ISPMA

INTERNATIONAL
SOFTWARE PRODUCT MANAGEMENT
ASSOCIATION

SPM Syllabus
Excellence in Product Planning

V.2.0 Student Edition

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Preface

The goal of the International Software Product Management Association (ISPMA®) syllabus for "SPM Excellence in Product Planning" is to promote in-depth understanding of the *discipline of product management for software products* including the management of software parts of software-intensive products, i.e. systems or services, in the area of product planning.

This syllabus covers the full spectrum of elements of software product management related to product planning that are well supported by literature and industrial practice. The syllabus corresponds to a 3-day industry course.

The syllabus addresses the needs of people involved in software product management and helps them to address the needs of people they interface with, e.g. general management, marketing and sales, research and development, service and support, and controlling.

The syllabus is the basis for examination to certify that the examinee has achieved the degree of knowledge described in this syllabus. The terms used in this syllabus are consistent with the glossary of the ISPMA®.

Purpose and structure of the Syllabus:

The syllabus is the basis for consistent training, learning, and examination of software product management. It provides:

- Explicitly phrased educational objectives for each chapter, and
- Informal explanations to detail the educational objectives.
- Informal references to literature (without limiting the interpretation of the syllabus to this literature only).

This syllabus consists of ten chapters. Each chapter covers one major educational unit (EU). Each chapter also includes the duration suggested to teach it. Each educational unit has educational objectives (EO) that are enumerated following the chapter headers (EO1.1.1, EO1.2.1 …). An educational objective has a defined cognitive level of knowledge that the course participant is expected to achieve. The numbering scheme for these objectives is aligned with the chapter numbering.

The educational objectives are expressed in terms of three cognitive levels of knowledge phrased using the verbs "knowing" for level 1, "understanding" for level 2, and "applying" for level 3. These three verbs are placeholders for the following:

- L1 (know): enumerate, characterize, recognize, and name.
- L2 (understand): reflect, analyze, justify, describe, judge, display, complete, explain, elucidate, elicit, formulate, identify, interpret, reason, translate, distinguish, compare, understand, suggest, and summarize.
- L3 (apply): perform, execute, develop, and adapt.

Each EO in the syllabus has one of the three cognitive levels assigned to it.

In order to address L3 objectives, ISPMA®'s Excellence syllabi are designed to put special focus on exercises. It is the trainer's responsibility to select exercises and to define concrete realistic scenarios in which all the selected exercises can be performed by the participants. ISPMA® recommends to spend about 50% of the available time on exercises. In trainers' material, exercises are described in abstract terms.

Included and excluded key areas:

The syllabus covers knowledge applicable for any kind of software systems and organizational contexts. A training course may cover more domain-specific details if needed by the course participants. This syllabus, however, does not provide guidance for such specialization, rather describes the base knowledge necessary, which can be complemented with domain specific items.

The syllabus is independent of any specific process model, and thus defines knowledge of a software product manager without prescribing exact interfaces to other roles in a product organization.

Training Courses:

The syllabus corresponds to a three-day industry course. The syllabus does not prescribe the specific form and approach of learning, however. It can also be administered with other forms of teaching or learning, such as self-learning supplemented by coaching or courses at universities or universities of applied sciences.

Training providers are encouraged to tailor training courses to the participants, and to add examples and an appropriate realistic scenario for the exercises described in this syllabus so that participants get an opportunity to apply the training contents. A participant should carefully choose the training provider. A list of training providers can be found on the ISPMA® web site www.ispma.org.

Examination:

The syllabus is the basis for the examination for the ISPMA® certificate "ISPMA® Software Product Management Excellence in Product Planning". All chapters are relevant for the exam. The exam takes the following form:

- Demonstration of knowledge with a multiple-choice test

Multiple-choice tests can be held immediately after a training course, but also independently from courses (e.g. publicly announced exams of the examination authorities). A list of accredited examination authorities can be found on the ISPMA® web site www.ispma.org.

Course participant prerequisites:

The training and learning of the syllabus assumes general knowledge of, and some experience in, the management or development of software products or software in software-intensive systems.
The formal background of the course participant is not crucial (whether it be engineering or management), rather the level of experience is predominantly the factor associated with the prerequisites. A course participant should have the ISPMA® Foundation Certificate "ISPMA® Certified Software Product Manager" or at least three years of experience in software product management. However, this is a generic recommendation and might not be applicable for all situations or course participants.

Terminology

The term SPM is used as an abbreviation for Software Product Management. It represents the functional area of SPM and not the individual person.

This syllabus usually uses a gender-neutral form. In cases where the masculine form is used, this is done for readability reasons and represents any other gender as well.

The terms used in this syllabus are consistent with the glossary of the ISPMA® available at ispma.org.

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EU1 Product Planning in Context

Duration: 2:00h

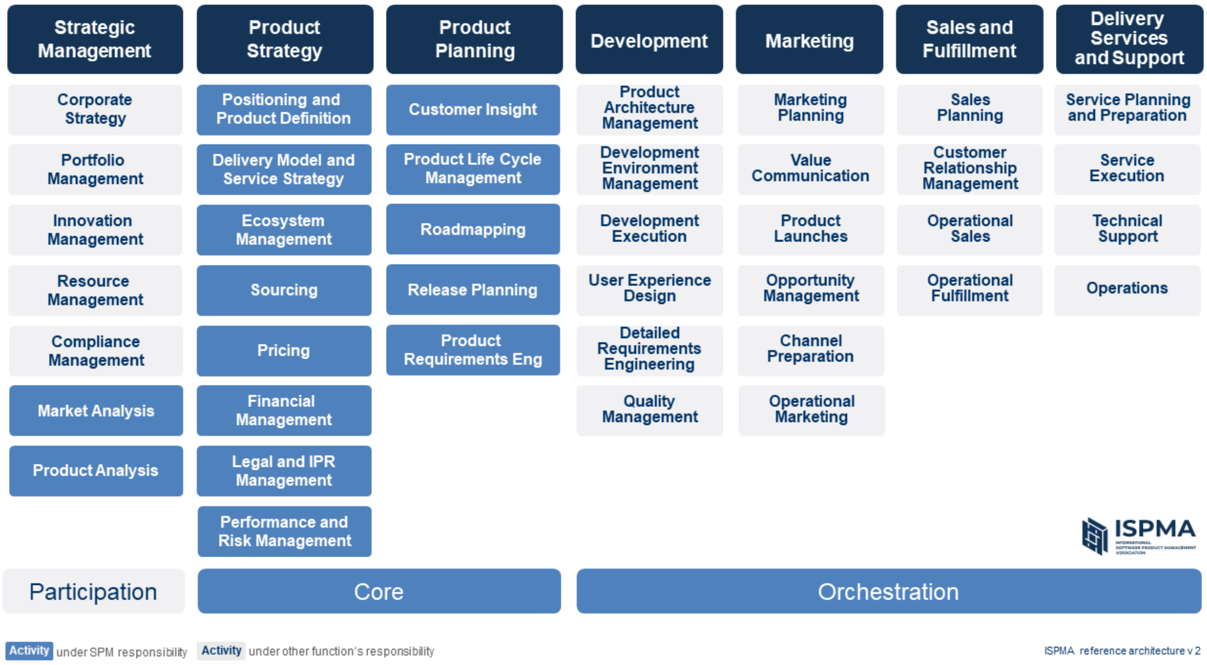
Educational Objectives:

EO1.1 Understand the role of product planning in operationalizing product vision and strategy

EO1.2 Be able to drive the implementation of product strategy and vision in the product planning process

EO1.3 Understand the relationship between product planning and orchestration

Product Planning encompasses Life Cycle Management, Roadmapping, Release Planning, and Requirements Engineering (see ISPMA's SPM Framework in Fig. 1).



Strategic Management	Product Strategy	Product Planning	Development	Marketing	Sales and Fulfillment	Delivery Services and Support
Corporate Strategy	Positioning and Product Definition	Customer Insight	Product Architecture Management	Marketing Planning	Sales Planning	Service Planning and Preparation
Portfolio Management	Delivery Model and Service Strategy	Product Life Cycle Management	Development Environment Management	Value Communication	Customer Relationship Management	Service Execution
Innovation Management	Ecosystem Management	Roadmapping	Development Execution	Product Launches	Operational Sales	Technical Support
Resource Management	Sourcing	Release Planning	User Experience Design	Opportunity Management	Operational Fulfillment	Operations
Compliance Management	Pricing	Product Requirements Eng	Detailed Requirements Engineering	Channel Preparation		
Market Analysis	Financial Management		Quality Management	Operational Marketing		
Product Analysis	Legal and IPR Management					
	Performance and Risk Management					
Participation	Core		Orchestration			

Activity under SPM responsibility Activity under other function's responsibility

ISPMA reference architecture v 2

Fig. 1 SPM Framework V.2.0

This framework reflects the artifact hierarchy of software products and their management:

1.	Portfolio	Portfolio Management (in Strategic Management)
2.	Product	Product Life Cycle Management + Roadmapping
3.	Release	Release Planning
4.	Requirement	Product Requirements Engineering

Product planning means developing a plan with associated actions for implementing the product vision and strategy and its execution. The time horizon and granularity of these activities go from strategic, coarse-grained (roadmap) to tactical, fine-grained (revitalization actions, individual product requirements). The vision describes what the future product will be, why it is needed, and why it will be successful. It helps to convince and engage the product's stakeholders to contribute to the success of the product, and it is a natural starting point for product strategy definition and execution. The product strategy documents decisions that turn the vision into a manageable and executable path into the future. Together, the product vision and strategy give direction. This syllabus assumes that a product vision and a product strategy have been created and can be used as an input to product planning (see ISPMA's Syllabus Excellence in Product Strategy).

The product strategy contains the elements below that are used by the product manager for product planning. Product strategy and product plan are interdependent and evolve as the product plan is elaborated and the product is developed, released, evolved, and maintained:

- Positioning and Product Definition
- Delivery model and Service Strategy
- Sourcing
- Pricing
- Financial Management
- Ecosystem Management
- Legal and IPR Management
- Performance and Risk Management

The roadmap is the bridge between product strategy and product planning. It shows the steps in which the strategy is intended to be implemented over the strategic timeframe. Product planning lays the basis for the implementation of the plan by the company. For a product manager, orchestration means ensuring that all relevant units within the company support and contribute to the product's success in the best possible way (see ISPMA's Syllabus Excellence in Orchestration). The contribution from development, marketing, sales, or services is needed for strategy, planning, and implementation (see Fig. 1).

Literature: *C. Alvarez (2014); M. Grath (2000); H.-B. Kittlaus (2022, p. 137 ff); G.A. Moore (2014); I. van de Weerd e.a. (2006)*

EU2 Product Planning Approaches + Scenarios

Duration: 2:00h

Educational Objectives:

EO2.1 Understand the role of product planning in operationalizing product vision and strategy

EO2.2 Be able to drive the implementation of product strategy and vision in the product planning process

EO2.3 Understand the relationship between product planning and orchestration

EO2.4 Understand the dependency of the product planning approach on the product scenario

The applicability of product planning approaches and techniques depends on the degree of vendor control of the runtime environment(s) in which instances of the product run, and on the product's life cycle phase.

Vendor-controlled means that the software vendor decides which changes to the software product are made when in the runtime environment, i.e. during execution. Vendor-controlled is typical for relatively unregulated environments like B2C internet platforms, and for SaaS or B2C license products and embedded software that offer automated maintenance over the internet. Customer-controlled means that customers want to supervise the runtime environment, often for quality or regulatory concerns. Customer-controlled is typical for B2B software license products, but can also be found with B2B SaaS, in particular when tied to business process outsourcing that is considered as business-critical. It also applies to software in embedded products where the customer decides if and when the product is given to the vendor or his partners for maintenance.

Software Product Scenarios		Life Cycle Phase	
		New Product Development	Existing Product Evolution
Runtime Environment	Vendor-Controlled	Powerboat	Speedboat
	Customer-Controlled	Icebreaker	Cruise Ship

Fig. 2 Software Product Scenarios (*H.-B. Kittlaus (2015)*)

With new product development ("Conception and Creation" phase in ISPMA's Foundation syllabus), there is a high level of uncertainty and risk. This situation encourages a fast release of a minimum viable product. Once the product is rolled out ("Market Introduction", "Growth", and "Maturity" phases), the focus shifts to extending the product scope and target market. Compatibility and migration aspects become relevant here. While roadmapping is important in all scenarios, release planning and product requirements engineering work differently in the four resulting scenarios (see Fig. 2) which we have chosen catchy names for:

- Powerboat – New products for vendor-controlled environments (such as Amazon before its initial launch): SPM focuses on defining the minimum viable product (MVP) for the first customers by evaluating the product idea. The definition of the MVP requires a close link with development for extensive prototyping.
- Speedboat – Evolved products for vendor-controlled environments (such as Google Docs): SPM focuses on extending the product scope and thereby increasing the target market. This scaling of the product requires ongoing analysis of the actual usage of the product, of the market, and of competition, e.g. by monitoring customer feedback and product use. The release frequency may be high, and updates to the software product tend to be automated.
- Icebreaker – New products for customer-controlled environments (such as Docker before its first release): SPM focuses on defining the minimum viable product for the first customers by analyzing the customers' business processes. A major SPM task ensures that requirements are sufficiently generalized so that the first release does not become too specific for a few customers only.
- Cruise ship – Evolved products for customer-controlled environments (such as the Oracle database): SPM focuses on extending the product scope and thereby increasing the target market. This scaling of the product requires ongoing analysis of requirements, market and competition, e.g. by directly collaborating with customers. Since customers do not want to test and install new releases often, the frequency of releases is rather low, often one or two per year.

Real-world situations may be of hybrid character. An organization may decide to offer both a licensed product and a SaaS product with a largely overlapping code base. Also, a product may consist of a cloud component and an on-premise component. In these hybrid scenarios, organizations often follow the different pure-scenario approaches in parallel for the different components but need to take care of resulting conflicts.

For a long time, the standard approach for software product planning and development used to be **requirements-driven**. This approach continues to be broadly used, for example for legal or regulatory requirements, commodity functionality requirements, and technology requirements. It is also applied in methods where hypotheses on customer needs, often referred to as "problems", and potential solutions are evaluated through qualitative and quantitative validation with customers, users and stakeholders. The requirements-driven approach is described in detail in ISPMA's SPM Foundation syllabus.

There is a second approach called **data-analysis-driven** where the product team experiments with different implementations of design and product concepts, and makes decisions based on the analysis of performance statistics or usage data. Data can also come from the (potential) user side covering how they behave in certain situations, or what their Jobs To Be Done (JTBD) are, or how much time they spend on what tasks. Such experimentation is a good approach when the focus is on innovation and optimization under uncertainty. A third approach is called **data-input-driven**. It applies to artificial intelligence/machine learning (ML) where data is used as input for an ML engine.

These three approaches are not mutually exclusive. In many real-world situations, it is recommended that they are used in parallel for different parts of a product and/or different types of requirements in order to achieve optimal results. For example, a software product may have three different components for which different approaches are most applicable:

Component	Most applicable approach
Back-end	Requirements-driven
Front-end	Data-analysis-driven
AI/ML	Data-input-driven

Tab. 1: Examples for most applicable product planning approach

Literature: *H.-B. Kittlaus (2022, p. 140 ff); H.-B. Kittlaus (2020)*

EU3 Customer Insight

Duration: 2:00h

EO3.1 Know typical activities how product managers can gather customer data
EO3.2 Be able so select adequate activities for given product questions
EO3.3 Understand the time management challenge for customer insight

The meaning of the term "Customer Insights" has evolved considerably in recent years. Typically, it is attributed to data analytics methods which are used by customer insight managers or data scientists.

The term "Customer Insights", as used in this syllabus, refers to a deep and always up-to-date understanding of customer context, problems, and their dynamics.

The term "customer" is used here for all types of customer-side stakeholders, like user, buyer, IT manager, owner, operator, etc.

Although data analytics methods are increasingly used by software product managers, experience shows that it is equally important to spend a significant amount of time in direct contact with customers to gain a deep understanding about their jobs to be done and the problems that arise.

Ideally, product managers are the subject matter experts for customer problems. This enables them to relate the product direction outlined in roadmaps to existing or upcoming customer problems. Basing product goals on customer data adds credibility for the product manager and therefore helps to get buy-in to the plans from the team.

The following list describes typical direct customer contact opportunities.

Customer visits: Product management should visit key customers on a regular basis. Such events can be organized by local sales or key account manager. During such visits, the product manager gains first-hand insights into the existing and changing use of the product. This helps to strengthen the product manager's empathy with the customer.

Meeting customers at conferences, workshops, and events: Conferences and events provide product managers with a cost-effective opportunity to speak with several select customers. No extra time or budget is required, as the customers are on site anyway.

Organizing customer round tables (focus groups): Selecting key customers who represent the target market for the product enables discussion and exchange of ideas about the product. Needs that only a few customers have are quickly identified. Product progress over the years can be reflected with representatives of the target segment. Focus groups are usually organized with representatives from marketing, sales, and product management.

Design sprints with customer participation: In agile development design sprints offer the opportunity to explore problems and solutions jointly with customers. This allows the customer not only to articulate their problems directly, but also to create a shared understanding of the customer's problem with the team. Care must be taken in selecting the customer representative, as this customer will have major influence on the product direction.

Supporting selected pre-sales activities: Since product managers are subject matter experts on the product, they are a sought after by Sales to support pre-sales activities. Product management can learn from these events about so called sales-inhibitors. E.g.: Which aspects of the product make it hard to sell? Which features are missing to close deals? Pre-Sales engagements are an essential tool for product management to understand the mental models of Sales and buyer personas.

Participating in support escalations: Support escalations are another opportunity for in-depth experiences with customers. Product management gains a deep understanding of current product use and personas that support the product. Such situations provide specific insight how a product supports analysis of problems and how customers can benefit from it through quick identification of a problem area.

Given the many opportunities to interact with customers, effective time management becomes an essential skill of good product management. Product managers should have a plan for how they will allocate their time for the various opportunities throughout the year.

In recent years, more and more customer insights are being gained through the use of **data analytics**. These are described in EU4 “The Data-Analysis-Driven Approach“.

A third category of customer insights gathering techniques are hybrid techniques. Three widely used techniques are:

Customer observation: Customers are observed working with the product. The focus is not only on the specific tasks performed with the product, but also which actions trigger these tasks and what happens before and after. Observations can be recorded on video to share with the product teams. Customer observation is usually carried out by UX specialists.

A/B testing: see “ The Data-Analysis-Driven Approach“ in EU4.

Launching a beta version or minimum viable product (MVP) for evaluation: Early product versions that may not be fully ready for release can be tested with selected customers. Product management is responsible for selecting the right customers, getting in touch with them and managing the beta or MVP contract terms. To achieve meaningful results, early access programs require substantial time commitments from product management. Customers must be notified in advance of the availability of the early access program. Scope and expectations about the test scenarios must be defined, and after a certain period of time, customers must be asked for feedback. Early access programs not only help to reduce risk of product defects, but also provide valuable first-hand insights about product use.

Literature: Alvarez, C. (2014); H.-B. Kittlaus (2022, p. 137 ff); Knapp, J., et al. (2016), Lombardo, T. (2017), Ries, E. (2011, Ch.1-4)

EU4 Product Planning Explained

Duration: 3:00h

Educational Objectives:

EO4.1 Understand the three product planning approaches and their differences
EO4.2 Understand the role of innovation and the Kano model in requirements engineering
EO4.3 Be able to apply the requirements-driven approach
EO4.4 Be able to apply the data-analysis-driven approach
EO4.5 Be able to apply the data-input-driven approach

In this chapter, the three product planning approaches introduced in EU2 are explained in more detail.

As stated in the Kano model, a product organization must not solely focus on stakeholder requirements; it also needs to bring innovative ideas into the product. Innovation requires the application of appropriate processes that help to prepare, incubate, illuminate, and verify the suggested ideas. Openness, dedicated time for idea generation, allowance to discuss or suggest risky ideas, and experimentation are among the key factors for establishing an environment that fosters innovation.

Innovation can apply to products, product features, quality, service, and process. Products have different degrees of innovation: from new-to-the-world pro ducts that are novel, useful, and surprising (radical innovations) to simple cost reductions or incremental improvements to existing features (incremental innovation). Highly innovative features can add substantial value to a product and differentiate it in competitive situations. On the other hand, radical innovations often require substantial investments and may not be warmly accepted by the customers.

So validation based on data is needed which is covered by the data-analysis-driven approach.

The Requirements-Driven Approach

Requirements engineering (RE) in a software product management context covers the classical requirements engineering activities, such as elicitation, analysis, selection, and validation, adapted to the market-driven situation with many often anonymous customers, competitors, and partners.

Product requirements do not only address the software itself, but all elements of the whole product offering including product-related services, terms and conditions, etc. They can come from a broad range of sources, i.e. not only customers. Nevertheless, it is more important than ever to get customer or user feedback during the elicitation and analysis phases. As described in ISPMA's SPM Foundation syllabus, we distinguish functional and quality requirements and constraints, and also stakeholder, product and detailed requirements. Functional requirements are often described as user stories.

To handle large numbers of product requirements, a process and corresponding tool support are needed. For tool support, see EU8 in this syllabus.

Product requirements engineering focuses on aspects which provide additional value for a larger group of existing or potential future customers and product-related stakeholders, whereas requirements engineering on the level of a bespoke development project focuses on an individual customer and the stakeholders of that solution. The focus on value is supported by approaches like the software value map (*M. Khurum, T. Gorschek, M. Wilson (2013)*). On the product level, market-driven requirements engineering that provides customer and market needs understanding is needed. Its key characteristics are the lack of an individual customer-supplier-relationship, a large number of continuously incoming requirements, the success of the product measured by market response rather than contract fulfillment, and the presence of competitors who generate pressure on long-term planning that integrates release planning, roadmapping and product strategies into the RE process.

Elicitation techniques based on Artificial Intelligence, in particular natural language processing and machine learning, are making the transition from research into practical application (see *F. Dalpiaz e.a. (2018)* and *T. Rietz (2021)*).

Requirements management applies tracing to manage requirements across stakeholder, product and detailed requirements and releases by documenting their change history, source, states, and rationale. In this way, requirements are analyzed only once, and changes are captured and correlated to the product versions, releases and variants. This enables requirements reuse and supports release planning and roadmapping as well as documentation in the form of release notes.

While techniques like workshops and interviews can be helpful for requirements engineering in all product scenarios (see Fig. 2 in EU1), there are some scenario-specific aspects:

Powerboat: Determining the minimum viable product (MVP) for the first customers requires intense cooperation with these first (potential) customers and users. Hands-on cooperation based on prototypes and iteration results from development is needed. Agile development supports this nicely with experimental requirements engineering being part of the agile team's work, usually with a data-analysis-driven approach.

Speedboat: The requirements-driven approach continues to be relevant, in particular for legal or regulatory requirements, commodity functionality requirements, and technology requirements. Other than that, the data-analysis-driven approach is typical for this scenario.

Icebreaker: Determining the minimum viable product requires extensive domain analysis with potential customers. Joint business process analysis may be applied. If regulatory requirements are relevant, early in-depth analysis is needed. The product manager needs to ensure that the resulting product requirements are not too customer-specific, but relevant to the complete initial target market. The degree of involvement of the development team in requirements engineering depends on the chosen development methodology.

Cruise ship: Problem reports and stakeholder requirements are valuable inputs. Release contents are a key to success. So release planning is important and it needs to be supported by product requirements engineering providing analysis results as a basis for decision making.

Literature: *H.-B. Kittlaus (2022, p. 141 ff); C. Alvarez (2014); S. Blank (2013); J. Cleland-Huang, R. Settimi, E. Romanova, B. Berenbach, S. Clark (2007); A. Croll, B. Yoskovitz (2013); J. Fagerberg (2005); T. Gorschek, S. Fricker, K. Palm, S. Kunsman (2010); N. Kano e.a. (1984); M. Khurum, T. Gorschek, M. Wilson (2013); G. Lucassen e.a. (2016); N. Maiden, A. Gizikis, S. Robertson (2004); K. Pohl, C. Rupp, (2011); B. Regnell, S. Brinkkemper (2005); K. Ulrich, S. Eppinger (2011); Q. Xu, R. Jiao, X. Yang, M. Helander, H. Khalid, A. Opperud (2009); D. Zowghi, C. Coulin (2005)*

The Data-Analysis-Driven Approach

Insight into how users work with the software product has always been of utmost interest to product managers. However, with the on-premise delivery model of license products, customers – in particular enterprise customers – have been reluctant to give vendors access to their runtime environments. So user-specific measurements and tracking of behaviour in the runtime environment has usually not been an option. Some vendors tried to do something similar internally, e.g. in usability labs with test users, but that could never really fully mirror real-world customer usage.

This situation changed with the SaaS/PaaS delivery model where the vendor is in control of the runtime environment. In this Speedboat scenario, the vendor has a plethora of options – except for some legal restrictions with regard to personal data – to measure and track usage. A lot of data can be generated and analyzed on a continuous basis to answer detailed questions, e.g.

a. which code paths are most heavily used and offer the strongest leverage with regard to improvements of technical performance,
b. which parts of the code are hardly used, may stand for functionalities that users are not interested in, and may be candidates for code reduction,
c. where do users spend a lot of time in a workflow which may be an indication for a usability problem.

Data can also be used to decide what to build and what not to build. This is known as **continuous product or customer discovery** (*Torres 2021*). One frequently used technique is **A/B testing**, an approach based on experimentation to find out which of two or more alternative implementations works best, e.g. which design of a web page results in the highest conversion rate on an e-commerce platform. A/B testing works like this:

Design:

1. What is the hypothesis that we want to verify / falsify?

2. Which measurable key indicator(s) can be used to do that?

3. What are the statistical requirements, e.g. sample size etc.?

4. Is our software + infrastructure prepared for these measurements? Can we get access to the measured data? Are there any legal restrictions?

Implementation:

5. Preparation of software + infrastructure + data access (if required) + legal clearance (if required)

6. Execution

7. Data analysis

8. Conclusion

An example for a hypothesis and a measurable key indicator is: New implementation B improves conversion rate by 20% compared to current implementation A on an e-commerce platform.

The design and execution of these experiments is usually done by product owners who need to have good skills in the area of statistics. Often there is a trade-off between statistical validity and time-to-conclusion (*S.H. Thomke (2020)*).

This approach helps with "local optimization" but does not replace product strategy which is the product manager's responsibility.

Additional data-analysis-driven techniques are:

- Monitoring online reports of market research agencies, reviews, tweets, blogs and trade press for customer information
- Using data analytics software that retrieves information about customer behaviour throughout the internet

Literature: *H.-B. Kittlaus (2022, p. 155 ff); W. Maalej e.a. (2015); M. Nayebi, H. Cho, G. Ruhe (2018); M. Nayebi, G. Ruhe (2015); S.H. Thomke (2020); T. Torres (2021)*

The Data-Input-Driven Approach

While a lot of artificial intelligence (AI) technologies continue to be research topics, progress in the area of machine learning (ML) has recently been so significant that components based on ML are more and more frequently included in standard software products. The most common approach uses an ML engine, which is the software implementation of a neural network, in combination with domain-specific data structures. When corresponding data which describes outputs to particular inputs is used as input into the ML engine, the neural network goes through a learning process. The combination of inputs and outputs can come from

- human labeling or tagging, e.g. with image recognition,
- real world data, e.g. with credit defaults.

Thereby the outputs of the ML engine to particular inputs are getting "better" over time, i.e. the accuracy rate increases. This approach has proven to be powerful in a lot of application areas from chatbots and image recognition to credit default prediction and automated driving.

A product manager whose product includes such an ML-based component needs to deal with the situation that the functionality of this component is no longer exclusively implemented in software code but emerges from feeding data into the engine. Organizations usually introduce a new role called data scientist in these situations. Data scientists are experts in statistics, data quality, data modeling, and data cleansing. Organizationally they can be close to product management, development, or in a unit of their own. In any case, the product manager needs to work closely with the data scientist who is – at least initially – not a domain expert, not experienced in acquiring relevant data or getting legal clearance for this data. The data scientist needs to learn about these aspects, but the responsibility for these tasks is typically with the product manager who needs to have a basic understanding of the AI technology used, its data requirements and its possibilities and impossibilities.

The product manager must make sure that the focus is on the customers and their business problems, not primarily on the technology. This includes the definition of personas and use cases. Care must be taken in defining the input training data. Product managers are responsible that all types of customers are adequately represented and no minorities are excluded. The data-input-driven approach is dependent on the application area. In some areas, in particular with a broad spectrum of consumers, data-pooling can work, i.e. the use of input data from different sources. In other areas that are very customer-specific, only data from the individual customer can be used as input for the learning process. In the latter case, the product needs to provide an easy-to-use interface that enables the customer to feed the system with his data on a regular basis.

Vendors tend to use a classic release concept for the standard product that includes the ML engine, software code around it, the data structures, and the generic data model inside the engine if applicable. In the early phase of an ML-based product, vendors usually work with an MVP (Minimum Viable Product) approach (see above). This works best when the first customers have some “skin in the game”, i.e. pay for the value that they get from the product.

Literature: *H.-B. Kittlaus (2022, p. 156 ff); A. Burkov (2020); ISTQB® (2021)*

EU5 Product Release Management

Duration: 3:00h

Educational Objectives:

EO5.1	Understand the different release approaches in different scenarios
EO5.2	Know the generic release planning process
EO5.3	Understand criteria for requirements prioritization
EO5.4	Be able to apply methods for requirements prioritization
EO5.5	Be able to apply visualization of prioritization results analysis

In the customer-controlled scenarios, the release frequency is relatively low, usually two to four releases per year. Each release provides significant changes, i.e. new or changed code. This requires release planning in order to define the content and schedule of one forthcoming product release so that the product value is maximized over its life cycle, and the changes are aligned. The software product manager needs to make sure that the release plan is in sync with the product roadmap and matches the organization’s capability for delivery. Release planning may be carried out for several versions of the product in parallel.

Usually, the development resources are not sufficient to implement all the identified requirements for the product. Therefore, product requirements need to be prioritized to determine which ones will be delivered in the forthcoming release. Requirements prioritization is the focal point of release planning decisions as it allows focusing on the most important functional or quality requirements and their timely delivery to the potential customers.

For market-driven companies, prioritizing requirements is challenging because of the number of candidate requirements suggested and a lack of direct customers to validate the importance of those requirements. Thus, balancing market pull and technology push as well as resolving conflicts between Marketing and Development becomes an integral part of requirements prioritization negotiations (*B. Regnell, S. Brinkkemper (2005)*).

In vendor-controlled scenarios, the release frequency is usually much higher. Product functionality is delivered often and in small increments. In these scenarios, an agile methodology is frequently applied, often combined with continuous deployment and a DevOps approach. A small number of items from the backlog are selected by the team, implemented, and deployed. Each increment delivers some value to the customers that can be evaluated. The feedback after each increment helps to maximize the customer value and satisfaction. Vendor-controlled environments enable product managers to experiment and apply a data-analysis-driven approach (see chapter 2). More systematic release planning is only used for larger requirements that need changes in different parts of the code with dependencies, or span teams or delivery cycles. Techniques how to address these issues are described in the methods for large-scale agile development, e.g. SAFe (*R. Knaster, D. Leffingwell (2020)*).

An explicit generic release planning process includes the following steps (*G. Ruhe, M. Saliu (2005); Amandeep, G. Ruhe, M. Stanford (2004); G. Ruhe (2010); M. Svahnberg e.a. (2010)*):

1. Understand the product and organizational environment
2. Understand the parameters of the development
3. Understand product life cycle dependencies that influence release decisions
4. Prepare release planning
5. Execute release planning by generating, evaluating, and negotiating possible release plans, and making decisions
6. Analyze and reflect on the release planning experience
7. Package the experience and the results to make the experience available to others

Regarding steps 1, 2 and 3, a solid understanding of the product and organizational environments helps the product manager in the execution of the release planning process. Knowing the parameters of development regarding stakeholders, requirements, preferences, constraints, and, in particular, cost constraints streamlines the release planning process.

Before the actual release planning process begins, product managers must make provisions: Appropriate information systems have to be selected, and stakeholder workshops need to be planned.

The execution of the release planning process is typically iterative and involves discussions and negotiations among various stakeholders, including in most cases SPMs, requirements analysts, engineering and management.

Depending on the product's life cycle phase, the release planning process varies. In the early product life cycle phases, release planning is characterized by a high degree of uncertainty. The product is not yet completely shaped, and product use cases are evolving. Release planning focuses, therefore, on the most valuable requirements that are needed next by customers to enable product success. A prominent technique to pursue this goal is minimum viable product (MVP). According to Eric Ries, an MVP "*is that version of a new product which allows a team to collect the maximum amount of validated learning about customers with the least effort.*" (*Ries (2009)*) MVP allows stakeholders to focus on a reduced market segment initially and expand later on.

Once products reach the maturity phase, release planning no longer focuses on new functional requirements. Typical requirement categories considered then are requirements dealing with changing environments, UX optimization, performance and reliability requirements. As the product architecture and constraints are well-known, requirements can be estimated more precisely than in earlier phases, leading to improved release planning outcomes.

For products approaching the end of their life cycle, release planning focuses on requirements to retain customers with minimal investment. Large and disruptive changes should be directed towards a replacement product so that user are not disturbed in their habits (*K. Hoffman, K. Wnuk and D. Callele (2014)*).

Depending on the product and organizational environments, specific criteria are used for driving release planning decisions. Business criteria are based on the product strategy and include marketing concerns, e.g. release themes and dates, competitive situation, Kano criteria, stakeholder priorities, and requirements volatility. Management criteria include development cost/value, risk, resources and competencies, delivery date and calendar time in relation to the roadmap, and support for education and training. System criteria include system impact, complexity, requirements dependencies, evolution, and maintenance. Requirements dependencies increase the complexity of release planning and require additional analysis to be performed, e.g. if a dependent requirement is removed from the release what would be the impact on the dependent requirements. A good release plan balances the most important criteria in a way that is accepted by the product stakeholders (*C. Wohlin, A. Aurum (2005), M. Cohn (2006)*).

Several requirements prioritization techniques are available. They range from simple methods requiring almost no prerequisites to more advanced techniques, which require detailed upfront estimations about multiple prioritization criteria. Simple requirements prioritization techniques include selecting the top ten, ranking (e.g. into three groups with high medium or low priority), or distributing 100 dollars among the candidate requirements (also called cumulative voting). Selecting the top ten requirements and ranking are considered easy but have coarse granularity. The 100 dollars test is considered to provide finer granularity. These methods do not require estimating the absolute cost and value of the prioritized features. Requirements can be prioritized on multiple criteria. Requirements prioritization differs greatly between companies and their development models.

For companies utilizing agile methodologies, requirements prioritization is an iterative process that helps to know the most urgent requirements or features to be developed in the next short development cycle. As a result, agile development uses frequent and iterative requirements prioritization as a method to adjust to the rapidly changing market situation and customer needs. Before each development iteration, the requirements backlog is re-prioritized, and new items are inserted based on their estimated priorities.

Collaborative prioritization methods with active participation of key stakeholders are usually more efficient and trustworthy than analytical methods. A prominent example of the agile techniques is called “Planning game.”

The results of the prioritization can be visualized in a two-dimensional space(see Fig. 3). The features (dots) placed in the upper left triangle represent the best tradeoff between cost and benefit. Other visualization methods for showing the prioritization results include simple or cumulative bar diagrams of relative priorities according to given criteria, and stakeholder satisfaction or disagreement charts (*B. Regnell (2001)*).

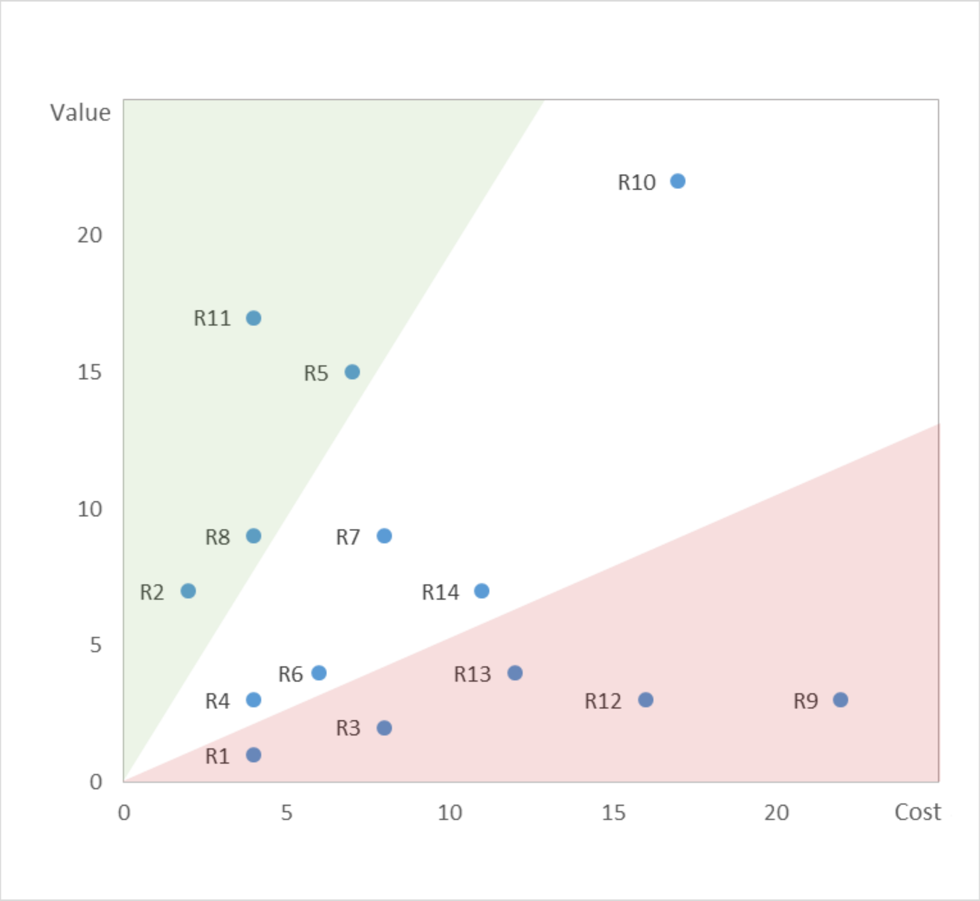


Fig. 3: Cost value prioritization results visualized on a two-dimensional space

Pareto analysis is a technique to match the most important requirements for the given delivery capacity. The technique is based on the 80:20 Pareto principle that 20% of the work will generate 80% of the results. The top 20% of the analyzed requirements are selected (*H. Raiffa, J. Richardson, D. Metcalfe (2007)*). Davis recommends starting development with a requirements baseline that represents 60% of the capacity available in development.

Results from release planning are documented in a release plan that all stakeholders have to agree to. Minimal elements of a release plan include release dates, resource assumptions, and selected requirements. Depending on the type of business, varying degrees of details regarding the requirements specification are required. The range starts at one-liners in requirements backlogs of agile teams to fully elaborated functional specifications in controlled environments.

Tool support for release planning is highly recommended, especially for large releases with hundreds of features and many decision iterations. Currently available tools offer functionalities beyond simple data storage, e.g. visualization and what-if-analysis.

Frequently, part of the product manager’s release responsibility is the final release decision, i.e. if the new release is ready for making it available to customers. There are a number of criteria relevant for this decision (*D. Al-Alam e.a. (2017)*) with the value of new functionality and achieved quality being the most important.

Literature: *H.-B. Kittlaus (2022, p. 169 ff); D. Al-Alam e.a. (2017); L. Bass e.a. (2015); P. Berander, A. Andrews (2005); M. Cohn (2006); A. Davis (2005); N. Forsgren e.a. (2018); D. Greer, G. Ruhe (2003); N. Kano e.a. (1984); C. Larman, B. Vodde (2010); H. Raiffa, J. Richardson, D. Metcalfe (2007); B. Regnell, M. Höst, J. Natt och Dag, P. Beremark, T. Hjelm (2001); E. Ries (2009); G. Ruhe (2010); G. Ruhe, M. Saliu (2005); J. Shore (2007); M. Svahnberg, T. Gorschek, R. Feldt, R. Torkar, S. Saleem, and S. MU (2010); L. Thompson (2005); C. Wohlin, A. Aurum (2005); D. Zacarias (2019)*

EU6 Product Roadmapping

Duration: 2:00h

Educational Objectives:
EO6.1 Understand the role of roadmaps for operationalizing product strategy
EO6.2 Understand elements, structures, and forms of software product roadmaps
EO6.3 Understand how to develop and obtain support for a roadmap
EO6.4 Be able to perform a roadmapping workshop

A roadmap is a plan to guide the work of a team towards the fulfillment of a goal. The term has its origins in automotive travel and has found increased acceptance in areas such as science, technology, industry, and business planning. In the software industry, strategic roadmaps are used to plan the upcoming software releases within the strategic timeframe, which can be between one and five years (*Lehtola (2009)*). When used by a company, the roadmap describes the company's intentions and assumptions of how the future will evolve (*Kostoff (2001)*). It is usually presented graphically to illustrate dependencies between its parts (*Phaal (2004)*).

In software product management, a roadmap is a plan for realizing a product vision according to the product strategy. As such, a roadmap is a tool for discussing and communicating the product vision and strategy. The roadmap is at a level of detail that the collaborating corporate functions understand how they contribute towards the implementation of the product vision and strategy. Short-term outcomes are planned in much more specific terms and with higher reliability than long-term outcomes. Product roadmapping enables top-down planning and coordination in addition to bottom-up iteration and learning.

In addition to planning, the most important uses of a roadmap within a product organization are:

- Alignment of company functions with the product vision and the strategy.
- Scheduling of multiple development projects or activities related to a portfolio of products, a series of product versions, or alternative product variants.
- Management of dependencies on technologies that are to be developed or procured, so that they can be used for development of the product.
- Transfer of product knowledge for marketing, sales, and other company functions that need to adapt their activities as product versions are released.

The roadmap operationalizes the product strategy by identifying the capabilities the product organization will deliver. A roadmap becomes an important tool when the product has been aligned with the needs of first customers and extensions and changes are planned for evolving that product. New product versions will be developed by product development. Components, platforms, services, and other technologies will be delivered by research or development and used as an input to product development. Other activities will be executed by marketing, sales, or other company functions and will use the results of product development.

A product roadmap defines the scope of planned releases and sets expectations for release dates. Drivers for software releases include:

- Market opportunities: customer needs that the product company can convert into substantial revenue and can defend against competitors. External stakeholders and partners will need to be able to consume the product changes.
- Threats: competitor moves, technology changes, and new alternatives for satisfying customer needs that threaten a product company's market share or revenue.
- Improvements: user experience and other quality improvements, reliability and performance improvements, security enhancements, and bug fixes. Bug fixes may have been explicitly requested by customers or may have been discovered by the product company's staff.
- Cost reduction: changes to platforms, components, and services that enable future development work.
- Revenue generation: for example, in the case of a one-time charge pricing model, customers pay upon product upgrades.
- Change of regulations: changes of regulations must be implemented for becoming or remaining authorized to offer the concerned products and services.

The schedules will be aligned with events expected to happen in the product organization's environment. Such events may be fairs or conferences where the product is presented or launches of competitors' products. Also, the resources available to the product organization, e.g. the developers that can be assigned for product development, will constrain the development velocity and the features that can be implemented.

A variety of graphical representations for product roadmaps has been developed. The variants account for the many ways product roadmaps are used. Examples include (*Phaal (2004)*):

- Bar roadmaps are used to specify expected technology evolution. Each row indicates states how technologies will evolve for a given technology domain.
- Trees are used to specify alternative options for product development. The branches and leafs state possible product variants or features.
- S-curves are used to specify series of product successions. For a given technology or platform, each s-curve states the relative timing and performance of product releases.
- Layers are used to specify series of interdependent development activities.

A layered product roadmap that is used for product planning consists of two axes (*Phaal (2004)*). The horizontal axis indicates the time and covers the strategic timeframe. For software products with frequent releases, this time frame is up to one year (*Lehtola (2009)*). Products with hardware elements often use longer time frames (*Groenveld (1997)*). The vertical axis refers to the organizational units that collaborate for achieving the product vision. Additional layers that may be used for product planning are scenarios for product use, development capacity, and availability of expertise (*Fricker (2012)*).

In vendor-controlled scenarios with the Agile and DevOps approaches, the cycle times from stakeholder requirements to deployed application features are shortened. In such an environment, the product manager is managing a portfolio of potential product features that are prototyped, exposed to selected customers, and evaluated to decide about maturation and inclusion of the feature into the product for all customers, respectively removal of the feature candidate. Here, the term "roadmap" is often used in the sense of a shorter-term development plan which is under Development's responsibility.

Roadmaps need the support of the organization to be effective. That support can be gained by co-creation of the roadmap in a workshop with the stakeholders who are responsible for the development work and events stated in the roadmap. Such a workshop includes the following steps (*Phaal (2007)*):

1) Share strategic landscape: each stakeholder presents its perspective, captures these and other relevant information on a roadmap wall chart, and sets priorities.
2) Identify innovation opportunities: together, the stakeholders identify and prioritize opportunities for creating efficient approaches to satisfy existing and future needs and for exploiting capabilities that are developed over time.
3) Explore priorities: the meeting participants explore ways forward to implement vision and strategy of the various concerned functional units of the organization. The timing of actions will be aligned with customer events, fairs, dependencies among product releases, the corporate heartbeat used for synchronizing product and system releases, and the availability of skills and resources.
4) Review and agree on the plan: the meeting participants review the roadmap and prepare the detailed planning and launch of imminent development activities.

A roadmapping workshop will lead to an understanding of context, objectives, activities, and dependencies that is shared among the concerned company functions. For the product manager, this shared understanding is critical to know that the organization supports the product development and evolution plans. When evolving a product, the roadmap is a useful tool for coordinating the activities that are launched. To account for the many events and surprises that emerge as the roadmap is implemented, the roadmapping process is regularly repeated.

In addition to the internal use for planning and coordination, roadmaps are used for communicating to stakeholders outside the product organization and company. Such sharing of a roadmap may be integrated into marketing communications. The sharing allows external stakeholders to understand the product vision and strategy and the approach initiated to implement the vision and strategy. The stakeholders' reactions are an input for validating the contents and messaging of the roadmap. Hence, an external roadmap is a tool to elicit feedback for the planned product development and evolution.

External roadmaps also play an important role in demonstrating the viability of a product. They are used to build trust in the commitment of the company to continuous long-term investment in the product. Influential customers or partners may want to see a product roadmap, against signing non-disclosure agreements, before they make a significant investment decision or decide about continued cooperation. Similarly, press and market analysts base their judgment of where the company is heading on a convincing story about a product's future, which is expressed in the roadmap.

Literature: *H.-B. Kittlaus (2022, p. 184 ff); S. Fricker, S. Schumacher (2012); P. Groenveld (1997); R. Kostoff, R. Schaller (2001); L. Loehtola, M. Kauppinen, J. Vähäniitty, M. Komssi (2009); R. Phaal, C. Farrukh, D. Probert (2004); R. Phaal, C. Farrukh, D. Probert (2007)*

EU7 Product Life Cycle Management

Duration: 2:00h

Educational Objectives:
EO7.1 Know the product life cycle
EO7.2 Know the category life cycle
EO7.3 Understand product planning options in the context of the product/category life cycle constellations

Product Life Cycle

A software product evolves over a series of phases. Each life cycle phase offers a distinct set of options for evolving the product. For example, common options are extensions of the product with new features, integration of the product with partner products, or additional product services. A product manager needs to select the right options to achieve the right business results. Also, each life cycle phase is associated with a set of leading stakeholders that influence the product and need to be considered for product planning.

Overall, a product moves through six life cycle phases. Typically, the first three phases are investment phases. Products in later phases serve as cash cows for a company. However, agile approaches combined with a minimal viable product strategy may yield a faster return on investment by generating cash flow much earlier.

Business outcome	Phase
Investment	Conception and creation
	Market Introduction
	Growth
Cash Cow	Maturity
	Decline
	Withdrawal

Tab. 2: Product Life Cycle Phases

Product management must have a solid understanding of the various life cycle phases to develop strategies and activities that optimally support a product in a specific phase. Data from product analysis and market analysis will be used to determine the current product life cycle phase. Challenging decisions are required when moving from one phase to another. For example, within the decline phase, a product manager might decide to move support services to a low-cost country. Methods that worked well have to be changed to prepare for the next phase. This change often creates irritation and resistance within an organization.

Category Life Cycle

According to Moore, a category is a way that customers classify what they are buying and distinguish it from other purchasing choices. A category has its life cycle, which is independent of the life cycle of an individual product. Fig. 4 provides an overview (*G. A. Moore (2005)*). The category life cycle phase affects the individual product life cycle.

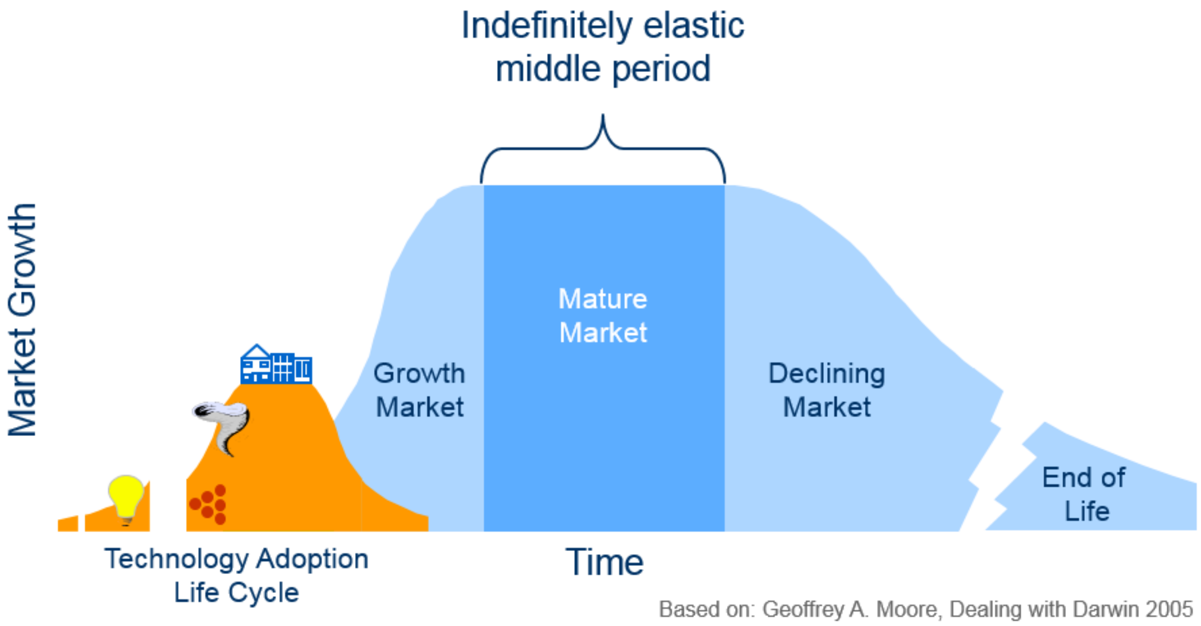

Indefinitely elastic middle period
Market Growth
Mature Market
Growth Market
Declining Market
End of Life
Technology Adoption Life Cycle
Time
Based on: Geoffrey A. Moore, Dealing with Darwin 2005

Fig. 4: Category Life Cycle

The technology adoption phase describes a market that starts to exist. Disruptive technologies appear in the market and define a new category. Early adopters are willing to experiment with the new technology. If the products fail to meet the expectations, the category will cease to exist.
If the products succeed to meet expectations, the market category will grow. A category that is in its growth phase typically shows double-digit growth rates year over year. An example for such a growth rate is Edge Computing. Mature market phases may last for decades. The declining market phase is characterized by replacement technology of a new market category that takes away market share from the existing category. A product market category is at end-of-life when a new disruptive technology has replaced an existing product category.

Product Planning Options

A product manager has to understand to which category his product belongs and in which phase this category currently is to pick the appropriate options for product planning. In combination with the product life cycle phase, this information will influence product planning.

Managing products within the “technology adoption” phase involves not only intense communication with early adopters, but also development and deployment approaches that allow rapid evolution of the product. Such a product planning option is facilitated by the Powerboat scenario. A product manager in the Icebreaker scenario should also strive to find ways to evolve and adapt the product to market needs. Alternatively, a product manager should evaluate whether and how the Icebreaker approach may be switched to a Powerboat approach.

Creating a new product for a mature market requires the selection of approaches to take away market share from existing products. The options correspond to the following four types of incremental innovation (*G.A. Moore (2005*)):

- **Product line extension** broadens the product offering by specialization. Variants of the product are created which target specific businesses and provide a better fit for that group.
- **Enhancement innovation** optimizes the product offering from a user experience perspective. Product features of this innovation type do not change the core product, but optimize existing features.
- **Marketing innovation** positions the more or less unchanged product for new markets.
- **Experiential innovation** modifies the customer's end-to-end experience from initial encounter to ultimate disposition.

Marketing and experiential innovation do not require changes to the core product. These innovation types give innovation options to the product manager that are independent of development resources.

The interplay between product life cycle and market category life cycle depends largely on the strategic planning within an organization. Based on portfolio considerations there may be situations where strategic planning decides to move a product to its end-of-life phase, even if the product is still in its growth phase.

Literature: *H.-B. Kittlaus (2022, p. 195 ff); V.T. Rajlich, K.H. Bennett (2000); D. Kolb (2014); G. A. Moore (2014); G. A. Moore (2005); Fotrousi, F., Fricker, S. (2016)*

EU8 Process Management for Product Planning

Duration: 2:00h

Educational Objectives:

EO8.1	Understand how to improve the planning processes of a software organization
EO8.2	Understand the role of tools to support the planning processes of a software organization

Various benchmarking frameworks have been developed for setting an agenda that guides the development and improvement of product management practice in an organization. Well-known published frameworks are the Software Product Management Framework by Kittlaus (*H.-B. Kittlaus, P. Clough (2009)*) and by Ebert (*Ebert (2009)*). Both frameworks cover the full life cycle from the strategy-oriented market and product analysis to product planning, development, marketing, orchestration, and evolution. Similarly, the ISPMA SPM Framework (Fig. 1), which is derived from these frameworks, can be used to obtain comparable guidance. The frameworks have been used for guiding in process improvement (*Ebert (2007)*).

A framework that focuses on product planning is the Software Product Management Competence model (*Bekkers (2010)*). The framework recommends 68 practices for portfolio management, roadmapping, release planning, and requirements management areas that are performed in collaboration with external and internal stakeholders. Within each area, the practices have been ordered to allow an organization to increase its maturity incrementally and where improvements are most important. The framework has become an important tool for a substantial number of companies to steer their process development for product planning.

The performance of product planning can be measured in terms of process and outcomes. Common process measurements are the size of the product backlog or the number of pending product requirements, the average and peak durations for requirements to be decided upon, time and money spent on product planning, and confidence in the product planning decisions. Changes in the number of pending product requirements and duration required for requirements decisions can be used to identify bottlenecks or overcapacity in the product organization (*Petersen (2010)*). Common confidence issues concern the linkage of requirements with business strategy, seeing the big picture of the offering, understanding of the planned product’s value, and knowledge of customer problems are present (*Komssi (2015)*).

The OKR approach (Objectives and Key Results) was made popular by Intel and Google and is focused on outcomes (*Doerr (2018*)). Outcome measurements include those related to product development, such as planning accuracy (*Herrmann (2008*)), and those related to how well requirement cost and value were predicted during the release decisions (*Karlsson (2006*)). A root-cause analysis of the major deviations between prediction and realized results should be used for guiding the future product planning decisions. Examples of causes that lead to deviations are under-estimation of development effort, orders issued by a specific customer, actions from competitors, or the lack of availability of a good solution to a design problem.

The tool landscape for Product Planning is rapidly evolving. Important for the product organization is that the tools support their users, integrate into the organization's toolchain, and yield productivity improvements. The following gives an overview of important tool categories:

- Office tools: documentation of ideas and decisions, visualization of concepts, and communication with stakeholders. Examples are word processors, presentation tools, e-mail, and messengers.
- Planning tools: direct support for planning tasks like roadmapping, release planning, and requirements engineering.
- Experimentation Tools: direct support for design and execution of experiments in the runtime environment including statistics.
- Modeling tools: informal structuring and analysis of data, information, and knowledge. Examples are mind mapping and roadmapping tools.
- Tracking tools: enactment of workflows. Examples are spreadsheets and requirements or backlog management tools.
- Prototyping tools: design of wireframes and other approximations of a product. Examples are GUI design tools.

In a recent study, McKinsey (*S. Srivastava, K. Trehan, D. Wagle, J. Wang (2020)*) proved the significant positive impact of product planning tools on “developer velocity” and business performance of an organization. However, tooling requires good preparation. A systematic tooling process investigates the problem to be addressed, identifies available tools to address the problem, evaluates tool candidates with adequate selection criteria, checks the feasibility of implementing the target processes by prototyping the tool with representative data, and checks acceptance of the tool in daily practices with a pilot. Only then a tool should be rolled-out organization-wide (*Gorschek (2006)*).

Literature: *W. Bekkers, I. van de Weerd (2010); C. Ebert (2007); C. Ebert (2009); T. Gorschek, C. Wohlin, P. Garre, P., S. Larsson (2006); A. Herrmann, M. Daneva (2008); L. Karlsson, B. Regnell, T. Thelin (2006); H.-B. Kittlaus (2022, p. 204 ff); D. Kolb (2014); M. Komssi, M. Kauppinen, H. Töhönen, L. Lehtola, A. Davis (2015); K. Petersen, C. Wohlin (2010); S. Srivastava, K. Trehan, D. Wagle, J. Wang (2020); E. Wenger, W. Snyder (2000)*

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