ESTABLISHING THE PRODUCT REALIZATION CONCEPT IN RAILWAY TECHNOLOGY

Fatih Öztürk

Istanbul Medeniyet University, Turkey[1]

Abstract:

Railway industry owes its ever-growing importance to several factors, chiefly the fact that it is considered a relatively more comfortable and efficient mode of transit in the face of rapid urbanization. This study deals with the ways of improving the manufacturing process of components used in the railway industry.

In this regard, IRIS plays a vital role in the process of ensuring the customer satisfaction, product quality, efficient process management and innovation for all components. Hence, the study attempts to investigate into the ways to obtain more optimized results drawing upon the IRIS standards.

JEL Classification: L6, M1, O1, O2, R4

Keywords: Project Management, Production Management, Product İnnovation, IRIS, Quality Management, Railway industry

Introduction

Based on the ISO 9001 Standard, the IRIS rail standard is a management system designed to processes specific to railways. As part of the IRIS standards, through substantial changes and extensions in the overall management of purchasing processes and supply chain management systems, a separate management system is established to allow for further elaboration unique to the sector (UNIFE, 2009). Thus, drawing upon the case study of IstanbulTram, the present study is intended to present the whole project planning process for innovation in line with the IRIS standards, and in doing so, proposes a comprehensive model from the customer to the product.

Product realization is described as "delivering the services and products fulfilling customer demands" according to Hinsch (2014). Hence, the main factors determining innovation in the development of products for customer satisfaction need to be defined in terms of product realization. As far as the term product realization model is concerned, it should be conceived as a universal guideline addressing the needs of the companies seeking for ways to promote efficiency so as to better adjust themselves to changing economic circumstances.

The available literature contains several prominent studies investigating into the product realization concept with special emphasis on innovation and railway standards. For instance, in their study on the virtual re-design of a railway locomotive in line with the existing European norms, Di Gironimo and Patalano (2008a) organized their project development process drawing a top-down methodology, and performed a series of aesthetic, functional and ergonomic analyses drawing upon the digital locomotive prototype they realized. Likewise, in an applied study intended to improve the performance of high-speed trains in terms of dynamic stability and comfort, Allota et al. (2011) administered innovative damping technologies to the secondary suspension stage. Investigating different control strategies and applying a series of simulations, the authors concluded that optimum results are derived through a mixed approach. In a study about improving the concept design of train interiors so as to enhance perceived quality in line with the existing standards, Lanzotti et al. (2008b) used the Kano method to identify and categorize user needs in the design of seats in a regional train. Drawing upon a combination of advanced CAD tools, experimental statistical methods and virtual reality tools, the authors obtained a significant increase in quality thanks to virtual experiments allowing for new design solutions based on continuous innovation loop. In their article concerning an innovative assembly process for railway cars in a virtual factory environment, Di Gironimo et al. (2009) presented a case study consisting of four modules that are set up in individual workplaces. Simulating assembly operations through a computer-aided system, they found that virtual simulation

[1] Engineering and Natural Sciences Faculty, Department of Industrial Engineering, fatih.ozturk@medeniyet.edu.tr

can significantly contribute to design in terms of time, cost as well as quality improvement, thereby highlighting the benefits of virtual reality technology in the sector. Last but not least, discussing the concept on the basis of rather a theoretical framework, Schmitt et al. (2011) highlight the massive breakthrough in the field of quality management following the emergence of the term Industry 4.0, and consequently the need for a new quality-oriented production concept.

In the railway industry, research is predominantly project-oriented, which is then harmonized with the IRIS project plan. The modeling is performed in two phases: First, the key operational processes in the railway sector are identified, which is followed by an application of the general rules of process management and process orientation. The modified norm instruments are re-structured during the subsequent phases of the project.

Main Factors along with the Business Strategy

Implementation of management systems is accompanied by various new processes. The first stage of the implementation process involves the identification of the main factors, which are the key elements contributing to the success of a business. As each enterprise has its own internal processes, the most important ones has to be ranked and independently formulated, thereby drawing the attention of the senior management to those of priority. (Oesterle, 1995) In a similar vein, the IRIS guidelines explicitly necessitate the identification of the main factors. Consequently, it is the business area and focus of the company's manufacturing process that define the main factors.

Figure 1: Main factors proposed for product realization process in railway industry

CUSTOMER →	• Customer Processes • Development • Procurement Process • Cost Management • PM • System Optimization • RAMS/LCC • Data Analysis	**→ PRODUCT**

Source: Author

Establishing the Product Realization Concept

Project-based work plays a key role in the rail industry. The project realization concept as illustrated below describes the process steps carried out with the insertion of standardized project phases.

Figure 2: The overall project planning for the innovation of the IstanbulTram

Project Definition	**Project Planning**	**Project Implementation**	**Project Control**	**Project Finalization**
• Customer demands • Defining project requirements and objectives • Project scope • Time management • Benefits and risks of the	• Concept • Establishing the project flow • Planning the financial framework • Feasibility test • Identifying the work steps • Training planning	• Procurement of manufacturing parts • Determining material composition • Implementing mechanical and chemical tests • Documentation • Communication /	• Auditing the control and measurement processes • Monitoring measures for customer satisfaction analysis • Supplier management	• Obsolescence management • Servicing • Maintenance • Launch of the product • Product safety • Project assessment • Re-calculation / re-examination /

project • Defining profitability, returns and expenses • Defining the Research Organization • Project organization and tasks • Project team • Initial project plan • Identifying problematic areas • Communication • TSI and specifying the norms	and know-how creation • Defining the Process Structures • Defining project officers • Scheduling meeting dates • Setting targets • Organizing documentation • Clarifying technical details and project requirements • Communication • Change management • Appointment planning • Procurement planning • Quality assurance • Resource planning • Developing the renewal processes • Cost management	Promotion Contract • Scenario analyses • Risk and safety analyses • Order verification • Order classification • Prototype production • Cost evaluation • Cost analysis • RAMS / LCC • FAI • Project assessment	• Production • RAMS / LLC • Customer communication • Documentation • Initial sample • test	continuous improvement • Data analysis

Source: Author

The above figure presents the realization process for IstanbulTram (i.e. Istanbul's locally-manufactured tram car) under five phases, which are further broken down into their respective sub-processes. A thorough implementation of the project phases would yield a high-quality end product. Based on the information obtained from data and the test results, the project duration was set at eight months, with the third project phase introducing the applied works, while the fourth phase involves the control processes, with strong emphasis upon the factor of deadline. In the subsequent phase, on the other hand, the existing project phases were enriched using the updated practical information, and following exhaustive discussions and in line with the IRIS standard, a model was built up for product realization.

Project Definition

Every project rests upon a meticulous project definition, which involves the planning of the project with reference to binding instructions. Here, customer demands constitute the fundamental point of origin. This could also be presented in a format allowing for its formulation as the project contract later on. The study case presented here deals with an innovation attempt on request for the manufacturing parts of a tramcar. In this respect, a poorly-defined project might even impact the entire project, leading to unintended and unfavorable consequences (cf. Burghardt, 2013). Quality targets, such as job descriptions of all responsible when starting planning a project is determined by official duty. The structure of the innovation process decision to implement the project can be arranged as follows. Thus, prior to the start of planning, issues such as targets of project officers, job definition are assigned and fixed through an official project tasking.

The structure of the project decision to implement the innovation process could be organized as follows:

Key Items of the Project Decision

- Definition of the targeted innovation
- Approval of the targeted actions

The project guideline is defined following the decision stage

- Definition of the conditions, economic status and risks pertaining to the project.
- Identification of the targeted activities on an individual basis.
- Definition of the organization-based resources.
- Estimated framework of project resources (staff, cost, work materials)
- Estimated project duration.
- Legal framework conditions and norms for agreements to be concluded with third parties.

The present case study is intended to reduce the weight of IstanbulTram (Turkey's first locally-manufactured tramcar). To this end, it was decided to go for innovation in the plastic fiberglass, the material itself as well as its composition. The reason behind such innovative attempt was that the vehicle turned out to be overweight despite all preventive measures. This in turn brought about higher energy consumption, greater energy costs, certain economic and ecological challenges as well as diminished transport capacity

Hence, the intended innovation process aimed to reduce the overall weight of the railway vehicle. Re-calculations and analyzes were carried out for the process, and it was consequently found out that an optimization attempt based on the replacement of the plastic fiberglass material would be effective on both the internal and external parts of the car. For as far as this study is concerned, higher material thickness, though depending on the structure and composition of the material, generally refers to greater emission in case of fire. As for the technical components, weight reduction was considered undesirable since the products procured from international suppliers already underwent innovation and complied with the norms. This would entail fracture risks which could further complicate the assembly process.

Project Planning

The second phase of the project involved the formulation of all measures associated with the project by the planning team, taking into consideration the project tasking as well as the key project decisions.

Structural Plans

Structural planning refers to the operational phase of the entire project planning, with the later step involving a thorough tasking for technical and operational processes.

The term technical area, on the other hand, means the planning of all technical equipment and materials required for product realization, which are materials such as fiberglass, gelcoat, and polyester resin etc. in our case. Researchers have to take into consideration all technical equipment needed for implementing the innovation. Furthermore, required parts also need to be calculated even though they are not used on the product. In our case such instruments include the Minitab software, technical measurement tools and simulation software.

Cost Management

Cost management is supposed to keep record of all expenses incurred as part of the project. In addition, as per the IRIS standards it also has to identify the most important cost items as well as the reasons for the expenses during the budgeting period, assessing them through a data analysis at the closure of the project. Cost planning is key to the overall project duration. A project-oriented, consistent calculation is also expected to provide an initial cost accounting and a preliminary calculation at the very outset. Account statement is a must for the overall project period, which should be followed by a re-calculation at the end of the project. In this regard, it is critical not to end up with excessive budgeting caused by miscalculation.

Project Scope

Structural planning allows for an approximate cost calculation. This process draws upon the optimum forecasting method; yet, it still has to do mostly with the experience potential. In this sense, it will

yield great operational benefits to incorporate experts with particular interest and substantial experience in preceding projects.

In the case of innovative works for the IstanbulTram, the data materials of the manufacturing company were used and brought together with the experiences of the operator. For the innovation process, the information acquired during the production would be of great avail and guidance. All modifications in the project process and project planning are to be fully documented so that they are intelligible to all.

Planning the Product Delivery Time

By identifying possible costs, a time management scheme is subsequently created for each and every package and partial tasks. Especially in the case of large-scale projects, it would be reasonable to actively use tools such as network plan, which are accessible by all project stakeholders. Organizing regular meetings is recommended as part of project management since it will strengthen communication with part-time employees. In our case, project term is set at eight months, which was actualized on time. Time-consuming processes included the testing performed abroad, rather than those held within the premises of the operator. Thus, such contingencies need to be taken into account when planning the project duration.

Utmost care should be taken for the selection of project managers and supervisors. This applies to each and every employee, and emergency plans should be drawn up to quickly replace employees with the competent ones so as to carry out partial project tasks. In the current case, supervisors open to teamwork were specifically selected from among the employees of the manufacturing company, and key figures involved in the manufacturing were included in the project team. This helped reduce the duration of training and also ensured that the process could be completed without any major setback.

Risk Management

Risk management constitutes one of the main elements of project planning. It is also required from enterprises by the IRIS railway standards. Risk management should also contain complementary elements of risk analysis for a correct identification of weak points and timely response during product development. Tools such as FMEA could be used in risk planning and the RAMS management method should be considered as a supportive tool according to the IRIS instructions.

Documentation

The IRIS framework prescribes that one should stick to results in project planning, document all processes and be made available to those in charge (UNIFE, 2012). Required documentation should be carried out in line with this prescription.

Project Implementation

The third stage makes up the core part of the product realization concept. All steps are specified in the work plan starting with the planning phase. Standardized project phases are used to carry out project implementation and some could be expanded to arrive at the concept below.

Figure 3: Tools used during project implementation

Project Implementation	Precise Planning
	Task Distribution Process
	Project Control
	Communication and Documentation

Source: Author

Precise Planning

The project in our case aims to create an innovation plan for the local tramcar, so development processes for new manufactured products are tendered out, with required assessments and tests being identified. Precise planning is the actual innovation processes, which uses pilot planning methods encouraged by the R&D management. With the help of the management, components corresponding

to relevant standards are identified, and specific training is also offered to the staff during precise planning.

In this stage of our case, factors most appropriate factors for reducing the weight of plastic materials were defined drawing upon the Taguchi method and also required mechanical and chemical tests were identified.

Task Distribution Process

Searching for the most suitable factors is followed by creating sample products and task distribution. The overall process is organized as material procurement, material combination and creation of sample products. Additional work stages may might be required depending on the manufactured material. The IRIS framework requires that the sample products manufactured should be subjected to multi-step mechanical tests. This process may be carried out in the operational field where the manufacturing components are produced.

Project Control

Project control is the most important part of the process and an Ist-state regularly reported to project stakeholders. This ensures both internal and external communication, all of which should be documented. Project development is carried out at various locations, which should be taken into account for management purposes. When providing feedback, the Ist-state of the project is identified and notified to the clients and the senior management (Hobel, Schütte, 2011). The obtained data is communicated to the project manager and could then be used to optimize the project plan. Thus, the project manager can either distribute the tasks or make recommendations for action.

The flow of detailed information among the work teams within the manufacturing company can be designed on a weekly basis during initial phases of the project. In the following phases of project implementation, however, meetings can be held with each department at intervals of less than a week. In doing so, when complications arise incomplete planning can be avoided. Timely response or teamwork for solutions are possible. During the cases of emergency, digital communication channels and media can also be used for instant communication.

Communication/ Documentation

Communication is vital to the implementation phase. Thus, sound communication is a decisive element in the project control phase. Requests for modification can only be met by the project team only when there is healthy communication. Permanent changes to be carried out by the operator and also with the clients is also an important factor.

It provides a good information flow between the partners to identify the individuals in charge and their areas of responsibility. Hence, these should be defined at the very outset of the project. Longstanding business relations will also enhance the communication process. The companies in our case had worked in harmony in the past years, which yielded good results for the project.

Project Control

The fourth stage of IstanbulTram's innovation process in our case involves the implementation of control and monitoring mechanisms.

Monitoring the innovation process could be classified in the following areas.

- Product testing: Product testing is performed using a measurement system which has been documented to guarantee whether all quality demands and customer requirements are fully met. The RAMS management provides documented data essential for the client. This stage also includes the first sample test, which could be carried out both in house and externally using mechanical and chemical tests. The final stage involves quality control for monitoring compliance with the norms.
- Project Control: Documentation and control is the key in the overall project process. Planning and feasibility control take place during the fourth phase of project planning. Product realization control measures the cost and success of the project and whether project objectives

have been achieved. Quality concept is monitored during quality control, with a detailed certification control being performed. In accordance with the IRIS, it is mandatory to comply with certification standards and apply the certification system.

Project Finalization

The final phase of the project is reached once the product is launched following the completion of all project phases. However, the process is not actually finalized for the operator. The final phase for product realization refers to the product innovation lifecycle. Later processes will require maintenance care and servicing, which means the monitoring of market availability for spare parts throughout the identified lifecycle through obsolescence management (cf. IRIS, 7.12)

Since an innovation project is based on the collaboration of the two enterprises, the project ending for the manufacturing company depends on project evaluation by the figures provided by data analysis. For analysis of such data is of great significance for future projects, an ending in the real sense occurs when a project manager shuts down a project, with the senior management taking over the responsibility. Finalization of a sample project means that the final product is well-received.

Conclusion

The results of working with the development and production processes used for domestic tramcar composite parts allowed a weight reduction of 40% in terms of composite parts. Reducing the weight of the composite parts contributed to a 27% cost-saving in terms of passenger capacity of the vehicle, with an annual capacity of 2.8 million passengers. Furthermore, weight reduction in terms of technical data will decrease the tramcar axle load, thereby contributing to a safer driving experience, which in turn positively impacts upon maintenance costs.

In terms of environment and human safety, the decrease in the mass of composite parts with high combustion characteristics resulted in a 27% improvement in the amount of chemical emission by fire. All these results will help the works meet the expectations and take the decision to carry out the production. In addition, it has achieved its goal by ensuring that the manufactured cars are safer and more cost-effective.

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