

The impacts of software product management

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Abstract

The success of any product depends on the skills and competence of the product manager. This article evaluates the relevance of good product management on the success of a product. The empirical study is supported by data from 178 industry projects from telecommunication industry over a period of three years throughout which the product management role and competency was defined, deployed and improved. The behaviors and project performance before and after strengthening the product management discipline are compared. We found that with increasing institutionalization of a consistent and empowered product management role, the success rate of projects in terms of schedule predictability, quality and project duration improves. To allow better transfer of achieved results to other settings, the article provides concrete guidelines about key success factors for good product management.

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1. Introduction

In today's competitive markets it is of utmost interest to have winning products. The success of any product depends on the skills and competences of its product manager. The product manager holds responsible for product requirements, release definition, product release lifecycles, creating an effective multifunctional product introduction team and – above all – preparing and implementing the business case. Yet, product management is complex: there are many stakeholders, many responsibilities and no formalized education or body of knowledge.

Our own definition which we derived from the process of competence building states that *product management* is the discipline and role, which governs a product (or solution or service) from its inception to the market/customer delivery in order to generate biggest possible value to the business. The *product manager* is a “mini CEO” representing the enterprise or business unit in strategy definition and operational execution. The product manager aims at hav-

ing the right product mix and selecting the right projects to implement a given strategy. He evaluates his products or product releases with respect to their overall contribution to business success. He makes use of the product life cycle to revisit assumptions and implement decisions. This brief summary is in line with non-software related descriptions of the role, such as in Gorchels (2006) or Cooper (2001).

How does this relate to systems and software engineering? Business success is the success of the product manager with his team. He decides with the stakeholders of his product line or business unit what contents to deliver in which timeframe for which market at what prizes and cost. He owns the business case and assures that a product release delivers value – to the customers and to his own business. A major obstacle though is the need to balance a variety of needs from markets, customers or stakeholders and align them into an optimized allocation of spare resources. This is where systems and software engineering comes into the picture. The successful product manager not only masters the life-cycle processes, he is the owner (Cooper, 2001; McGrath, 2004). He must get as early as possible and way before project start a good systems perspective to judge on

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value proposition and priorities. He needs strong understanding of technical aspects to reply to market and customer needs with a feasible solution. To our own studies and having surveyed hundreds of incumbents, most product managers in software and IT advance from a technical career (often they were technical project managers or systems engineers before) and grow into this discipline. This article provides insight and experiences to successfully master this responsibility.

Too often projects or product releases fail due to misunderstanding or misinterpreting customer needs and later on coping with associated changes. In a recent meeting the author had with Chinese product managers they claimed that there are continuous changes because of European interference on the requirements. Back in Europe local product managers asserted that it is impossible to closely follow the variety of politics and relationships in China. An American senior manager pointed out that his unit could do very well – if only the European and Asian regional sales would follow his roadmap and not continuously disturb it.

The successful product manager has to balance projects, people and politics. His primary tools are roadmaps, requirements, gate reviews and the business case. Looking only to technical aspects, like many product managers are doing might help to master technical projects and interact well with engineering staff. However these product managers will continuously blame “politics” for not achieving their missions. Mentioned observations underline that the respective product managers do not master their role. Insufficient requirements engineering is typically the first sign of product management failure. The difficulties with misunderstanding needs, changing and creeping requirements, missed deadlines and budgetary commitments and more globally speaking failing business opportunities can only be cured with a thorough understanding and implementation of the product manager’s role.

“Companies win or fail depending on their product managers” is a frequent observation not only in our study but also summarized by many other researchers of the field (Gorchels, 2006; Davis, 2005; Cooper, 2001; Lehtola et al., 2005; Cooper et al., 2004; McGrath, 2004). At Alcatel we understood this need and during the past years built the discipline of product management. We did this in parallel to building the product marketing management and project management competences. We realized that with a wide variety of unclear profiles and role understanding, insufficient training, and informal selection processes for these roles, there would always be fragmented processes and insufficient addressing of customer and business needs. We will in this article reflect and evaluate how key practices glue together and help in making product management successful. We will share experiences from Alcatel in introducing these practices so they can be used in other enterprises.

The article investigates the impacts of product management on product performance. Performance is measured in duration (time to market), schedule adherence and hand-

over quality. All three improve with strengthening of a coherent product management role. Several explanatory factors for this positive impact of product management will be further explained. The article is structured as follows. Chapter 2 summarizes the challenges of product management specifically within requirements engineering. Chapter 3 describes the setting of this scientific evaluation, the empirical study and some concrete results. Chapter 4 provides a practical synthesis of lessons learned and concrete guidance for product managers in the SW- and IT-industries that can be generalized for transfer into other settings. The split between Chapters 3 (study) and 4 (practice) underlines the author’s belief that empirical studies must also provide insight how these results can be transferred to other settings. This is the target of Chapter 4. Finally, Chapter 5 summarizes results.

2. Product management role and life-cycle impacts

Often the roles of product manager, marketing manager and project manager are confused. People address questions or tasks to a person not educated or formally responsible for doing it. This leads to avoidable conflicts. For instance, the project manager is measured in successfully delivering exactly his defined project. He will not look normally into the success of other projects or even arbitrate between those in case of resource conflicts. This is where the product manager comes in. He is measured on the success of several projects and the resulting products over a time much longer than project duration. The product manager would struggle if asked to set up a customer marketing plan, because it conflicts with his more global role of overall product success. Being nice to each single customer will create a flood of requirements that he could not address. This is where marketing comes in, that are educated in creating needs and markets. We will therefore first of all define the three roles and distinguish them from each other. These definitions are inherited from our own competence building over the past years, however are in line with the relevant literature (Gorchels, 2006; Cooper, 2001; Royce, 1999; Kotler, 2005).

The *product manager* leads and manages one or several products from the inception to the phase-out in order to maximize business value (Gorchels, 2006). He is working with marketing, sales, engineering, finance, quality and operations in order to make his products a business success. He has the business responsibility beyond the single project. He determines what to make and how to make it and is accountable for the business success within an entire portfolio. He approves roadmap and content and determines what and how to innovate. He is responsible for the entire value chain of a product following the life cycle and asks: What do we keep, what do we evolve, what do we stop?

The *marketing manager* on the other hand determines how to sell a product or service (Kotler, 2005). She is accountable for market and customer success. She has a

profound understanding of customer needs, market trends, sales perspectives and competitors. She communicates the value proposition to sales and customers. The marketing manager drives the sales plan and execution and asks: What markets will we address?

The *project manager* determines how to best execute a project or contract (Royce, 1999). He ensures the project is executed as defined. He is accountable for business and customer success within a contract project. He manages the project plan and its execution and asks: How do we get all this done? Seasoned project managers claim: “When I see how your project starts I can tell you how it ends”. This article looks exactly to this aspect and underlines that it is the upstream part of the project – lead by the product manager – which determines project success!

Product management covers all life-cycle phases from the strategy definition downwards to delivery, market launch and service until retirement of the product. Fig. 1 shows this perspective versus the limited and precisely defined scope of individual projects within the life cycle.

Fig. 2 shows the scope of product management within the enterprise and also the interfaces towards project management. The product manager is positioned right at the heart of the company and assures business success by taking the right decisions in defining products and executing the life cycle. Product management is closely linked to requirements engineering, because it is the product manager to plan and prioritize requirements into roadmaps, releases and projects (Gorchels, 2006; Davis, 2005).

The general role of product managers has been analyzed and described in several industrial studies, especially that of Gorchels (2006). She provides a general-purpose description of the role and the responsibilities plus its interfaces to other roles, especially towards marketing, sales and project management. Cooper (2001) underlines the need of the product manager in order to drive new product introduction and to steer the product life cycle by means of gate reviews. These studies provide useful groundwork; however do not specifically deal with SW- or IT-products. Davis positions the product manager at orchestrating stakeholders, however does not clarify the role versus other marketing- or project-related roles (Davis, 2005). In fact the product manager’s role in SW and IT has so far not been summarized in a comprehensive perspective. There are a

number of more specific studies that relate software engineering to a business perspective. Lehtola et al. (2005) describe the roadmapping process and how it links to product requirements. The product manager’s responsibility in this context of business planning is summarized as “*road-mapping and balancing needs of different stakeholder over a long time in order to maximize benefits*” (Gorchels, 2006; Cooper et al., 2004; Karlsson et al., 2002).

Product management is not a discipline you can study at university. We did extensive search in a variety of databases and found no reference to a distinct curriculum – such as it is available for marketing in practically all business schools. There is not even a reference body of knowledge such as the PMBOK for project managers. This makes education and selection of product managers more difficult than for other roles, for which there is a clear outline of education and career paths. From our own studies at Alcatel and with collaborating research teams we found that most product managers have either marketing or engineering background (each accounting for 30–50% of the entire population). The role evolution of a product manager is typically horizontal, i.e., from one product to the next, while gaining more responsibility in terms of business scope. Career-wise his next step external to product management is mostly marketing or general management, indicating that this role also serves a interface and gatekeeper between the more product- and engineering-related responsibilities in a company and those with more focus on business.

Despite such obvious needs most life-cycle management and software engineering standards overly narrow look only into the engineering aspects within a *single project*. The ISO life cycle related standards for systems life cycle processes (ISO/IEC 15288:2002, 2002) and software life cycle processes (ISO/IEC 12207:1997, 1997) primarily look into the processes from analysis to development to distribution and further downstream towards operations and even disposal. They do not detail the upstream activities before project start or product launch. The same holds for the recently updated IEEE standard for application and management of the systems engineering process (IEEE Std 1220–2005, 2005) which has an overview on life-cycle processes and eight functional life-cycle processes (e.g., development, manufacturing, test, etc.) but does not mention *how the system is defined* and *how the requirements are decided*. The starting point in these standards is the assumption that there are requirements that are elicited or collected from customers and key stakeholders which then are analyzed to design and subdivide a systems structure. Not even the industry-renowned CMMI (which otherwise is extremely strong on business-driven processes) takes the perspective above the single project to demand product management related processes (Chrissis et al., 2003). Generally speaking there is no standardization and thus not even standard terminology on topics around product management and upstream processes before the start of a (development or maintenance) project or after its end.

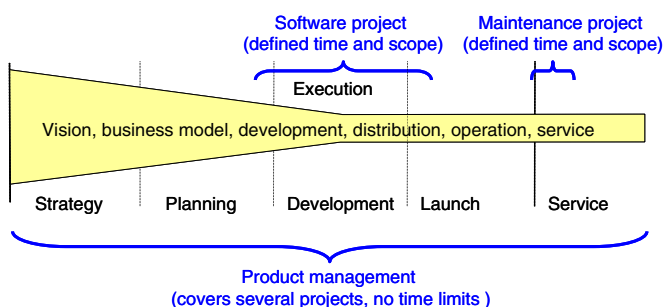


Fig. 1. Product management and the life-cycle.

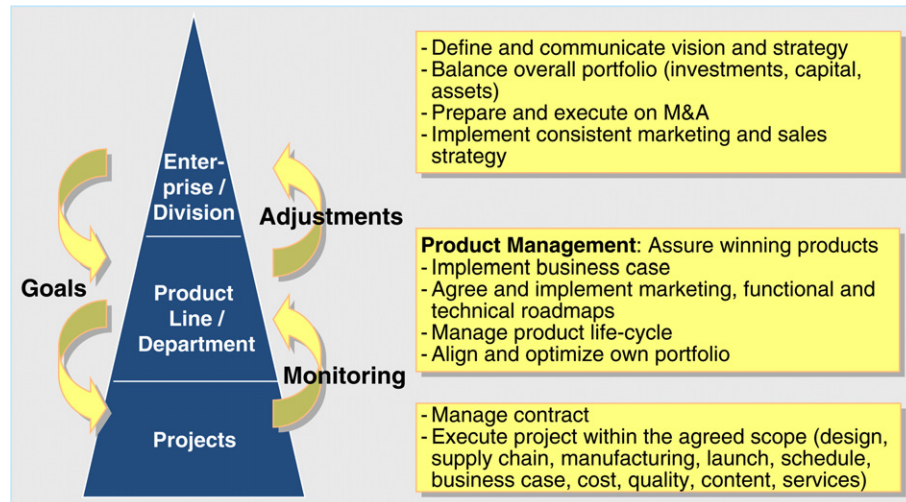


Fig. 2. Product management within the enterprise.

Along the same lines, product management has *not yet* received equal attention in empirical studies compared to project execution. For instance, the Chaos report (Standish Group International Inc, 2003) only looks into projects, but not to the processes *before* the projects or the success on portfolios of projects. But it points to the right direction regarding root causes: Only 52% of the originally allocated requirements appear in the final product release (Standish Group International Inc, 2003). This is primarily the consequence of this process not having a clear corporate owner with assigned accountability for its success. In a similar study looking at new product development from a broader scope, Cooper et al. (2004) found in 105 business units from various industries in USA that the top 20% of enterprises deliver 79% of their new products in time, while the average delivers only 51% in time. From that same set of the top 20% ranking companies 66% relate their resource breakdown to strategic needs. But only 31% of the average companies are aligning their strategies with resource utilization in projects. The challenge in many IT and software companies lies in between sales/marketing, strategy/product management and technical/R&D management. Not that the people don't talk to each other, but nobody has the formal lead to drive successful product execution. We observed in our own studies over the past years that with a more thorough product management role understanding and execution, not only the success rate of products will increase, but also the incumbents and their management will be more satisfied.

3. Empirical field study

To better understand the practical impacts of product management on project success (and therefore have a solid reasoning why we need strong product managers), we looked into the evolution of product management and its impacts within one of Alcatel's business units. Alcatel provides communications solutions to telecommunication car-

riers, Internet service providers and enterprises for delivery of voice, data and video applications to their customers or employees. With sales of EURO 13.1 billion and 58,000 employees in 2005, Alcatel operates in more than 130 countries. Specific and dedicated solutions for customers have been provided in this market for many years. The challenge today is to build upon technology platforms, while offering tailored solutions.

The business unit that we selected was amongst the first to introduce consistent product management in a defined way. It operates in North America, Europe and Asia, thus assuring representative results independent of geography. The products of that business unit are components used in communication networks. Examples of usage include voice over IP and video solutions. They comprise platform products that are developed typically every few years and then customized for contract projects. The approach behind is product-line driven, so that platform products would have the basic functionality and customer products are enhancements (or changes) to those platforms. There are also network management systems included which help to configure and operate these products.

The technology used is real-time and embedded software written in languages such as C, C++ and Java running on a mixture of own and commercial off the shelf hardware components. Middleware (e.g., stacks, operating systems, databases) is commercial off the shelf and might include open source software components where appropriate. Network management systems include user interface frameworks adapted to a variety of customer-specific needs. With the exception of few platform products all projects were linked to a traceably customer contract. The projects evaluated in this study, though primarily in the domains of embedded systems or software applications cover a wide range of the entire world of software dominated projects. Results therefore apply to other industries than communication. This is also supported by benchmarks we have been doing in the field of information

systems, service, automotive and defense (for published records see also: (Cooper, 2001; Cooper et al., 2004; Jones, 2001; McGrath, 2004)).

178 projects had been reported in the timeframe of product management institutionalization to our corporate history database by this business unit. They were finished between January 2003 and December 2005. Project size in effort was between several person weeks up to several hundred person years. Project data had been collected in a standardized way for years by means of a history database. Data is aggregated from the operational databases (e.g., project milestones with originally planned dates and achieved dates) towards projects and aggregated per business unit or division. Having collected such raw data since the nineties and more thoroughly since 2001 allows us to study impacts of various process changes and other parameters on project performance (see also (Ebert et al., 2004) for data collection details and how history databases are exploited). The author was not involved in developing or managing any of these products and was only indirectly measured to the success of this business unit. He was working over several years with engineers, product managers, marketers and senior management of practically all Alcatel business units in order to advance skills and competences in the field of product management. This allows describing the results of the study as an observer not as a part of it.

We will use in this study the data of mentioned 178 projects, which we could relate to several stages of improving product management. All projects that had recorded valid data in the history database were used. No “outliers” have been thrown out, thus avoiding overlooking influences from other parameters than those being analyzed here.

In order to achieve business success, the product manager in this domain works towards several dimensions:

- Creating a winning product and business case.
- Conquer markets and grow market share.
- Deliver value to customers.

Evaluating the impact on product management on business success naturally should evaluate these three dimensions. For this study we reduced the impacts towards the first dimension, namely successfully defining products and managing product development. It is impossible to fully evaluate business cases and marketing for such empirical study from a mere product development perspective due to the many other effects on cost and sales (let alone the confidentiality of such data). We took proxies for the second and third dimension nevertheless. Market success in such highly dynamic technology area is determined by time to market with new innovations and products. Therefore one variable that we will evaluate is project duration from start of development to delivery. Market success and customer value depend also on keeping commitments in terms of schedule and quality. The two other variables being evaluated are therefore schedule adherence (or project delay at handover) and project quality at handover time.

To summarize the approach of this study, we will evaluate *three dependent variables*, namely *project duration*, *project delays* to show schedule predictability and *project quality* at handover. These three variables together form a proxy for business success from a product development perspective. We will evaluate how these three factors are influenced by the implementation degree of product management.

Project duration is measured between the gating review which kicks off the project and the gating review that decides to release the project to the customer or market. Latest at the time of project start, a firm end-date of the project has to be committed. This end-date is then recorded together with other planning data. *Project delays* (or schedule performance) are measured by comparing the project end milestone as committed at project start with the actually achieved project end milestone. This absolute difference in calendar days is normalized by the originally committed project duration in calendar days. If a project has been initially agreed to run for 100 calendar days and is actually finished after 120 calendar days, it has a (project) delay of 20%. *Project quality* is measured as the percentage of total defects found after handover to the customer compared to the totality of reported defects during the product life cycle. An activity-based defect counting is used, so that defects found during code review or test of a maintenance release would not be accounted as post-release defects. For telecommunication products there are precise definitions how to account defects and their different severity, which we used in this study (QuEST/TL9000, 2003). These three metrics are the dependent variables which we analyze furtheron. We also measure project size to provide a feeling for the scope of projects and whether this scope would influence or distort the three dependent variables. *Project size* in this study is measured by the effort of the project from start to end in person years. A more design-oriented size metric (e.g., lines of code) is ruled out because of the variety of development paradigms, automatic code generation and reuse approaches used to engineer the products.

We found that delays are independent of project size (measured in person years of effort) – within the range of

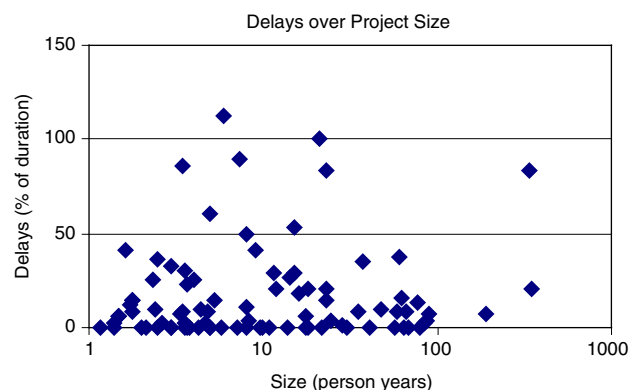


Fig. 3. Schedule performance is independent of project size.

project size that we had in our set (see Fig. 3). A Pearson rank correlation showed $r = 10\%$ which indicates no relationship between size and delays.

Any empirical study on product management must distinguish between implementation issues in requirement engineering and project management from actual product management related effects and conclusions. We therefore selected the mentioned business unit because it was from begin to end of the study at CMM maturity level 3 or above with long process improvement experiences, thus assuring defined organizational processes in the domain of engineering and project management. We also ruled out the impact of “product ageing” which could improve performance because people know what to do. The business unit introduced several new products in the timeframe which we investigated and played from begin to end a lead role in Alcatel’s global portfolio, being both innovative as well as addressing markets around the world.

As a *control variable* we took the degree of implementation of the product manager role. Naturally there was a pro-forma product manager role available since long, however the responsibilities, competencies and operational behaviors were very heterogeneous. Only with an orchestrated approach towards defining a competence profile for product managers, aligning their roles and responsibilities versus other roles in the same organization (e.g., product marketing manager, technical project manager, regional sales) triggered more consistent and effective behaviors. We mapped the implementation degree of the product manager role to three phases:

Phase 1: Agree roles and responsibilities. This initial phase prepared the stage for role alignment. First we created a sense of urgency with some critical stakeholders in the organization. Concrete behaviors and business results were mapped to underline deficiencies in the current way of working. It did not take much effort to convince the stakeholders and incumbents on the need to strengthen the role of product manager. We brought together the leading product managers and assessed success factors and the elements of the role. We compared these elements to other related roles, such as marketing manager or project manager. We benchmarked with other companies and asked external experts for advice in defining the role. Finally we drafted a business case to show the added value from this change initiative. After all, any such change must be baseline, measured and proven in its success.

Phase 2: Prepare and pilot. During this second stage we worked with product managers, training experts, and other functions towards building training materials, self-assessment tools and hands-on success stories. Our standard product life cycle was enriched during that phase with more templates to ease the product managers’ work. Training modules were created and piloted for key functional competences, such as building the customer business case or preparing an operational plan. Specific emphasis was given towards aligning the product management role with that of product marketing management. Often we found that mar-

keters and product managers work in isolation. We worked with both communities to assure mutual understanding and better collaboration. Pilots were conducted for training modules, role execution and some key elements of the role, such as roadmapping and requirements prioritization. Measurements were agreed.

Phase 3: Institutionalize. As in any change project the last step is the deployment. Deployment takes longest, however can be done in a deterministic way if prepared well. During deployment we worked closely with the established product lines and organizations to avoid a big bang effect. Measurements were used to monitor progress and to identify deficiencies. Continuous feedback with incumbents, specifically within training courses and afterwards from the trained community helped in identifying further improvement needs.

The impact of each of these three phases could be deducted from our history database by means of mapping product releases (projects) to dates and organizations. Having this control variable closely linked to the projects in our study, we could evaluate the impact of product management institutionalization on the three (dependent) performance parameters. This avoids conclusions of the type described in experimental software engineering as shotgun approach with uncontrolled independent variables (Ebert et al., 2004; Fenton and Pfleeger, 1997).

Fig. 4 provides an overview of the 178 projects evaluated in this study. The first column is what we call the control variable of the study. We evaluate the impact of using product management techniques and distinguish three phases as described before. The three phases are indicated in this first column. The next column shows how many projects fall into each category. In the column counting the amount of projects per phase we see a steady increase of projects. Each phase has a representative set of projects (as a rule of thumb one would need at least 10 projects per dependent variable being analyzed). Minimum and maximum size (in person years) of the projects per phase is shown in the columns 3 and 4. Size is represented from very small projects (few person weeks) up to several hundred person years (PY). Note that the first phase has two rather large projects (which we kept for completeness of the study), while phases 2 and 3 had only projects below 100 PY. The last three columns show the dependent variables of our study. Average duration takes the duration in weeks per project and normalizes each single value to the average value of the baseline at the start of the study (i.e., phase 1). Average delay takes the percentage of schedule overrun compared to originally committed release

Prod. mgmt. introduction phase	# Pro- jects	Min size [PY]	Max size [PY]	Average duration	Average delay	Average quality
1	47	0	346	100%	100%	100%
2	55	0	84	87%	25%	30%
3	76	0	91	64%	15%	18%

Fig. 4. Overview of projects used in this study and results achieved.

dates. Again we normalize to the average value at start of the study. The last column shows the quality level in terms of defect detection percentage after handover and again normalized to the baseline value of phase 1.

Fig. 4 highlights that *with increasing focus on product management project duration decreases and both schedule performance and quality level improve*. Late projects are a primary cause for shrinking margins and insufficient business case validity. From a business perspective we thus evaluate furtheron how project delays can be reduced by improved product management. We did not investigate effects such as on sales, revenues or customer satisfaction because they have much more influences from the market situation and are thus difficult to compare.

Looking to the data one could argue that we simply reduced size of projects and therefore achieved better schedule performance. Besides that Fig. 3 already showed no such relationship, our customers and markets would not reduce needs and thus content according to such desires. This would be the same as demanding to freeze requirements before start of a project, which also sounds intriguing but is impossible to achieve. It would also not help much to simply make two or three projects where there was only one before (as suggested by agile development principles), because customers do not want to have several incremental installations – besides that installation and service of so many variants would be too expensive.

Fig. 5 summarizes the results of this impact analysis of product management on project performance for all three dependent variables. With progress in the introduction of product management techniques and better training of the product managers (phase 3 to the right of each chart) the delays (as percentage of duration) are substantially reduced. Not only is volatility decreasing, but also the majority of projects arrive with delays in the range of below 10%, which is the target in such dynamic markets. Note that in these diagrams many data points contribute to the trend line. What looks like a single “outlier” for instance in the quality diagram, is in fact contributed by several projects not even showed on the scale due to their big variance, so removing one such project would not make a relevant difference.

In our evaluations of projects we found no single root cause explaining this evolution. For instance, if the main

root cause was having an insufficient product vision, that could be cured with working on portfolio management, roadmapping and creating product strategies. But we found in more detailed investigation that roadmapping was not the single answer, because it doesnot address execution of roadmaps.

To further explain root causes of delays, we will look to typical behaviors during phase 1. One representative product line exhibited during phase 1 a 73% change rate (median: 50%) of any project’s requirements after project start. By “change” we mean modifications to existing requirements or – more often the case – deletion or replacement of requirements. As a consequence of this high change rate on delays, often projects were delivered with insufficient functionality. We found that one third of the changes are of technical nature (e.g., a specification was infeasible for design), while two thirds are of commercial nature (covering the majority of requirements uncertainties).

4. Lessons learned: product management solutions

What are the pre-requisites of good product management? We will summarize in this chapter lessons learned from introducing product management and relate it to our targets of reducing cycle time, mastering schedule adherence and improving handover quality. This chapter is a corollary to the previous chapter. While Chapter 3 shows the empirical study, this chapter shows how results can be practically used. The mentioned experiences here come from our work with Alcatel product managers. These are not opinions or literature quotes but experienced best practices from day-to-day work.

4.1. Business objectives and accountability

Goals that are defined and measured will be achieved. This is ancient wisdom and still valid. Lots of management fads had tried to hide or distort that human beings are driven by objectives. Being the business owner, the product manager must set objectives – and then achieve them. Objectives must be measurable linked to business needs and the strategic planning. There are hierarchical dependencies between portfolio, product line, product release, and individual project that must be managed continuously

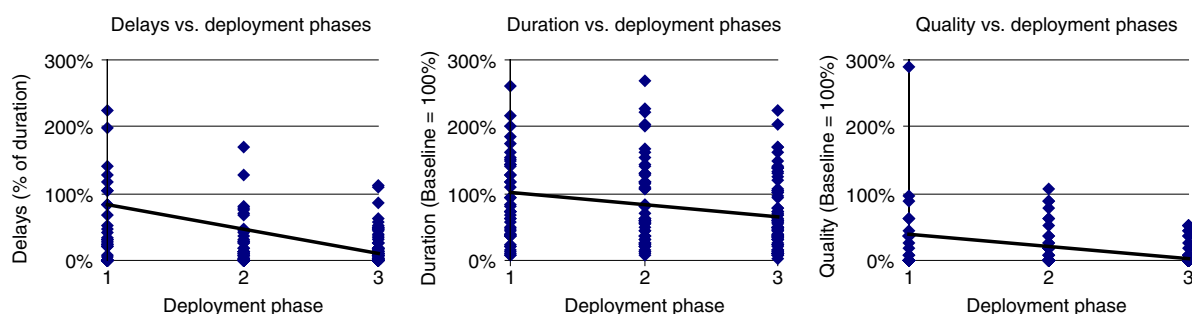


Fig. 5. The three dependent variables improve with increasing focus on product management (from phases 1–3).

by the product manager, his team and his management (see also Fig. 2).

Performance objectives depend on the business model, markets, competitive situation, and other factors. They are decided and approved within the bigger context of the business unit in which the product manager operates. Typical examples include business case success; meeting estimated cost targets; reducing cost (e.g., fixed cost across a product line and variable cost within a project), portfolio innovation and optimization, portfolio profitability (summarized business cases); milestone accuracy and schedule predictability; time to market or project duration; and product quality. Some of these objectives clearly go far beyond the product development scope, which explains why we evaluated in this study only three of them, namely duration, schedule and quality.

Accountability means that agreed milestones, contents or quality targets are maintained as committed. Having a project plan that is directly linked with requirements is mandatory for all projects. If there is a change to plan or contents, both must be synchronized and approved by the entire core team. Committed roadmaps and requirements must be accessible online together with other relevant product and project information. Different tools can be used, starting with simple spreadsheets. We have seen agile project using one spreadsheet to manage the entire project. Such a spreadsheet has all requirements, their status, effort, responsables and mapping to increments, test cases and work products. Reporting can be generated directly from such spreadsheet. For bigger projects we recommend online accessible vaulting systems to trace requirements to work products. A requirements database helps with this effort. Contents include requirements, implementation status of each requirement, priorities, estimated cost, value assessment, mapping to releases – especially future releases to communicate the roadmap –, relationships between requirements, and links to related implementation and test details.

Should projects target an average zero delay? The clear answer is no. If the target is zero overruns, projects will take much longer to get started because they try to perfectly analyze the requirements in order to understand uncertainties and how to mitigate those. They would hope that with longer lead-time during analysis, requirements and their dependencies would become clearer. And they build in extra buffers. These concepts (which we observed repeatedly) are costly and dangerous and thus not suitable for a market that is extremely cost conscious. Having broad empirical data on project success available we evaluated this question quantitatively. The results are revealing: Targeting 5% or less delay has no significant difference between the datasets (with or without product management)! Roughly half of all projects are 50% late in both data sets. Product management makes no difference in this aspect. However if we target 10% delays as a global performance target, we suddenly see a big difference: 53% of the projects without product management (phase 1)

are late, while only 34% of those with product management (phase 3) are late.

Engineering and product development performance targets must be set realistically in order to be accepted and show business value. Product success is not about zero delays but about mastering the trade-off of business needs, project duration, cost and contract commitments. The zero-delay concept (which can be achieved with time-boxing and rigorous rejection of changes after given milestones) holds only when the contract date at hand is mission-critical such as in some of our satellite business (e.g., reaching a certain orbital constellation) or in services targeted for a specific date (e.g., soccer world championship).

4.2. *Balancing value and requirements*

Properly expressed requirements form a high-level abstraction of the functional and nonfunctional behavior of the product. Formalizing such a description helps in identifying reusable aspects of systems at a level independent of any particular solution or component structure. Requirements evaluation thus starts with a standardized specification that captures both the functional/non-functional content and the business reasoning. Requirements are evaluated by the entire core team to ensure that different perspectives are considered. Each single requirement must be justified to support the business case and to allow managing changes and priorities. Impact analysis is based on requirements (Davis, 2005; Giesen and Voelker, 2002), as well as priority setting and portfolio management (Cathleen, 2003; Bower and Christensen, 1995). Often a business case is done and impact analysis is done for a group of requirements. If those start changing later on, it is very difficult to assess what is really necessary and what was a lower priority or maybe only an enhancement to existing features.

Should requirements drive schedule and resource allocation? Again, the answer is a clear no. Projects should be designed to cost and schedule. Requirements are evaluated – one by one – in line with these business needs, but should not drive them. Do not start with the long list of potential requirements but rather find out, which few key requirements uniquely characterize the product (release). Evaluation looks into several dimensions: What are the requirements? How do they relate between markets and correlate with each other? What is their impact? What markets have asked for it and for what reason? Are they necessary for a solution or just inherited from an incumbent approach perhaps becoming obsolete in meantime? To address these questions requirements must be documented in a structured and disciplined way. They must be expressed allowing both technical as well as business judgment. Any incoming requirement should be reviewed with the product catalogue and global product evolution in mind to also evaluate marginal value versus marginal costs. If changes cannot be met move them to the next

release, instead of making the current project overly late and thus delay the entire roadmap.

Requirements are aligned with release planning through roadmapping. The following steps show how a product manager uses roadmapping to manage releases and requirements (and feature evolution):

- Identify key needs across markets and technologies. Demand from stakeholders the valuation of key requirements. Avoid already at this stage getting caught by a list of too many requirements, all labeled “critical”. You will never ever be able to reduce such list.
- Coin a product vision with essential features mapped to releases. Set up and evaluate the business case and the major business drivers.
- Evaluate requirements depending on customer value, cost structure (e.g. capital investments, operational cost, recent changes in cost structure, new revenue sources, opportunistic factors), complexity in development and maintenance, extendibility, or internal life cycle cost.
- Map major requirements to releases. Describe and maintain a functional (based on contents) roadmap for each product line. Map it to major customers or markets. A standard requirements management tool such as DOORS will help to maintain different views on the same underlying evolution paths and feature catalogues. Have different regional needs be defended by their respective stakeholders (e.g., sales teams) to agree a priority list that holds for the entire product across markets.
- Describe and maintain a more detailed technology roadmap. It should describe within defined and agreed steps which functions would arrive and what their dependencies are. Identify within specification, architecture and roadmap documents clear evolution tracks. Determine dependencies, cost/investment, priorities and major milestones. Use a modular architecture, which allows splitting features or merging related customer needs.
- Decide and communicate within the entire company, which products, platforms, features or even markets are active, which are on their phase-out and for which you have effectively stopped support. Agree communication strategies with marketing and sales to avoid that your engineers in a customer meeting would confuse the picture with their own opinions. Specifically agree dates from which onwards specific contents would be allowed to be communicated. Implement migration roadmaps that allow your customers to move from one to the next release.
- Use an incremental or iterative (depending on technology novelty and requirements uncertainty) approach spanning the entire product definition and engineering processes. This will help to focus on major requirements and stay predictable. Track progress based on earned value on the basis of integrated requirements.
- Set concrete time-to-profit targets for increments and releases. Trigger re-evaluation if they are not met. It’s

key to stay predictable and deliver to business objectives. Use the product life-cycle to formally decide scope changes beyond the normal noise level, schedule acceleration, resource changes, early termination or phase-out of releases and products. Never ever agree such changes without a formal decision process.

4.3. *Managing risks and uncertainty*

Requirements are uncertain and need to be managed in order to keep risks within accepted limits. A number of solid techniques exist to deal with requirements uncertainty and master project risks (Ebert and DeMan, 2005). They deal with requirements elicitation, communication, analysis and planning. Projects must be planned to handle risks coming from uncertain customer needs, supplier commitments or technology evolution. Prioritizing requirements and planning incremental stabilization, measured by the earned value achieved in the project is a key success factor.

A product manager manages risks on the product line and roadmap level – as opposed to the single project. This means to utilize basic portfolio evaluation techniques, in order to avoid taking isolated decisions in the heat of the (project) day. Fig. 6 shows the relationship of product strategy with roadmapping. The driving force is the product vision which then has to be consolidated with necessary technologies and their evolution (lower part of the picture). Depending on feature valuation and prioritization and the technology availability, releases are planned. Each single product release has its own story with major features which will be used for marketing and sales prospects. A product release is executed as a project (see Fig. 1) with defined scope, deadlines, budget and content. Due to the dependencies between these product releases, content is often used as a buffer for risk and uncertainty management.

Roadmapping builds upon all product and project related information and the decision on the totality of all projects in order to maximize their value for the enterprise. This includes the following aspects:

- Building an inventory of your overall software engineering assets in terms of products, reusable software, ongoing projects and their opportunities, employees, etc.
- Continuous evaluation of new opportunities in comparison with ongoing activities.
- Combined evaluation of all major static and dynamic assets (e.g. customers, contracts, technologies, platforms, knowledge, skills).
- Deciding which resources will be (re-) allocated to which opportunities.

Full portfolio visibility in software projects means to access and to assess all projects continuously and in totality. It’s not a project review and should in fact not mix with regular project monitoring and oversight. It means that costs and benefits, contents and roadmaps, threats, risks and oppor-

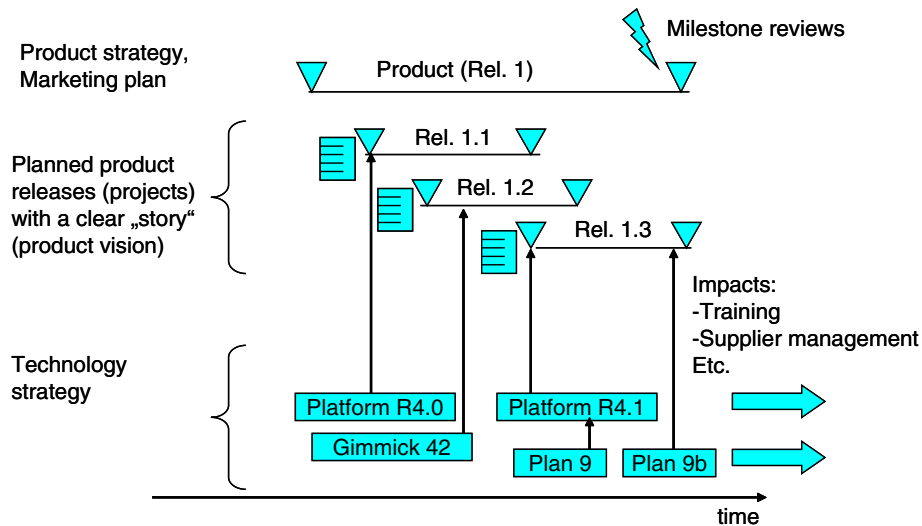


Fig. 6. Product strategy and roadmapping.

tunities are evaluated comprehensively in order to implement a coherent strategy. It is independent of the size of the enterprise.

4.4. Leadership and teamwork

Traditionally product management, marketing and project management co-existed and tried to individually influence requirements engineering and optimize locally to their ad-hoc needs. Different ways of setting and monitoring objectives (e.g., long-term versus short-term or sales versus profitability) plus heterogeneous terminology added to the obvious split between these disciplines. However, projects do not exist in isolation. Customers should come back for future projects. Strategies must be executed consistently. Therefore we underline that these three roles of product manager, marketing manager and (technical or contract) project manager must build a multifunctional core team fully accountable for the success of a product. They represent not only the major internal stakeholders in product or solution development, but also sufficiently represent the sales and customer perspective.

The leadership role clearly is with the product manager. He is empowered to set directions, while the others work with him to assure success. The product manager is a business owner in the small and accountable for both revenues and profitability, in the short-term (e.g., one project, one customer or contract) and in the long-term (e.g., one product-line or one program). The product core team must have a clear mandate to “own” the project. We found that if such a core team is available but underlying commitments are not baselined, it is of no value.

Collaboration in such diverse team is achieved by means of a stable process framework, which is the product life cycle (Cooper et al., 2004; Ebert and DeMan, 2005). The product life cycle must be mandatory for all projects. This implies that it is sufficiently agile to handle different types

of projects. Gate reviews with defined checks distinguish life-cycle phases. They must not result in lengthy meeting, but are rather prepared with online checklists so all attendees are prepared and can decide in short time the go/no go for next phase. Project information should generally be available online. On this basis the product manager can establish clear rules and focus his team on business-oriented decisions without getting lost in the “technical” details of marketing, engineering or operations.

4.5. The business case of product management

The cost and effort to strengthen the product manager role is rather small compared to these effects. We found during the three-year observation period a ROI of introducing and strengthening this role of over 20, because the value is big, while the investment is rather small. Value is measured in the mentioned results, such as better predictability and more stable commitments. Cost is primarily on training, role enforcement and continued communication as we do with e-learning, webinars, etc.

There are some pre-requisites during the introduction and shaping of the product manager role. They all center on *training and empowerment*:

- Define and agree the role in relationship to other functions, namely marketing, engineering and sales.
- Empower the product managers to own the product in a true business sense. This implies that they have the last word in agreeing feature content and roadmapping.
- Train the incumbents and new product managers on the role and its execution. Such training must be specific to SW- and IT- product management needs and tools.
- Give special emphasis on product life-cycle management, negotiation skills, business case and roadmapping. These are the typical weaknesses of product managers.

Is a described methodology with training and competence management sufficient to foster roles and responsibilities as we approached it in phase 1 of our transformation towards a stronger product management culture? It is clearly not sufficient, as several other scholars have noted. For instance, Baskerville (1992) has shown within projects “Methods are never practical as described, they are not used exactly as described.” Fitzgerald (1998) states that, “Methodologies are neither applied rigorously nor uniformly, even when training in their use has been provided.” It is clear that methods as we describe here to manage life-cycle processes and to achieve better uncertainty and risk management depend on culture and many other factors. They strengthen the product manager as a mini business owner and help him achieve this mission together with many other stakeholders. We could see over the three phases that our product management community started to shape, incumbents had a role model and the role was actively trained with an increasing amount of product managers being attracted to working more methodologically just because they faced the success of other business units that already started.

5. Conclusions

The impact of product management as a defined and institutionalized discipline has been evaluated. During a three-year period the introduction of product management was observed from the shaping of the role to its deployment and full usage. 178 projects of one business unit were analyzed in terms of product performance during this institutionalization process. The study showed that duration (time to market), schedule adherence and handover quality improve with strengthening of a coherent product management role. Explanatory factors for this positive impact of product management have been explained and coined into guidelines towards successful product management:

- Business objectives and accountability.
- Mastering requirements.
- Managing risks and uncertainty.
- Leadership and teamwork.

Why do these elements impact product performance? We performed a root cause analysis of projects which underperformed and found similar causes reappearing. One such aspect is the lack of a consistent story behind the product. If a product release is developed on the basis of “collected” requirements, it is in trouble because such requirements always change. Any product must address a need and must have a strong business vision. This vision (i.e., what will be different with the release of the product) must be coined into a story. The story then translates to business objectives and major requirements. Requirements and business objectives must be managed (planned, prioritized, agreed, monitored) to assure focus. Too often we

found that requirements would change continuously because no story and roadmap had been agreed with the stakeholders. If they only see a loose assembly of requirements they naturally pick out some and start changing. A good product manager masters his business case and the requirements, which means to plan, agree, and monitor. Cycle time immediately improves with a clear focus on the major requirements. Once the product manager drives according to the customers’ business case he will almost certainly reduce cycle time to deliver value.

There are risks and uncertainty, especially in very dynamic markets like ours. It is the product manager to anticipate risks and deal with uncertainty. Several techniques have been explained which of course depend on environmental constraints. A key success factor is to manage requirements with their underlying business case. Another root cause we found was the lack of commitment amongst stakeholders. We strongly recommend installing a product core team with product management, marketing (or sales) and engineering – lead by the product manager. They use the product life cycle and specific planning and tracking tools in order to assure visibility, agreement and commitment as a team. By doing so, they reduce requirements changes and together with strong project management in this team of empowered stakeholder representatives improve predictions, schedule performance and quality at handover.

With focus on product management techniques as explained in this article, cycle time in the business unit was reduced by 36% compared to the initial baseline. Delays and quality at handover improved by over 80%. The techniques are sufficiently generic and can be gradually introduced to product lines or business units, thus reducing the change impact (i.e., no big bang). Product managers and their product core teams (notably engineering and marketing) accepted the clarified and strengthened product management role because they see more effective and efficient work in their teams. In some cases the changes might mean sales or customer education, which is feasible given the benefits our customers will face with more predictability and faster reaction time.

Are the mentioned success factors of good product management complete? Certainly not. We still need to further explore and improve this essential role in the company. Further research should address questions such as:

- How to cross-fertilize the product- and market-perspectives in product management? How to evolve a single product perspective to a more global portfolio and value perspective?
- How to deal (or cope) with uncertainty, changing assumptions and unknown requirements?
- How to determine and optimize the duration from inception to break-even? What is “good enough” market analysis and “good enough” requirements?
- How do parameters such as market, project type, product age, variation of changes, architecture, technology,

platform alignment, culture influence overall product success?

- How to anticipate and foster disruptive innovations? How to better harvest research results in commercial products while minimizing the risk of following hypes.
- How to use knowledge management techniques to relate marketing, product and engineering assumptions?

What makes us sure of being on the right track are the related evidences from the “non-software” product management experiences and our own improved performance (e.g., cycle time, quality, schedule adherence). Feedback from the SW and IT product management community is positive. A first reference framework and related lessons learned were extensively discussed during the 2006 workshop on software product management (IWSPM, 2006). Product management is here to stay. It is not a proxy to arbitrate a variety of conflicting interests, but rather a key business role in the entire company – empowered to act as a business owner.

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