Is project management the perfect fit?

Integrating Project management with New product development for engineering design

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Abstract

This paper critically evaluates the suitability of the project management (PM) methodology for managing new product development (NPD). The area under examination is development of consumer products (e.g. dishwashers) that have a significant engineering production content. The Project Management Institute (PMI) Body of Knowledge (PMBOK) identifies nine knowledge areas: Project Integration, Scope, Time, Cost, Quality, Human Resource, Communications, Risk, and Procurement. These are each addressed in the context of NPD, and the merits and detriments of the PMBOK approach discussed. The paper includes representative data for the case under examination. On the whole project management provides a large set of tools to support NPD, and these are expected to generally be effective. However, NPD does have some peculiarities, especially the large uncertainties in project path, that are troublesome to effective project management.

Implications for project managers are the need for initiative and innovation (occasionally even rule breaking), clear stable goals, vigilance against biassed estimates, avoidance of a single-minded focus on cost, motivation of team members, a participative leadership style, good team communication, and effective procurement processes.

Keywords: new product development, design, project management, body of knowledge, PMBOK

1 Introduction

New product development (NPD) is an important organisational activity since it provides future business capability for the organisation. However NPD often involves large capital investments that are made under risk. Therefore diligent project planning, including the identification of risks, is necessary to provide quality information to support robust decision making by senior executives. Furthermore, an organisation may have multiple candidate new product developments, in which case additional life-cycle information is necessary to support decisions on capital rationing.

2 Definition of the problem

The problem is to integrate project management closely with the new product development process, particularly to support strategic decision making at an executive level. The area under examination is development of consumer products (e.g. domestic appliances) that

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have a significant engineering production content. Representative case study data are used in the analysis, simulating the issues that are faced by a typical organisation that designs, manufactures and sells dishwashers.

3 Description of process and results

A project was developed for the life cycle of a dishwasher. The perspective was that of the producer. Typical activities include development of the product, testing, production, and eventual withdrawal from the market. Producing a project of this magnitude is a challenging task, because of the extended durations and the large uncertainties.

The Project Management Institute (PMI) has developed a ‘Body of Knowledge (PMBOK)’ (PMI, 2004) that describes all the activities that a professional project manager might have to consider. The PMBOK identifies nine knowledge areas where management is necessary: Project Integration, Scope, Time, Cost, Quality, Human Resource, Communications, Risk, and Procurement.

The PMBOK approach to project development offers five stages: initiating, planning, executing, monitoring & control, closing (PMI, 2004, p42) and the knowledge areas are distributed through these five stages. However, these stages are too general for the NPD case under examination, and instead this paper develops a more comprehensive list of activities that are more closely aligned with the context. This list formed the basis of the work breakdown structure (WBS), which is shown in Table 1. The list itself was compiled by the author from personal experience in several NDP projects, and is intended to be generically representative rather than comprehensive. There are several phases to the project, including design, testing, production, market growth, and provision for eventual withdrawal of the product.

These work packages and tasks were modeled with MS Project® software (MSP, 2003). Other representative information, such as resources, was included, and finally several reports were produced. Sample progress and performance measures were also determined.

New product development Life cycle	
A1 Idea generation	
A2 Concept design	
A3 Feasibility study	
	Check strategic feasibility (e.g. SWOT)
	Check market
	Check technology capability
	Check financial feasibility
	Check schedule feasibility
	Check for resources available
	Make decision to proceed/not
A4 Detailed design	
	Set the specifications
	Design key characteristics
	Produce drawings
	Produce prototype
A5 Test product	
	Test product for user satisfaction
	Test key characteristics (e.g. engineering)
A6 Finalize design	
	Review the design
	Board approval
	Revise design
	Freeze the design
B1 Set up production	
	Procure manufacturing capability
	Design the tooling
	Build the tools
	Modify building
	Obtain equipment
	Obtain manufacturing staff capability
	Start up production
	Get first parts from production
	Test parts
	Verify quality tolerances
	Produce in volume
B2 Arrange marketing	
	Identify key benefits of product
	Identify potential users
	Plan marketing strategy
	Produce brochures, adverts
	Produce 'rainforest' campaign
B3 Arrange distribution	
	Establish sales chain
	Find local representatives
	Establish business proceedures for ordering, shipping, accounting, repair
	Set up technical support capability
	Write user manual
	Write service manual
	Decide on warranty conditions
	Obtain staff capability
C1 Market growth	
C2 Market maturation	
C3 Market decline	

	C3a Declining sales
	C3b Refresh product
	C3c Launch derivative product
	C3d Differentiate service
	C3e Launch new product
C4 Product withdrawal	
	Decision to withdraw
	Produce lifetime spares requirement
	Decommission production
	Archive documentation
Project closure	

Table 1: Work breakdown structure for generic NPD project.

4 Critical review

This section provides a review of the application of PM methods to NPD. It illustrates the application of the principle to the case under examination. The planning activities are described, with reference to sample reports produced in MS Project. Where relevant the discussion also includes the control activities.

4.1 Project Integration Management

Project Integration Management is simply the overall project management task that keeps the whole project together. This activity occurs throughout the project (see Figure 4-1 and 4-2, PMI, 2004) and includes planning, control and closure.

The intensity of project management efforts in NPD varies with the development stages, being low during the conceptual stages and higher during development (Lewis, Welsh, Dehler, & Green, 2002; Panico, 2004). In many organisations product development occurs on multiple different projects simultaneously, and since development resources are typically limited, it is necessary for the project manager to coordinate resources between multiple projects. Recent developments in project management software have actively pursued this functionality, by permitting multiple projects to be integrated using one resource pool (MSP, 2003). Further, those resources, at least the people component, may be extracted from organisational email address books, and the task allocation and monitoring also done via email. Even so, the management of multiple projects is problematic for the project management methodology (Elton & Roe, 1998).

While the above analysis has been structured primarily around the project management approach to new product development, it is worth noting that not all researchers agree with such an approach. Some suggest that NPD is too dominated by project management methodologies with their focus on planning and prescribing; that instead there should more trial-and-error, empathy and cooperation (Smulders, de Caluwé, & van Nieuwenhuizen, 2003). Actually this is not a radical or hostile concept, since it has long been known that projects with vague objectives and high epistemic uncertainty, e.g. research, are not well suited to project management methods. Unfortunately, such projects are not easily managed with any methodology, and PM may be better than none. It is prudent to assume that the risk of project management failure increases with the extent to which a new product development involves innovative research and development. Task dependencies are perhaps better handled with design structure matrix (DSM)

(Denker, Steward, & Browning, 2001; Eppinger, 2001; Yassine & Falkenburg, 1999) though that is a prototype method that is not yet mature enough for complete project management.

Projects can have numerous perturbations during deployment, e.g. changing resource allocations (Leus & Herroelen, 2004) and technology barriers, and a degree of initiative and innovation is necessary from the project manager to solve these. This may explain why research suggests that rule breaking may be necessary for success (Olin & Wickenberg, 2001).

4.2 Scope Management

Scope management is about defining the scope and creating the work breakdown structure (WBS) down to the level of work packages (see Figure 5-1 and 5-2 PMI, 2004).

Successful product development requires that senior management set clear goals, and keep these relatively stable (Barczak & Wilemon, 2003). Poor staff motivation can result if this is not done.

Many product development projects aim for a particular window of opportunity in the market, especially if the product life cycle is fast. Consequently, robust estimates of duration are valuable. However, this is particularly difficult to achieve when the product is innovative and experience is lacking. Existing methods such as project evaluation and review technique (PERT) and critical path method (CPM) provide some support for this case, but have the significant limitation of being unable to accommodate the uncertainty in project formulation (Sonnemans, Geudens, & Brombacher, 2003).

A popular approach to managing the uncertainty inherent in product development is to have a check point or gate (Hart, Jan Hultink, Tzokas, & Commandeur, 2003; Palmer, 2002) at the end of each stage. This approach fits well with conventional project management methods, such as the Gantt chart, in which the gates may be represented as milestones. However, not everyone believes that the stage-gate approach is necessarily the best for product development, because it tends to be risk-averse (Buggie, 2002).

Product development projects often have complex interrelated activities (Söderlund, 2002), and large uncertainties about precisely which solution path will be taken. The full scope of the project can often not be anticipated beforehand, especially with novel projects. This imposes challenges on project management, which tends to prescribe complete scope definition (Buggie, 2002; PMI, 2004) because it materially affects the work breakdown structure. With product development projects it is necessary for senior managers to change their expectations as to the certainty of the process, and be accommodating of changes to the work breakdown structure as the project unfolds.

4.3 Time Management

Time management covers the definition of detailed activities, estimating their duration, and linking (sequencing) them together. It also includes allocation of resources (see Figure 6-1 and 6-2, PMI, 2004).

The biggest problem with estimating time (and cost) is the intrusion of bias. Bias refers to a person's inability to see something impartially. Projects may be affected by bias in various ways. At the activity level this might be someone underestimating (or overestimating) the time required to complete the activity. Many people are usually involved in providing the information that goes into a project plan. Therefore the project manager has to be vigilant about bias, not only self bias, but also that of others. Different types of bias (adapted from Vose, 1996) are:

- representativeness (stereotyping)
- availability (vividness of experience)
- over/under confidence
- motivational (comply with group expectations, management requirements, personal ambitions)
- anchoring (can't conceive the possible range)

During the control phase of NPD it is necessary to monitor the degree to which the work is completed and according to schedule. There is no reliable way of determining percent complete (Meredith & Mantel, 1995). The conservative approach is to set it as either 0% or 100%, but this is not followed here as it results in large inaccuracies when the cash flow analysis is performed (since the tasks occur over several years but the analysis is required at yearly resolution). Instead a value from the range 0% to 100% was used. An alternative approach would be to extend the WBS down into such small tasks that no accuracy is lost by following the 0% or 100% approach: however this is arguably impractical as a solution because of the risk of over-managing the project and being de-motivating to project staff. Instead, it may be preferable to rely on the worker's own perceptions of completeness of tasks.

4.4 Cost Management

Cost management covers the estimate of costs, production of a baseline, and then the cost control activities that arise when the project is under way (see Figure 7-1 and 7-2, PMI, 2004). Deterministic project paths are typically assumed, although this may result in inaccurate cost estimates (Herroelen, van Dommelen, & Demeulemeester, 1997; Isidore, 2001; Isidore & Back, 1999; Isidore, Back, & Fry, 2001).

The strategy taken towards cost management on NPD may be important, since research suggests that a focus on target costing may be inappropriate when the product is differentiated not on cost but on technology, time-to-market, or customer satisfaction (Davila & Wouters, 2004). Thus a single-minded cost focus may distract designers away from creating other value in the product.

Primary cost categories are fixed, labour, and consumables. Fixed costs are relatively straight-forward since they represent the work that is subcontracted, or plant and equipment. However the labour costs warrant further discussion in the context of NPD. This is because many of the staff involved, such as engineering designers, are often already paid by the organisation, and therefore it could be argued that their cost should not be debited to the project. In the case under examination their costs were nonetheless included, since the objective was to provide information about the total project cost and to compare that to other candidate NPD projects (not part of the current scope). The labour data is thus relative to other project that may require more or less labour. However it should be noted that the absolute value of the labour costs is not necessarily accurate. This is because the project plan only includes the time that staff are budgeted to work on the project: their slack time is not costed to the project although in reality it may be. This is a limitation, at least of MS

Project software. There is a work-around, which is to assign the staff to a single task that runs the full duration of their expected involvement. However, while this would fix the cost ambiguity, it would make it impossible to determine the workload issues, and for this reason it is not a particularly viable option.

From the project management perspective the NPD case under examination has the unusual characteristic of involving both expenses and income. Conventional projects tend to only spend money, and thus cost is the primary focus in the PMBOK. In the present case there was also income because the project included the entire life cycle. It is unfortunate that the sign conventions for project management and accounting are in conflict because this increases the risk of confusion and error when integrating project management into life cycle considerations. The overall cashflow implications for the sample project were determined by data processing of the cash flow report using a spreadsheet. The budgeted costs and incomes are shown in Figure 1 at present value (PV).

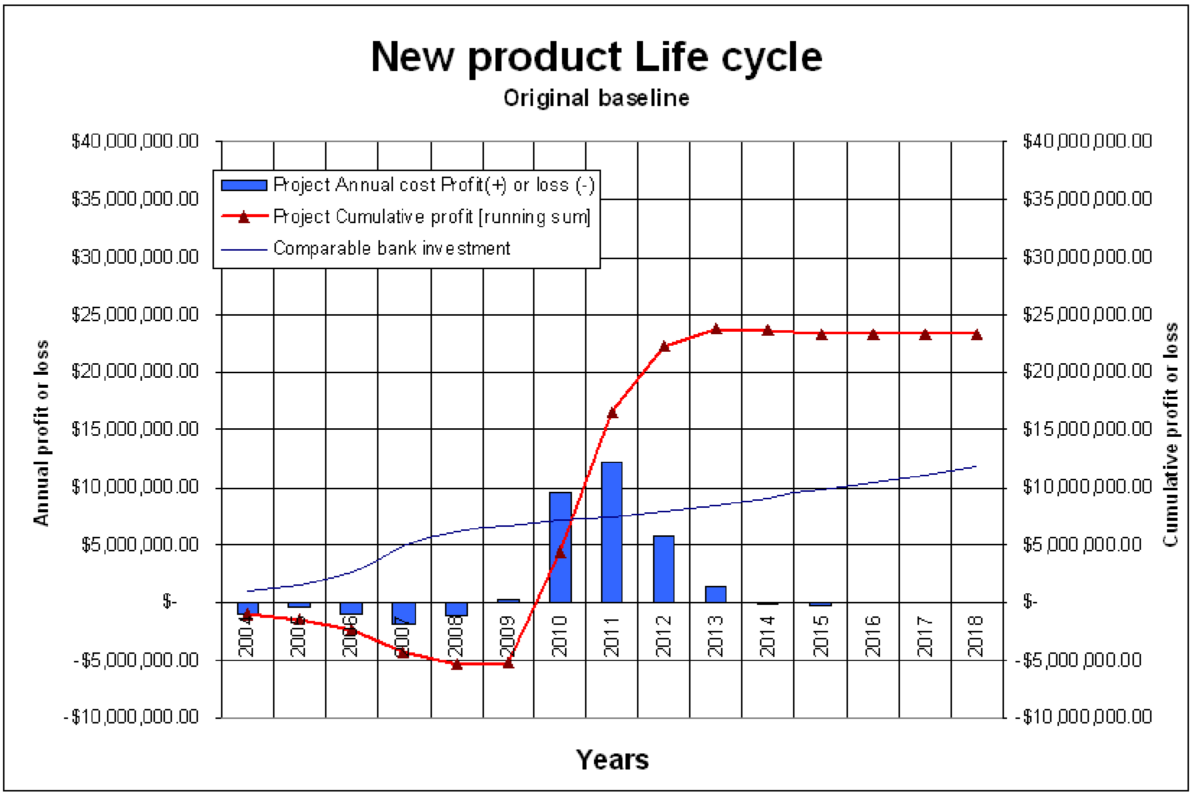

Figure 11: Life cycle cost for NPD project (baseline). The bars (blue) show the annual profit(loss), the thick line (red) with markers shows the cumulative profit(cost). The project sinks capital up to 2008, reaches breakeven in 2010, and eventually returns $23M. The light line (blue) shows the alternative investment, of leaving the money in the bank at 6% and forgoing both the opportunity and the risk: the balance would be $9.9M at 2015. The NPD gives a better return (IRR is 16%, calculation not shown).

4.5 Quality Management

Quality is a broad discipline that originally developed in the manufacturing engineering areas. Topics such as total quality management (TQM) have since been developed to apply quality principles to the whole organisation. In the process the focus of quality has moved away statistical techniques, though those are still useful in production environments, to include customer satisfaction (e.g. voice of the customer) and continuous improvement (e.g. the plan-do-check act cycle, six sigma), and much more. Design of experiments is also included, but this is a mainly a statistical tool for research and development or problem solving, and is thus of limited relevance to many projects.

The PMBOK provides an abbreviated coverage of the comprehensive topic of TQM (see Figure 8-1 and 8-2, PMI, 2004). Unfortunately it is more enthusiastic than discerning in the opinion of the present author. It includes topics like control charts, run charts, scatter diagrams (among others) that are highly relevant to continuous production processes. However these are not particularly relevant to project management, other than perhaps in commissioning of plant.

The main quality activities from the project management perspective are to determine the required quality of the deliverables, in such a way that comparison of actual vs intended quality can be done. This is important because the project manager will want to only authorise payment for services where the quality is up to scratch. Thus the project manager may produce a project plan (describing how quality will be ensured - a statement of intent), checklists to be used during project deployment, and the metrics by which adequate quality will be measured.

For the case under examination it would be necessary to determine detailed technical specifications for the product. These include the physical geometry of the typical kitchen spaces into which the product will be required to fit. Unfortunately, there are slightly different bench-top standards between different nations. Kick space, the recess of the cupboards at floor level, is particularly variable. Although this does not affect product function, it seriously and adversely affects style considerations since the appliance does not blend into the kitchen. This is important because all appliance manufacturers seek a global rather than only a single-nation market since economies of scale are important for financial viability. Other quality standards for which metrics are usually set are wash performance (ANSI/AHAM, 1992), electrical power consumption, water usage, noise, electrical and fire safety (UL, 1997), reliability, and style. These are from the consumer perspective. The producer also has important measures of quality, including takt time (production cycle time), cost, plant capital, design for manufacture, and warranty exposure.

In this industry the technical specifications are usually derived in turn from experience with prior similar products, and interaction with the customer. These industries are sensitive to customer perspectives since the financial margins are slim and market-sensitivity is important for survival. Producers seek to hear the voice of the customer and incorporate features into the design to delight the customer. Typical mechanisms to determine customer preferences are focus groups, though market surveys are sometimes also used. Formal methods may be used, such as the analytical hierarchy process (AHP) which permits pair-wise comparison of bundles of alternative product features (Calantone, Di Benedetto, & Schmidt, 1999; Perego & Rangone, 1996). Quality function deployment (QFD, or 'house of quality') QFD converts customer preferences into engineering specifications (Gustafsson, 1996; Kim, Moskowitz, Dhingra, & Evans, 2000; Sivaloganathan, Andrews, & Shahim, 2001). It is popular in this industry through it does have limitations that are easy to overlook (Martin, Kmenta, & Ishii, 1998; Mill, 1994).

4.6 Human Resource Management

Human resource (HR) management includes the assembly of the staff (definition of responsibilities, perhaps an organisation chart, workloads required) and the assignment of tasks to staff. Many of these outputs are available off the Gantt chart and other reports produced by project management software. The project manager will also need to manage the team, for example provide training and motivation, sort out conflicts, appraise staff performance, and help decision making work effectively (see Figure 9-1 and 9-2, PMI, 2004) .

The team is an association of people from diverse backgrounds. They may be from the organisation or external consultants. They bring different skills, and have to be managed. The assignment of a person to a project team is usually temporary. However it may be disruptive to normal business operations because of the loss of staff, especially if no relief staff are provided. If the assignment is partial, i.e. a person is expected to contribute both to the normal job and the project, then this can be stressful for the person and there may be a workload issue. Some projects may be long duration, in which case people may find that they have no job to go back to at project closure, since the normal business has compensated and made the position unnecessary. The expectation of this may lead to fear and reluctance to commit long-term to the project.

Team composition appears to be an important factor in NPD success. Matrix management is popular, but has been found to be problematic for research and development projects (deCotiis & Dyer, 1977). Research tentatively suggests that cross-functional new product development teams may be effective
(Hong, Nahm, & Doll, 2004; Lantos, 2005; Sethi, Smith, & Park, 2001). However, this must be interpreted with caution, as other research suggests that cross functional teams do not work reliably since the members feel stressed, neglected by the organisation and unsure of the rewards they will receive:

> '*Overall, our results indicate that management entrusts NPD teams with work critical to the maintenance and future of their organizations, yet often fails to provide these hardworking teams and team members with the support necessary to help them fulfill their charge.'* (Barczak & Wilemon, 2003 p475)

This has important implications for how senior managers influence motivation of employees, e.g. through selection of appropriate financial and encouragement rewards
(Jeffrey, Michael, & Shin, 2003).

The Project manager holds the team together. While individual team members need only know their part in the project, the Project Manager needs be able to create the project plans and keep the overall objectives in sight. The Project Manager position is a difficult one. The uncertainty and possibility of failure is very much more apparent in projects than in general management, creating stress. Time and cost constraints are more intense than ongoing management. There is also less job security. In addition team members are more difficult to coordinate as they are from different professional backgrounds and have no long-term relationships to maintain with colleagues. Also, the team may consist of people from both client and service provider organisations, with different and conflicting strategic objectives. It can be frustrating to have a task to do, but have to rely on other people to do their part when those others are not task focussed and not answerable to the project manager. However the project management position also has rewards, such as the opportunity to prove abilities. There is also excitement, challenge and a sense of accomplishment.

The importance of style of project leadership in new product development has relatively recently been identified as important for success
(Clift & Vandenbosch, 1999; Lewis, Welsh, Dehler, & Green, 2002; Swink, 2005). Thus different types of projects benefit from different types of leadership. Unfortunately, research has not yet made those relationships sufficiently clear that they can be reliably implemented

in practical projects. However, it is clear that it is essential that the organisation selects a project manager who has skills in all of technical, project management and interpersonal areas (Barczak & Wilemon, 2003). A participative leadership style in the project leader has also been associated with NPD success (Jeffrey, Michael, & Shin, 2003), although it also seems that the style of the project manager may have to change as a project progresses (Lewis, Welsh, Dehler, & Green, 2002).

4.7 Communications Management

Communications management includes the flow of information between the project manager and clients, superior managers, sub-contractors, and staff, all of whom have different reporting needs. The PMBOK calls for a communications management plan (p227), although some projects will not need this level of formal statement up front. Most important is the topic of performance reporting (p231), since clients and managers will generally want to be informed about project status (see Figure 10-1 and 10-2 PMI, 2004).

Teams with better communication, specifically the ability to share knowledge inside and outside the group, have been associated with better performance (Hayashi, 2004), suggesting that organisations may benefit from creating structures that encourage such communication. A little conflict in a project team can be beneficial, but not too much (Gobeli, Koenig, & Bechinger, 1998) otherwise there is a strong negative effect on project success.

The skills developed during product development, and the technical knowledge gathered are an important component of future capability. Formalising that knowledge in some way, so that it can be used by the organisation for future projects is not easily done, but has been identified as a potentially valuable activity (Marsh & Stock, 2003; Olsen & Reitz, 2002).

4.8 Risk Management

Risk management seeks to treat the hazards that could adversely affect project outcomes. Even routine projects have schedule and cost risks. Novel projects have those risks plus technology and quality risks. There is a large separate body of specialised knowledge on risk management, and the PMBOK extracts some of this
(see Figure 11-1 and 11-2 PMI, 2004). The main activites are Risk identification, Risk analysis (qualitatively or quantitatively), and Risk treatment. Suggested methods to respond to risks are avoidance, transfer to a third party, and mitigation (reduction in likelihood or consequence). Monitoring and control of risks is also included.

Another perspective on risk management is provided by the AS/NZ standard 4360 (AS/NZS 4360, 2004; SAA/SNZ HB436, 2004). There the process is generally perceived to be a progression of sequential tasks, and the main activities are to 'establish the context', 'identify risks', 'analyse risks', evaluate risks', and 'treat risks'. Collateral activities include 'communicate and consult' and 'monitor and review', which are further elaborated with text descriptions (SAA/SNZ HB436, 2004).

4.9 Procurement Management

Procurement refers to purchase of goods and services, including subcontracting or work packages. Consequently it is necessary to decide what work will be done in-house vs subcontracted. The external work packages may need contracts to ensure that the deliverables are correct in quality, time and cost. These contracts have to be managed and may need to be changed during the project to accommodate changes in scope or environmental factors (e.g. the cost of goods may increase during the project) (see Figure 12-1 and 12-2 PMI, 2004).

Single organisations no longer have the capability to design and produce every component in a product, at least not within the window of opportunity presented by the short product life cycles for consumer products. Instead it is a strategic imperative that organisations leverage their links with other organisations, forming partnering relationships (outsourcing) (Fraser, Farrukh, & Gregory, 2003) to provide pre-manufactured sub-components and specialised design expertise. This minimises the time to market, but it also provides other benefits including components with proven reliability and the possibility of minimised cost. However, the geographically dispersed nature of global engineering enterprise means that product development organisations must have effective communication and procurement processes (Amami, 2000; McDonough III, Kahn, & Barczak, 2001; Vijayan, 2005). In some cases it may be advantageous to support collaborative design too (Michel, 2004). There are many software applications that provide at least part solutions to this problem, such as collaborative computer aided design (CAD), and part document management (PDM). Project management applications are likewise developing greater capability for management of a distributed project (Pratim Ghosh & Chandy Varghese, 2004). However, NPD projects typically have many work packages, even thousands, which can be difficult to handle (Mesihovic, Malmqvist, & Pikosz, 2004).

The issue of product configuration (or build) arises with any product that is a complex assembly or has a long production life. The product design changes in small ways, due to incremental quality improvement or production efficiencies. On its own this is beneficial, but it has the consequence that nominally similar products may not be interchangeable as regards parts, so a larger inventory of parts is required. Most product manufacturers have sizable profit margins on spare parts, so the business is attractive, but not if inventory cost is excessive. At the end of production the organisation has to anticipate the life-time spares requirement and manufacture (and store) this before the tooling is decommissioned. Having multiple builds complicates this. At very least, it is essential for a manufacturer to have a robust method of tracking build, for example the capability to determine the build from the serial number. A related issue is the need to manage product families (Tatikonda, 1999; Tatikonda & Rosenthal, 2000).

5 Discussion

The MS Project software readily permitted creation of the work breakdown structure, estimates of duration, creation of links (sequences), imposition of milestones & deadlines, estimates of fixed and labour cost, and identification of resources (people, equipment, and consumables). See Figure 2 for a sample of the data. Reports, including the critical path and tracking Gantt, were readily available.

The PMBOK approach provides a comprehensive coverage of the activities required for new product development (NPD). This approach has been explored with specific reference to NPD and taking into account relevant research from other sources. On the whole project management (PM) provides a large set of tools to support NPD, and these are expected to generally be effective. However, the large uncertainties in project path sometimes decrease the effectiveness of project management (Herroelen & Leus, 2005; Leus & Herroelen, 2004). Nonetheless, PM is arguably the best available tool for NPD.

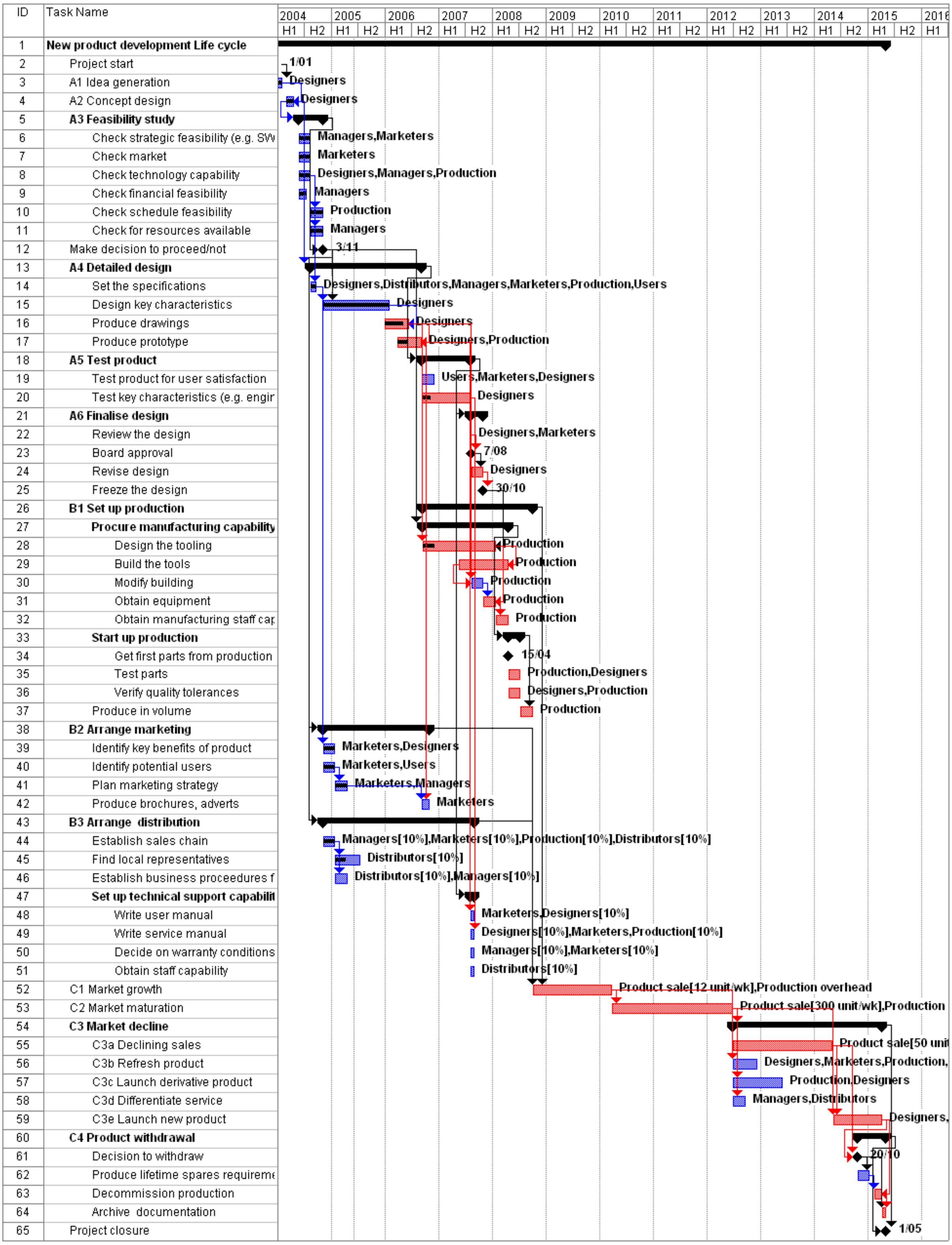

Figure 22: Gantt chart for project (baseline), showing the phases of the life cycle, the resources, and the schedule. The project commenced in 2005 and was due to complete 2015 with product withdrawal. The profit over the product life is shown in Figure 1.

6 Conclusions

This paper demonstrates the application of the project management body of knowledge (PMBOK) to the new product development (NPD) process. It is shown that the nine knowledge areas of the PMBOK provide a largely effective support of NPD, although care must be taken when the NPD has large path uncertainties.

Implications for project managers follow:

Project Integration Management
In many organisations product development occurs on multiple different projects simultaneously, and since development resources are typically limited, it is necessary for the project manager to coordinate resources between multiple projects. Possibly NPD is too dominated by project management methodologies with their focus on planning and prescribing; that instead there should more trial-and-error, empathy and cooperation

A degree of initiative and innovation is necessary from the project manager, occasionally even rule breaking.

Scope Management
Successful product development requires that senior management set clear goals, and keep these relatively stable. They need to change their expectations as to the certainty of the process, and be accommodating of changes to the work breakdown structure as the project unfolds. Not everyone believes that the stage-gate approach is necessarily the best for product development, because it tends to be risk-averse.

Time Management
The project manager has to be vigilant about bias, not only self bias, but also that of others, when estimating durations.

Cost Management
A single-minded cost focus may distract designers away from creating other value in the product.

Quality Management
The main quality activities from the project management perspective are to determine the required quality of the deliverables, in such a way that comparison of actual vs intended quality can be done. Quality function deployment (QFD, or 'house of quality') QFD is popular in this industry

Human Resource Management
Matrix management is popular, but has been found to be problematic for research and development projects. Research tentatively suggests that cross-functional new product development teams may be more effective. This is providing that the members are not overly stressed, neglected by the organisation, or unsure of the rewards they will receive. Motivation of team members does not feature strongly in the PMBOK, and senior managers probably need to be more aware of their influence on the motivation of employees, e.g. through selection of appropriate financial and encouragement rewards.
The importance of style of project leadership in new product development has relatively recently been identified as important for success. It is essential that the

organisation selects a project manager who has skills in all of technical, project management and interpersonal areas. A participative leadership style in the project leader has also been associated with NPD success.

Communications Management
Teams with better communication, specifically the ability to share knowledge inside and outside the group, have been associated with better performance. A little conflict in a project team can be beneficial, but not too much.

Risk Management
Risk management seeks to treat the hazards that could adversely affect project outcomes. This can be integrated with other perspectives on risk management such as AS/NZ standard 4360. NPD managers have to select risk treatment strategies depending on the tolerable level of risk for the organisation.

Procurement Management
NPD projects have some unique challenges such as numerous work packages that are geographically distributed. The geographically dispersed nature of global engineering enterprise means that product development organisations must have effective communication and procurement processes. Sometimes collaborative design (e.g. with suppliers) can be an advantage.

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