Araştırma Makalesi / Research Article

# Ürün Yönetimi için Bilişim Sistemi Altyapısı

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| MAKALE BİLGİSİ | ÖZET |
|---|---|
| | Ürün Yönetimi, ürün yaşam döngüsünün tüm paydaşları tarafından yürütülmesi ve takibinin kolay bir şekilde sağlanabilmesi için kapsamlı bir bilgi yönetim sistemine ihtiyaç duyan bir alandır. Entegre bir sistem altyapısının kullanılması, ürünün başlangıcından sonlandırılmasına kadar tüm ürün ekibi paydaşları için işbirliğine dayalı bir geliştirme ve yönetim platformu sağlayabilir. Makalemizde ilk olarak; ürün yönetimi yaklaşımlarını uygulamak için bilgi sistemlerini kullanacak uygulayıcıların sistem beklentilerini, ideal bilgi sistemlerinin pazar problemleri olarak analiz ettik ve sıraladık. İkinci olarak, pazar problemlerini karşılayan sistem özelliklerini belirledik. Üçüncü olarak, önerilen entegre bilgi yönetim sisteminin bağlam modelini ve veri akış şemasını çizdik. Önerilen bu çerçeve, yalnızca uygulayıcılara değil, aynı zamanda akademisyenlere yeni ürün geliştirme yönetimi için geliştirme altyapılarının yapısı hakkında içgörü sağlar. |

# Information Systems Infrastructure for Product Management

| ARTICLE INFO | ABSTRACT |
|---|---|
| | Product Management is a domain that needs a comprehensive information management system so that the execution and tracking by all stakeholders of the product life cycle can provide in an easy way. The use of an integrated system infrastructure can provide a collaborative development and management platform for all product team stakeholders from the beginning to the termination of the product. In our paper, firstly we analysed and listed the system expectations of the practitioners who will use the information systems to implement product management approaches as the market problems of the ideal information systems. Secondly, we specified the system features that meet the market problems. Thirdly, we drew the context model and data flow diagram of the suggested integrated information management system. This suggested framework gives insights to not only practitioners but also academicians the development operations structure for new product development management. |

## 1. *INTRODUCTION* (GİRİŞ)

Product management is a more challenging domain relatively than project management, because it is affected from product market and product dynamics. Continuous planning and marketing activities are needed by the reason of the competitive market conditions and the wants of the customers, through the product lifecycle [1]. Product management is a comprehensive area, which requires the application of market analysis, product planning, product marketing, requirement management, configuration management, data management, system development and manufacturing, customer relationship management. Various product management methodologies are recommended in the literature for

practitioners [2, 3], but each organization has to develop its own infrastructure suitable for its product and market. On the other hand, project management functions have standard and accepted practices thanks to ISO (International Organization of Standardization), CMMI (Capability Maturity Model Integrated), agile/lean manufacturing models applied for years.

In our day, organizational digitalization is very important for provide automation, easy and fast implementation and prevention of human errors. An end-to-end digital infrastructure should be used for a collaborative and traceable asset management to deliver a quality product. Also, due to the complexity of product management processes, it is critical to be supported by information systems. Establishing the best management structure for your organization is a very effective way to organize successful product management. For this purpose, knowledge management, innovation management, product lifecycle management (PLM), requirement, design, quality and configuration management software tools are mostly used for product management in companies, as seen in Table 1. Today, the beginning of the process is market requirements analysis and its continuation is collaborative and concurrent engineering [4, 5]. With a structured development operations (devops) environment, all product management needs can be met.

Traditional PLM systems should be developed with lean and market-oriented approaches. In our article, we try to define the system features and high-level architectural structure of the information systems required to provide a strategic, agile and cross-functional product management and portfolio management. For this purpose, the tools suggested in the literature were reviewed first. Second, market problems were determined by expert opinions. Third, the system features that meet the problems in the market are listed. Fourth, context and data flow diagrams were created to describe an ideal comprehensive end-to-end product management information system.

Our study gives insights not only to practitioners but also academicians to improve their standards and models. The enterprises can use this study to understand which capabilities they should have in their management environment and how they can establish their devops system, to manage their products.

Table 1. Literature Review
*(Literatür İncelemesi)*

| Product Development Function Focused On | Source | Insights |
|---|---|---|
| Product Life Cycle Management and Product Data Management | Product lifecycle management in aviation maintenance, repair and overhaul, 2008 [6] | The importance of the PLM systems in aviation |
| | Implementation of Product Lifecycle Management Tools using Enterprise Integration Engineering and Action-Research, 2008 [7] | The integration of the organizational business processes |
| | Product Lifecycle Management Tools, 2013 [8] | The details of the functions of Siemens Teamcenter PLM tool |
| Innovation Management and Knowledge Management | A Methodology for Evaluating The Adoption of Knowledge and Innovation Management Tools in A Product Development Process, 2003 [9] | A suggested model for innovation and knowledge management in research and new product development |
| | A comparative study of architecture knowledge management tools, 2009 [10] | The usage of knowledge management tools for software architectural design |
| | Software Process Improvement for Practitioners based on Knowledge Management Tools, 2006 [11] | The detailed explanation of process improvement based knowledge management for software projects |
| | Classification of Tools and Methods for Knowledge Management in Product Development, 2008 [12] | The importance of knowledge management for design The required software systems in each phase for knowledge management |
| | Knowledge Management Tools, Inter-Organizational Relationships, Innovation and Firm Performance, 2010 [13] | The importance of time-to-market and new product development The usage of knowledge management tools to measure performance |
| | Decision-Aiding Tools in Innovative Product Development Contexts, 2011 [14] | The phase by phase hybrid PLM flow for new product development |

| Category | Title | Description |
|---|---|---|
| Requirements Management, Variability Management and Software Product Line Engineering | Requirements for Requirements Management Tools, 2004 [15] | The requirements of requirement management process and DaimlerChrysler example |
| | An Evaluation of Requirements Management and Traceability Tools, 2007 [16] | The function capability comparison of the several requirements management tools |
| | Requirement Modeling Systems for Mechanical Design: A Systematic Method for Evaluating Requirement Management Tools and Languages, J. M. McLellan et al. / Proceedings of the ASME 2010 International Design Engineering Technical Conferences & Computers and Information in Engineering Conference (2010) | The function capability comparison of several requirements management tools |
| | Requirements Engineering Tools, 2010 [17] | The explanation of the requirements management needs for complex products by using different scenarios |
| | A Systematic Literature Review of Software Product Line Management Tools, 2011 [18] | The literature review of software product line management which is used for variability management |
| Design Management | Integrating System Analysis and Project Management Tools, 1999 [19] | The integration of system design and project planning by using data flow diagrams and gantt chart |
| | R&M and Risk-Analysis Tools in Product Design to Reduce Life-Cycle Cost and Improve Attractiveness, 2001 [20] | The customer/market need in the beginning of the life-cycle |
| | Educating the Guess: Strategies, Concepts and Tools for the Fuzzy Front End of Product Development, 2003 [21] | The importance of the fuzzy front end phase in new product development and the usage of fuzzy cognitive maps |
| Quality Management | Management and Planning Tools, 1995 [22] | The planning and monitoring usage of the total quality management and statistical process control for continuous quality, productivity improvement and customer satisfaction |
| | Quality Management Tools for Lean Production - Moving From Enforcement To Empowerment, 2002 [23] | The planning and control needs for quality management |
| Configuration Management | An Approach to Support The Implementation of Product Configuration Tools, 2009 [24] | The usage of virtual prototyping for configuration management. The market requirements step of the beginning of the whole process |

## 2. *METHODOLOGY* (METODOLOJİ)

The research questions of our study are below.
1. Which features should a product management information technology tool have?
2. How can these features be provided as an information system?

The methodology applied to answer these questions is detailed in the subsections below.

### 2.1. Literature Review (*Literatür İncelemesi*)

The literature has been reviewed with the keywords: product management tools, project management tools. The resources obtained were categorized according to the product development functions they focused on: product lifecycle management or product data management, innovation management or knowledge management, requirements management or variability management or software product line engineering, design management, quality management and configuration management.

### 2.2. Definition of System Market Requirements
(*Sistem Pazar Gereksinimlerinin Tanımı*)

The customer (market) requirements of the product management tools are defined as the below.

Market: Enterprises (SMEs (Small and Medium-Sized Enterprises), corporations, public institutions) that apply product management methodologies for their developed products

End users: Managers and engineers of the cross-functional product development team. These team members are product manager, sales engineer, market

analytics engineer, marketing engineer, system engineer, developers, verification engineers (quality, configuration, test) and portfolio managers.

Market expectations of a product management system are elicited by the literature review results and the expert opinions from two SMEs, one corporation and one public institution.

### 2.3. Definition of System Features *(Sistem Özelliklerinin Tanımı)*

The system features that meet the market problems of the product management system are specified by the experiences of the authors.

### 2.4. Architectural Concept Design *(Mimari Bağlam Tasarımı)*

The top-level software architectural concept is designed with context diagram and data flow diagram methods.

### 3.    *RESULTS (SONUÇLAR)*

The market requirements table and product specifications described are not included in this article due to page restriction. Conceptual diagrams are given in Appendix 1 and Appendix 2.

The stakeholders of this collaborative system are given in the context diagram. The data received from and sent to the system are shown.

Sub-processes and information flows are given in the data flow diagram. There are four data repositories: market analytics, product requirements, roles and sales, and return on investment (ROI). The inputs and outputs of sub-processes are shown. The diagram represents the interactions of stakeholders and data stores graphically.

### 4.    *DISCUSSION AND CONCLUSION (TARTIŞMA VE SONUÇ)*

The research questions that are given in the Materials and Methods section of this paper are investigated and the answers to these questions are presented as the below.

Which features should a product management information technology tool have?

The main functions of the information system;
- Market analysis, product commercial model (sales/income/marketing) definition, product market problems definition, system features definition and problems traceability, product core, variant and custom components decision, product breakdown structure (PBS) creation and PBS-component-problem-feature traceability, return-on-investment (ROI) definition and calculation and ROI income/outcome-component sales/costs traceability, user stories and acceptance criteria description and feature-user story-acceptance criteria traceability, marketing planning (included prototyping, alpha test, beta test) by schedule and ROI income-component sales-commercial model-marketing plan traceability, planning and marketing plan-campaign traceability, component acquisition/reuse/development planning by schedule in user story and ROI outcome-component-problem-feature-user story-manufacturing plan traceability, purchasing/reuse request creation and marketing plan-purchasing/reuse/integration request traceability, marketing campaigns-user story-task traceability are the data to be supported for entering information.
- Market status, component-problem or feature changes and impacts, purchased/reused/developed user story status, user story verification and validation status, product/market fit status, time-to-market status, resource allocation status, planned-actual ROI status, core/variant/custom components sales and financial status, marketing campaigns planned-actual results are the data to be supported for monitoring knowledge.

How can these features be provided as an information system?

Product management requires a cross-functional team and management. Therefore, the system should allow multiple functional stakeholders to use it collaboratively. The data and information entered by different stakeholders should be traceable and should be reported to the management after being converted into knowledge.

The user stories should be tracked for all tasks of the product such as acquisition/reuse/development, integration and verification. The marketing campaigns should be tracked by the system like the user stories. We can say that the user stories are the tasks of the development team, and the marketing campaigns are the tasks of marketing, sales (BD: business development) and planning team.

The planned/actual development cost and planned/actual sales revenue should be monitored for all components of the product. The cost and revenue should be tracked on the basis of product breakdown structure. The sales plans included in the product breakdown structure should be broken down into the marketing campaigns throughout the product lifecycle.

The validation of the product prototypes should be planned, carried out and monitored with the marketing

campaigns in the system. The evaluations of the customers should be collected and analyzed by the system.

In conclusion, the focus of development throughout the product lifecycle will be the user experience. This perspective will provide agile development. The system that will provide these features will facilitate the strategic cross-functional management of products and product portfolio.

Our work guides product management professionals to establish the appropriate corporate digital infrastructure.

For future work, existing information systems in the market can be analyzed for comparison with system features recommended in our study. The applications intensively used in the current market can be analyzed; their strengths and weaknesses can be defined. Integrated use of existing systems suitable for comprehensive product management can be evaluated. Additionally, a maturity model can be created to present to the organizations. The systematic path in this maturity model provides can guide organizations to set up or improve their development operation systems step by step. The requirements of the relevant maturity level provide an understanding of what the organization's goals should be in order to upgrade their systems from current maturity to the next higher maturity.

Our model can lead standardization institutions and information systems developers to adapt their design architectures to modern market-oriented competitive system requirements.

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**APPENDICES (EKLER)**

Appendix 1. The Context Diagram of Product Management Information System (Ürün Yönetimi Bilişim Sistemi Bağlam Şeması)
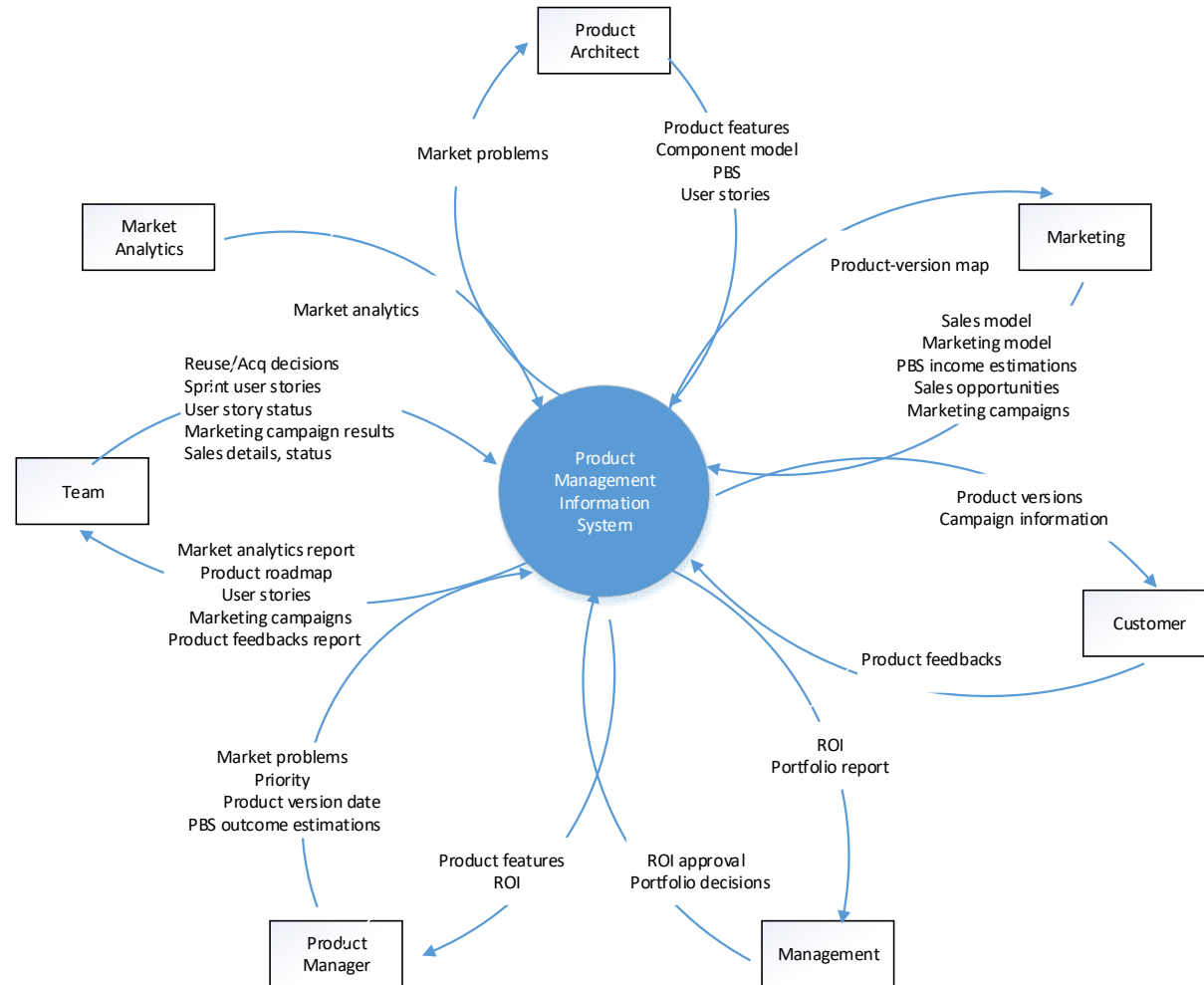
Appendix 2. The Data Flow Diagram of Product Management Information System *(Ürün Yönetimi Bilişim Sistemi Veri Akış Şeması)*