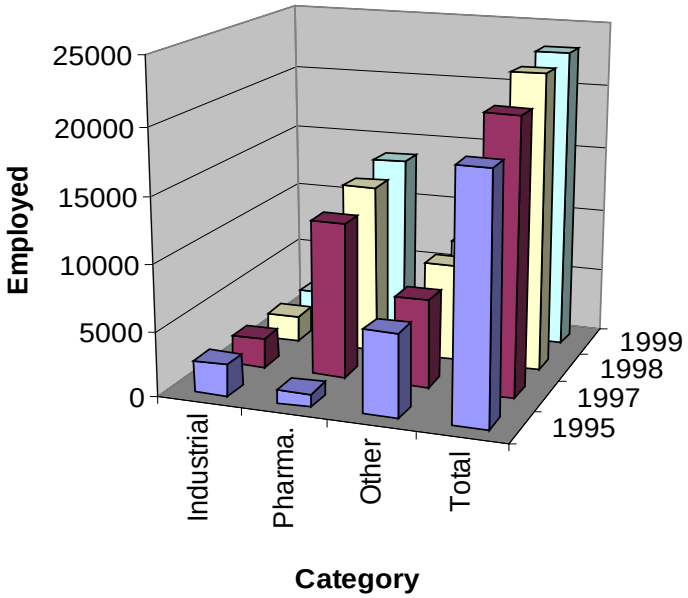

Table 2 Employment growth in the chemical industry by sector [2].

Moving towards New Product Development

The Irish pharmaceutical industry has traditionally been focused on manufacturing. However more recently there has been a move to bring some of the other activities involved in drug development to Ireland, in particular the process development of new products. It is in the economic interest of the Irish subsidiaries (of global pharmaceutical corporations) to encourage this approach as it will help to embed the industries in Ireland. In general contemporary organisations are becoming more knowledge intensive. This is particularly evident in processes such as new product development where knowledge based activities are increasingly important [3-4]. Organisations are placing more value on knowledge, organisations are moving away from 'cost based' competition towards more 'high value' activities [5-6].

The development funnel for the pharmaceutical industry is perhaps unique in that so many proposed projects (new chemical entities) have to be screened before one project is accepted for development [7]. The development of a new pharmaceutical product is a process which involves a wide variety of activities. Table 3 shows a very simplified version of the main activities in the process along with typical success rates and the timeframe. The activities to be covered in this paper are highlighted. The sequence in which the activities are completed is not represented in the table. Most of the four main activities clinical, chemical, regulatory and marketing activities can be carried out concurrently but certain activities must be carried out sequentially. API

process development refers to the Active Pharmaceutical Ingredient whereas drug product development refers to the dosage mode

This process is very expensive, time consuming and risky. Thus companies need to ensure all activities can be completed as efficiently as possible to ensure competitiveness.

Clinical	Pre-Clinical	Phase I	Phase II	Phase III	Phase IV
Chemistry	Lead Discovery	Lead Optimisation	***Process Dev: API*** & Drug	***Scale up & Validation***	***Commercial Manufacture***
Regulatory	Compilation of the data		Filing with regulatory authorities	Approval	
Marketing	Product profile		Market research	Product Launch	
Success	5000 compounds evaluated	5 enter trials			1 approved
Years	3.5	1	2	3	2.5

Table 4 Development cycle of a pharmaceutical drug [8].

As mentioned earlier the pharmaceutical industries in Ireland traditionally have been involved in commercial manufacturing portion of the overall process but this is changing to include the portions on process development of the API and the scale up and validation of the process. For the purpose of this paper the focus will be on these three parts of the overall development and will be termed New Product Development (NPD). Some companies in Ireland are also involved in the process development, scale up and validation of the drug product (dosage mode) but this is outside the scope of this paper.

In general there is a lack of published material pertaining to the NPD process in the pharmaceutical industry, this may be attributed to the fact that this entire development cycle is long and difficult to manage with typical cycle times approaching 12 years. Literature does stress the fact that project management is a key enabler for this process [9-10]. New product development strategy, company culture and information flow are also seen as important within the pharmaceutical context [11-12].

Current situation

In Ireland and globally, pharmaceutical companies must reduce the time it takes to create new products in order to remain competitive, this is the conclusion of the centre for the study of drug development [13]. The pharmaceutical industry is under pressure from a number of fronts. With average development costs of more than US$500 million per new drug and rising marketing expenditure, pharmaceutical companies are facing the challenge of sustaining current levels of profitability [14]. It is therefore essential that a pharmaceutical company embarking on this competitive and potentially rewarding route has a robust NPD system along with the manufacturing capabilities to meet the growing market pressures. In order to analyse NPD in the Irish pharmaceutical industry reference will be made to the NPD process of SIFA limited, as this company is analysed as a case study.

With a highly skilled workforce of almost 250 employees and situated in an industrial area (Shannon) that offers many advantages in terms of transport and costs, SIFA Limited, specialising in the development and manufacturing of medicinal drugs for the

global market, is currently in a very strong position within their parent company Schwarz-Pharma Corporation. SIFA is the only internal facility for the development, scale up, validation and manufacture of new chemical entities from laboratory to bulk production within the Schwarz Pharma Corporation. Strategically the existence of a reliable in-house clinical trial manufacturer and scale up facility within the Schwarz Pharma Corporation ensures visible process control and reduces reliance on external companies. With today's continually eroding operating margins and narrow windows of market exclusivity between product approval and patent expiration [15] SIFA has engaged in making faster and smarter NPD a core element of its business plan.

Aim

The main aim of this work is to examine NPD in the Irish pharmaceutical industry by focusing on NPD models and project management from literature and determining critical success factors from research. Based on the findings areas where improvement is needed will be identified and recommendations will be made which will enhance efficiency and ultimately profitability.

LITERATURE REVIEW

Based on a review of the literature three models were identified which have been used to access new product development processes in a number of industries (including but not limited to the pharmaceutical industry):

- Nine step acceleration method [16-17]
- Process model of technical innovation [18]
- Product and cycle time excellence (PACE) [19]

Nine step acceleration method

Millson's and Wilemon's [16] nine-step acceleration approach was found by the authors to be a very comprehensive model. The model deals with organisational values and focuses mainly on elimination or streamlining of activities. In its tabular form it gives a guide to important objectives in the development of a new product from a management perspective, these include speeding up activities, implementation of support systems and stimulating inter-functional cooperation. The model has been used predominately in engineering industries and uses ideas such as modular design and simplification of procedure which may not be applicable to the NPD process in the pharmaceutical industry. However these elements could be omitted in a pharmaceutical context. The main deficiency of the nine-step acceleration approach is that it does not priorities the objectives in an order of importance. Langerak *et al* [17] has added to the nine-step acceleration approach by prioritising the objectives using a laddering approach. Most emphasis is placed on reducing the number of project components and implementing support systems and techniques, such as project management and project auditing.

Process model of technical innovation

This model uses a scorecard for monitoring performance. The scorecard emphasises recording real time indicators of the current process as opposed to macro indicators of past performance. The auditing tool assesses whether the processes necessary for innovation are in place and the degree to which it is in place [18]. The model itself is

dynamic and sees integration of all functions and teamwork as paramount. The scorecard is divided into four sectors that have to be managed:

- Conception
- Product development
- Process innovation
- Project management

The model firstly relies on general scorecards to provide an overview of the company's strengths and weaknesses. The conception section is scored based on creativity and the generation of new ideas. Process development is the transfer of concepts through development and into manufacturing and usage, the scorecard lends a high weighting to integration, teamwork, and communication. The development of innovations in the manufacturing process is viewed in terms of continuous improvement and closing gaps between current performance and targets. Project management techniques can be used for monitoring and the organisation of technical acquisitions. Development of human and financial resources, investment in systems and management leadership are three enablers of the four core sectors [19].

Product and cycle time excellence (PACE)

The PACE model which is a variation of the stage gate approach to new product development has been mainly used in engineering industries and the model itself is too structured and rigid for the pharmaceutical industry as a whole. This model is a seven-phase sequence that involves a sequential review process. The stage gate approach involves each of the subsequent phases being reviewed by a committee prior to progress to the next phase. Ottosson [20] as an opponent to this approach argues that the stage gate model can be time consuming because of the need to complete one stage before moving on to the next. Attempting to apply work breakdown analysis on a process which spans a long period of time, as is seen in the pharmaceutical NPD process, would be very time consuming. The model seems to be bureaucratic in nature with continuous micro-analysis of progress. However this idea may link in well with regulatory constraints if implemented in a pharmaceutical setting. The model addresses the decision making process well, another aspect that may have applications in the pharmaceutical industry.

Suitability of the models for the pharmaceutical industry & additional viewpoints

Ten key attributes were used to assess the models within the confines of the pharmaceutical industry, see table 4 overleaf, ⊕ symbolises the authors view that the framework has positive attributes towards application in pharmaceutical NPD, ⊗ denotes having a neutral effect and ∅ indicated having a negative effect. Minimisation of costs, time and ease of implementation should be the main drivers. The Customer focus and communication driven attributes are also important. In addition whichever system is put in place it must have a monitoring or auditing function to ensure continuous examination of the process.

Attribute	Nine-step acceleration approach	Process mode of technical innovation	Product and cycle time excellence (PACE)
Suitable for Pharma NPD	⊕	⊕	∅
Monitoring tool	⊗	⊕	⊕
Cost minimisation	⊕	⊗	∅
Customer focus	⊕	⊕	⊗
Logical flow	⊕	⊕	⊗
Ease of implementation	⊕	⊗	∅
Comprehensive	⊗	⊕	⊗
Communication driven	∅	⊗	⊕
Functionality integration	⊗	⊕	⊗
Time reduction focus	⊕	⊗	⊗

Table 4 Comparison of 3 models used for improving the development of new products.

Based on table 4 the nine-step acceleration method and the process model of technical innovation would serve as useful tools for monitoring and improving the NPD process in the pharmaceutical industry. The use of PACE to control regulatory elements of the NPD process may be useful. Literature has shown that auditing is an effective means of highlighting problems within new product development [19]. In addition to the three models other topics relevant to new product development are also found in literature. Barczak and Wilemon highlight the following key drivers: team characteristics, clear project goals, clarity about evaluation and rewards, effective leadership, management support, and manageable levels of conflict and stress [18]. Literature is also cited as seeing success coming from more efficient new product development and not simply outspending the competition on resources and technology [21]. Kleinschmidt [22] saw successful new product development performance being attributed to the process and the specific activities within the process, the organisation of the program, the firm's strategy and the firm's culture and climate for innovation.

Project Management

The effective use of project management in the pharmaceutical NPD process is essential for the success of the process. It is important that all the elements of scope, resources and measures are linked in a sequential manner so as to ensure clear definition and communication of project metrics and degree of project completion. Clear and decisive flow of information in the form of schedules and progress is vital. Project selection is best addressed in terms of a formalised procedure that is consistent throughout projects [23]. Activity based costing and budgeting are useful techniques for apportioning costs. Prioritisation and resource allocation can be linked to these factors by weighting techniques [24]. By assigning appropriate weightings to project priorities it is possible to identify the most important current project issues. The resources can then be linked to a responsibility matrix that determines which functional group does which action item. A priority matrix can be used to identify the capital costs and the payback period (Return on Investment) for each project on a real time basis.

On a macro scale the identification of a formalised approach to project planning and management is also seen as crucial. The identification of the project management tools that display the best potential for improving NPD will aid the overall NPD process.

RESEARCH METHODOLOGY

The research was carried out on the NPD process in the Irish Pharmaceutical industry. A number of companies were involved in the assessment and a more detailed case study was carried out at SIFA Limited. As the research deals with contemporary information and there is little investigator control over events, a qualitative research method was determined to be the best approach. It must be noted as NPD in many companies is relatively new it is still evolving and this could have an impact on the results obtained from the research. Data sources in this research section include interviews, surveys and literature. Dougherty states that this approach is very well suited to examining product development activities [25].

Initial investigations & development of questionnaire

Primary data pertaining to NPD in the Irish pharmaceutical industry was acquired using structured interviews and supporting questionnaires with a number of people in management positions in the area of NPD. The interviews served as a means of prioritising the areas of NPD to be addressed in a later survey of a wider group. Interviewees were asked which areas of NPD and project management needed to be addressed in order to benefit the pharmaceutical NPD process. The questionnaire used in the survey was made up of eight critical success factors, figure 1. The success factors for assessment were selected based on the structured interviews with NPD managers and information from the literature [10-12 & 16-19]. An open ended question was also included in order to allow for other areas of concern not covered by the critical success factors appendix 1.

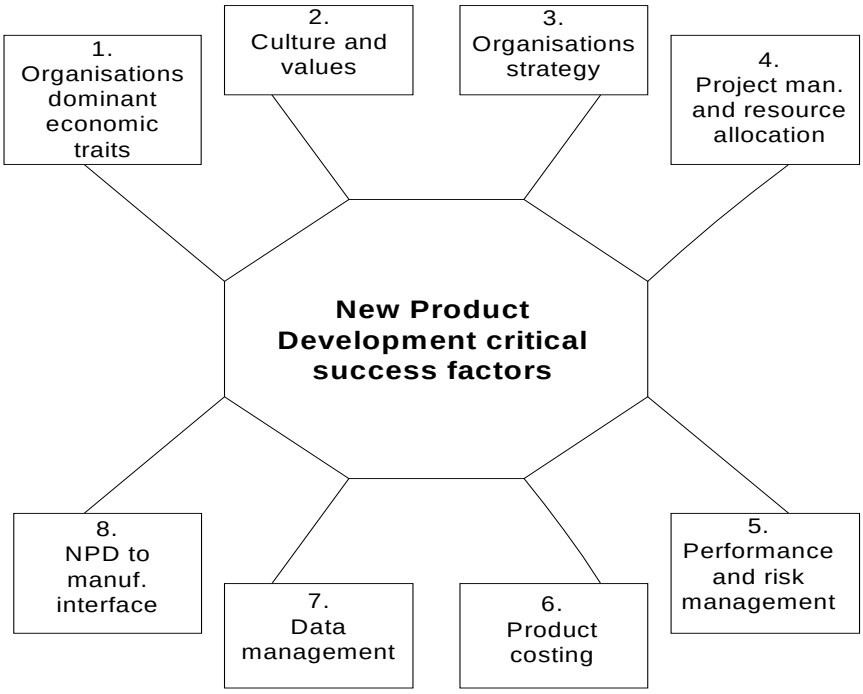

Figure 1 Critical success factors for pharmaceutical New Product Development.

Factors 1 and 2 deal with the candidate's views on employee attitudes to NPD and the general team spirit in the company [18]. The existence of good communication flow and employee buy in to new projects has been highlighted in the nine-step acceleration approach and the process model of technical innovation.

Factors 3 and 4 are then addressed by asking specific questions on the effectiveness of these management elements within new product development in the company [9-10]. Performance and risk management are factors that deal with effective reporting of project performance and ensuring that safety and risk contingencies are addressed. The financial and accountability factors of new product development are address by focusing on performance measures, budgeting and product costing [26-27].
Finally critical success factors 7 and 8 are concerned with the flow of easily accessible information through the new product development function. These areas deal with having effective hardware and software tools.

As stated earlier the development of the questionnaire involved sourcing information from a number of areas. However it must be borne in mind that the questionnaire may have limitations due to the following points:

- NPD is itself quite unique to every industry. There have been no specific tried and tested models developed for the Irish pharmaceutical industry.
- The pharmaceutical NPD process is long and highly regulated and it is difficult to get relevant literature.
- Although there are a number of NPD and project management techniques available for the pharmaceutical industry there is no substantive evidence that they work [28].
- There are numerous recommended models and methodologies presented in literature but they often contradict each other [16-20].

Survey

The research basis for the survey is displayed in figure 2. The survey was a means of directing questions at a group of people, in order to explore issues largely in the present [9]. The questionnaire was used as a tool in the survey to allow for the 'description' and 'explanation' of the current NPD process. Based on the results from the survey it is possible to 'predict' potential areas for improvement and ultimately put measures in place to 'control' the process more effectively. Controlling and ultimately improving these key areas within the NPD process will improve the process.

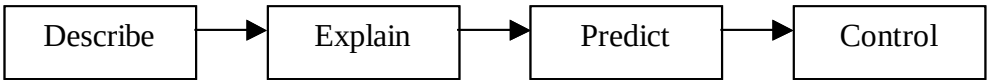

Figure 2: The scientific research process [29]

In total ten companies responded to the questionaire, six are presentely involved in NPD within the Irish pharmaceutical industry (inlcuding SIFA Limited) a further four companies responeded who are involved in the development of new chemical products but are not in the pharmaceutical industry.

Candidates opinions were assessed under the eight success factors developed. The test audience were asked a series of questions related to the degree to which the eight critical factors, figure 1, were working effectively in their organisation. The questions

related to different aspects of the success factors. Candidates were asked to express their level of agreement with 31 statements relating to new product development and project management. 1 indicates the candidate strongly disagrees with the statement whereas 5 indicates they agree strongly, see appendix 1.

RESULTS AND DISCUSSION

The results from the completed questionnaires were tabulated by functional area in the case of SIFA Limited and by company for the pharmaceutical and scientific companies see appendix 2.

Case study

SIFA employees were asked to complete the survey. A 75% return rate was achieved for the survey. In all employees from 12 functional groups completed the survey. Participants were derived from the following areas, Management, Finance, Materials and Logistics, Process Laboratory, Quality Assurance, Quality Control, Health Safety & Environmental, API Support, API Production, NPD, Human Resources and Engineering, appendix 1.

The area of strategy in particular scored high among candidates from all functional groups, rating this factor greater than 3.1. The two linked areas of culture, values and organisations dominant economic traits also score very high averaging 3.3 and 2.9 respectively. Project management and performance and risk management both achieved good results also. Conception to manufacturing interface, costing and data management are the areas which scored low in the survey. This could indicate that these areas need to be given more focus. However as the survey is based on peoples interpretations it may not totally reflect the actual situation. Figure 3 gives a graphical representation of the survey results based on importance of the current success factors.

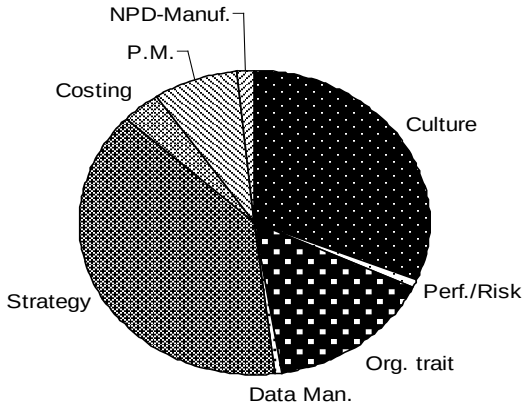

Figure 3: Critical success factors rated based on SIFA survey results.

The open ended question section of the questionnaire yielded some interesting results. This question asked for ideas that would aid NPD at SIFA. 'Communication improvements' were seen as highly important with respondants flagging this area as needing attention. 'Up-to-date information on new products' was seen as a necessity, hence promoting employee buy-in. The improvement of the plant facilities and the

hiring of more 'specialised personnel' was cited as being a major requirement for the NPD function. The implementation of an activity based costing system as an efective means of allocating costs to individual projects was suggested.

Results from other pharmaceutical and scientific companies

A variety of pharmaceutical and scientific companies in Ireland (outside of SIFA) were the second target audience, figure 4. These companies vary from large multi-national pharmaceutical companies to small to medium enterprises. In total 12 companies were asked to complete this survey, a total of 9 companies responded. All companies were asked to complete the survey based on their own new product development (NPD) functions, for results see appendix 2.

Very similar trends in weighting of the success factors are seen for the other pharmaceutical and scientific companies surveyed. Strategy, culture, values and organisational economic traits all score well throughout the groups. Project management also has a very high scoring indicating that project management is working effectively as a critical success factor, there is some variance in results though. Performance and risk management is weighted relatively low. New product-technical transfer scores well in most companies but there is some variance in results. Once again the areas of data management and costing are seen as requiring focus.

The open ended question showed that a high proportion of respondents see the 'design to manufacture interface' as a key imperative in new product development. Project management, better job knowledge and expertise are seen as the next most important elements along with better communication and management input. A new area is also highlighted in this group, 'Marketing input'. This area may not be getting focus because the marketing function is often many years away from fruition at the outset of a new project. This view from the open ended question is supported by Nystrom [30] in literature. However as Ireland is currently expanding its pharmaceutical scope marketing may be an area to address in the future.

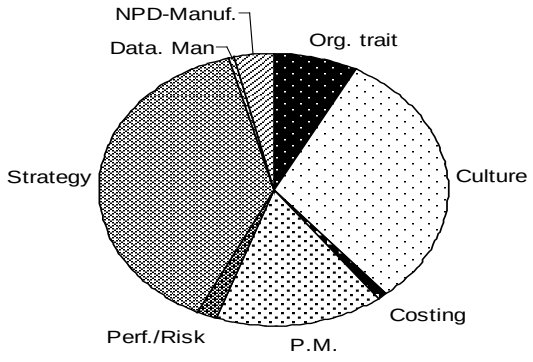

Figure 4: Critical success factors rated based on other companies results.

SUMMARY AND RECOMMENDATIONS

The nine step acceleration approach and the process model were both shown to be suitable for implementation in the pharmaceutical industry. These models have a focus on time reduction, implementation and are customer focused. The scorecard accompanying the process model of technical innovation is an effective tool for monitoring the current NPD process and identifying areas of concern. The linking of scope, resources and measures within the confines of project management is crucial from the outset of new product development. The implementation of an activity based costing system for the forecasting of project costs will offer a greater knowledge of hidden costs and will make potential cost over-runs more predictable during the actual project.

The survey indicates that the company strategy employed by all the companies surveyed works well and caters well for the financial and business needs of the company. Costing has a low weighting for both test groups, the implementation of activity based costing has been highlighted as a means of keeping better control of product costs. The vast majority of those who responded to the questionnaires agreed strongly that there was a need for a more structured costing. Culture, values and dominant economic traits both score high. This indicates that employees whose companies are engaged in NPD are generally content with their jobs and see attitudes contributing positively to the NPD process.

From the survey results a number of areas for improvement within pharmaceutical NPD were cited. The level of project management within some of the pharmaceutical industry is good but there is room for improvement especially within the areas of resource allocation and planning. The NPD to manufacturing interface scored low relative to other factors. This is a key conduit for product development and needs to be addressed within any NPD process improvement project. The current level of communication and information flow within new product development was generally considered adequate, however investment in cohesive and flexible data management systems was strongly highlighted. The following recommendations are made on the basis of the results from the analytical research and literature, table 5:

Factor	**Recommendation**
NPD process	Combination of nine step acceleration approach with process model audit.
	Perform regular project audits for efficiency,
Project management	Greater emphasis on project time management
	Focus on cost efficiency.
	Access to information and data management must be addressed.
Costing	Activity based costing.
	Real time measures of project progress and success.
	Minimise production and development costs.
	Specialised equipment and spending
Information flow	NPD to manufacturing interface needs some attention.
	Data management and information flow needs improvement.

Table 5 Recommendations for pharmaceutical NPD

CONCLUSIONS

The improvement and optimisation of the pharmaceutical NPD process in Ireland is crucial for the continued prosperity within this industry. As with all industries it is critical that the pharmaceutical industry remain competitive in an increasingly global competitive market. To ensure competitiveness all aspects of the industry must be streamlined and efficient. This includes the NPD process as more companies are moving towards having at least some NPD in Ireland. The continuous iterative development of the NPD methodology will ensure suitability. It is also important to continually monitor the NPD process, the nine-step acceleration approach and the process model of technical innovation can both be used in the pharmaceutical setting as tools to improve the NPD process and also to monitor this fluid process. Project management is highlighted as being an important conduit for the streamlining and management of NPD. The application of project management tools and techniques will give a more structured and transparent view of pharmaceutical NPD.

This work is limited to the areas of process development, scale up, validation and manufacture of drugs. In order to encompass the whole drug development lifecycle the research areas of screening, lead development and lead optimisation should be addressed. Areas such as knowledge management, business models for NPD and detailed financial analysis of firms may also have relevance to the pharmaceutical NPD setting. Further work to increase the test population may also be prudent.

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APPENDIX 1

New Product Development survey

1 indicates strongly disagree
5 indicates strongly agrees

I agree/disagree with the following statements….	SCORE				
1. There is a low turnover of staff at SIFA LIMITED.	1	2	3	4	5
2. There is a healthy relationship between key personnel in the NPD function.	1	2	3	4	5
3. SIFA Ltd is growing quickly and can cope with the increasing rate of change.	1	2	3	4	5
4. There is greater conflict in new products than with main steam projects.	1	2	3	4	5
5. The long-term future of SIFA Ltd will not rely heavily on new products.	1	2	3	4	5
6. The timelines for new product are always too short.	1	2	3	4	5
7. There is a positive attitude at SIFA LIMITED.	1	2	3	4	5
8. The overall management of new product projects is good.	1	2	3	4	5
9. My department manager puts more focus on new products rather than on mainstream products.	1	2	3	4	5
10. There is often conflict in my department regarding resource allocation.	1	2	3	4	5
11. New product development will change SIFA LIMITED's focus from their main products.	1	2	3	4	5
12. New product development projects are not very time consuming and problematic.	1	2	3	4	5
13. New product development project schedules are flexible and change regularly.	1	2	3	4	5
14. New product development at SIFA LIMITED would be helped by? 1. _____ 2. _____	1	2	3	4	5
16. SIFA Ltd.'s existing infrastructure is suitable for new product development.	1	2	3	4	5
17. SIFA Ltd. has the technology and expertise to perform new product development projects.	1	2	3	4	5
18. Accessing routine data/information is slow at SIFA LIMITED.	1	2	3	4	5
19. There is a strong team spirit at SIFA LIMITED.	1	2	3	4	5
20. There are good opportunities for career development at SIFA LIMITED.	1	2	3	4	5
21. There are effective/strict measures for NPD projects.	1	2	3	4	5
22. There are many possible cost savings in NPD projects.	1	2	3	4	5
23. I find managing/finding time for NPD projects difficult.	1	2	3	4	5
24. The conditions and facilities in my workplace aid me in NPD projects.	1	2	3	4	5
25. SIFA LIMITED is a good place to work.	1	2	3	4	5
26. The risk associated with NPD projects is greater than the risk with main stream products.	1	2	3	4	5
27. We need to invest more time in accurate product costing.	1	2	3	4	5
28. SIFA LIMITED is keeping up with changes in the industry.	1	2	3	4	5
29. SIFA LIMITED has the competencies to introduce new product projects.	1	2	3	4	5
30. It is possible to decrease the time it takes to run a new product project.	1	2	3	4	5
31. SIFA LIMITED operates as a best in class pharmaceutical company.	1	2	3	4	5
32. There is a strong business focus in new product projects.	1	2	3	4	5

APPENDIX 2

Survey results

SIFA Limited:

Area	Org.trait	Cult.&Val.	Strat.	P.M.	Costing	Perf./Risk	Data Man.	NPD/Tech.
Man	3.3	3.3	3.8	3.0	2.3	3.1	2.5	3.0
Fin	3.0	3.1	3.6	3.1	2.2	2.9	1.8	2.8
M&L	2.9	3.2	3.3	2.8	2.4	3.0	2.3	2.9
Process Lab	2.9	3.3	3.5	2.6	2.1	2.7	1.8	2.7
QA	3.1	3.0	3.4	3.1	2.3	2.6	1.5	3.0
QC	2.9	3.3	3.6	2.6	2.2	2.7	1.7	2.7
HS&E	2.7	3.2	3.1	2.6	2.2	2.6	2.0	2.6
BPC	2.9	3.3	3.2	2.7	2.5	2.9	1.9	3.0
PO	2.7	3.1	4.2	2.6	2.1	2.9	1.9	2.9
NPD	2.8	3.9	4.0	3.4	1.9	2.9	1.4	2.5
HR	3.3	3.3	3.4	2.7	1.7	2.5	1.5	2.5
Eng	2.7	2.9	3.1	2.6	2.2	2.6	1.9	2.5

Irish pharmaceutical and scientific companies:

Area	Org.trait	Cult.&Val.	Strat.	P.M.	Costing	Perf./Risk	Data Man.	NPD/Tech.
Pharma 1	3.0	2.9	3.9	3.0	1.3	3.1	3.0	2.5
Pharma 2	3.2	3.9	3.8	3.3	2.0	3.3	3.3	3.3
Pharma 3	2.4	3.3	3.5	2.9	2.3	2.5	2.0	3.6
Pharma 4	2.7	3.4	3.7	2.8	2.3	2.4	1.5	3.3
Pharma 5	2.3	3.7	3.8	2.8	2.0	3.5	3.0	3.3
Scientific 1	3.3	3.2	2.8	2.7	1.2	2.4	1.0	2.0
Scientific 2	3.3	3.3	3.8	3.3	2.4	2.6	1.0	2.7
Scientific 3	3.0	3.2	2.5	3.3	2.6	3.0	1.0	2.0
Scientific 4	3.3	3.5	3.5	3.3	1.6	2.8	3.0	3.0