

# BY MANAGING THE REQUIREMENTS AND INTERNAL STANDARDS OF RENOWNED CUSTOMERS TO BETTER BUSINESS RESULTS IN THE MOTORCYCLE INDUSTRY

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**Abstract:** *The effectiveness of the organization depends largely on the ability of managers, employee involvement in clear strategic orientations and its integrated culture. A successful management system of the organization is no longer dependent just on a process approach and continuous improvement. Increasingly, risk and opportunity management is at the forefront, taking into account the requirements of the business environment, particularly the requirements of the largest buyers of the company's products. It is very important for the organization to incorporate risk management into its operations, not only to reduce the negative consequences but also to increase its business opportunities. The paper presents the company's cooperation with one of the largest motorcycle manufacturers in the world - BMW Group, which took place while the company was introducing a new steel frame for the BMW F 800 S motorcycle in global markets. Due to the right approach including a positive risk, compliance with the requirements of the SPQM (Supplied Part of Quality Management) and last but not least our ardent desire to cooperate with BMW, the company has been given the opportunity to become the supplier of complex components for BMW and other large manufacturers in this industry.*

**Keywords:** NOMINATION, FUNCTIONAL PROTOTYPE, SPQM, PFMEA

## 1. Introduction

The organizations that use their quality management systems to good advantage have a head start over others in the phase of the introduction of new standards, and later the certification and internal and external evaluation processes. Continuous changes require adjustments and new ways of designing and developing products and services. Therefore, the design and development of products and services are of vital importance to each organization as the very existence of the company depends on how successful they are.

In September 2015, the fifth edition of the ISO 9001: 2015 Quality Management System was published, giving a new strategic orientation to the standard by taking into account the fact that more and more quality management systems are used together and integrated with the business processes of the organization, that priority is given to the effectiveness and the results of the management system and that the requirements of the system need to be adapted to current and future business circumstances and requirements. Increasingly, risk management and opportunities are at the forefront, taking into account the requirements of all stakeholders. The quality management system should become a tool for the realization of strategic decisions and the fulfillment of the mission of the organization<sup>1</sup>. Among the seven principles of quality management, there is no longer an explicitly stated systemic approach that is covered by the process approach, and the principle of a mutually beneficial supplier relationship has spread to all stakeholders.

A brief summary of the principle of planning and improving could be that preventive measures are no longer there because organizations have to assess and manage risks. Organizations must prevent key risks or at least reduce unwanted impacts in order to ensure that the quality management system achieves the expected results and actualizes the identified opportunities for improvement. The chapter explicitly sets out requirements for quality objectives and planning for achieving them. In addition, organizations are expected to plan and manage change. The principle of improvement deals with inconsistencies, corrective actions and improvements, but no longer speaks of preventive measures, which are now covered by requirements in the planning chapter (risk management). When measuring, the identified risks and opportunities must be taken into account.

Entrepreneurial action is full of uncertainty, which can be the result of changes in the business environment, possible changes in

the company, the perception of opportunities, or the lack of information. Therefore, the goal is to identify the potential effects of the uncertainties and take appropriate action. Contrary to crisis management or problem management, risk management is characterized by a distinct focus on the future. With persistent measures, effective and efficient risk management will contribute to the prevention of crises and problems in line with the motto: "Good managers manage risk, poor managers manage problems."

The paper presents a practical example of opportunity search and project uncertainty in the nomination phase and industrialization of the complex product for BMW.

## 2. Requirements of the customer BMW

The cooperation between a prominent motorcycle factory, Slovenian company Tomos, and the world-renowned motorcycle manufacturer BMW date back to the late 1990-ies.

The value of the successful supplier increased when BMW entrusted Tomos the task to enter the competition with other companies in the segment of complex welded components. Project team was entrusted with the management of the project named BMW K71 with a large format drawing containing dimensional and technological requirements. The product is the rear frame of the motorcycle BMW F 800 S/ST made from steel structure, as indicated in the figure 1.

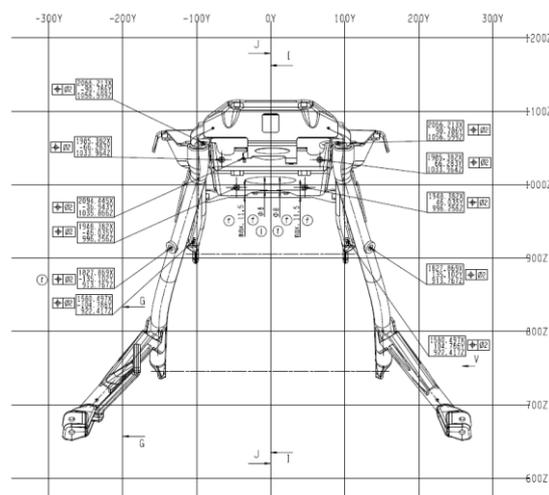


Fig. 1 Drawing of rear frame BMW F 800 S/ST.

With competitiveness in the manufacturing and supply of welded components for BMW, Tomos gained advantage over other companies, which enabled the growth of the company and its new owner Hidria, not only in the segment of welded components but also in the segment of smaller aluminium castings.

With good present cooperation, we entered the nomination process with the rest of other major companies whose aim was similar to ours: to become manufacturers and suppliers of the complex welded product. The deadline for making the calculation was predetermined by BMW. BMW's development department in Munich acceded to our request and soon we acquired a 3D model of the product, made in the program Catia 4.0.

The product was disassembled to single elements and the indicative value for each of them was determined. The calculations of technological processes of welding, painting, inspection and delivery were followed by the final price and its entry into the BMW system. Our manufacturing costs turned out to be interesting to BMW auditors and we came to a shortlist of suppliers.

The project team was given a month to prepare for the visit and assessment by BMW, in the areas of development, industrialization, quality and logistics. Assessment is carried out using SPQM system Supplied Parts Quality Management.

## 2.1 From the prototype through the challenging SPQM assessment to the winning of the nomination

The BMW engineering and production of quality parts after calculation process, starts with the nomination of suppliers. During the selection process, we must prove that we meet the demanding requirements of BMW Group. The BMW Group Purchasing Division is responsible for the satisfactory completion of all supplier selection and contracting activities. Purchasing is supported by the engineering, parts quality and logistics departments. Supplier selection is performed in different project phases, depending on the type of suppliers and the responsibilities they take.

The relationship between BMW and suppliers is based on partnership and trust. In the supplier selection process, potential BMW suppliers successfully convince our teams that their concepts will meet the requirements in terms of specifications, innovations, quality, and cost. Having signed a contract as a supplier to BMW Group, suppliers together with BMW engineers share responsibility for achieving challenging goals.

SPQM is predestined to develop the questionnaire. At the end of each question assessors appropriately labeled the adequacy of the response to the "traffic lights". Figure 2 shows the initial preparatory form SPQM for carrying out quality management assessment in the field of development, supply, logistics and product quality.

BMW Group		SPQM				Name: Hans-Jürgen Dulkiewicz	
Qualitätsmanagement		Massnahmen pro Umfang				Datum: 28.08.2004	
Kaufstelle						Postleitzahl: LU-T-13	
Projekt		SE				Telefon: +49-30-3599-2309	
Verantwortlicher	Guido Hofbauer - LU-M6-1	SE	01.12.2005	Status	Freigegeben		
Umfang	Lieferant: 101822-10	Verantwortlicher:	Wolfgang Rombergner - LU-M6-2	Modul: 84	NAEL	Risiko: hoch	FIBNRID: 2091021450
Interaktion:	Tomos	Verantwortlicher:	Bernhard Kistler - LU-EG-3				
			Hans-Jürgen Dulkiewicz - LU-T-13				
			Robert Tappener - LU-T-3488				

Fig. 2 SPQM questionnaire, free form BMW2.

We received the SPQM questionnaire at the same time as other nomination candidates. The group had a month to prepare for the external evaluation of BMW experts according to the SPQM questionnaire. Each individual area of audit consists of a large number of questions, which enable the auditors to provide the criteria for the selection of the best among all candidates at the end of the audit. While waiting for the arrival of the auditors from the company BMW, the project team decided to manufacture the first

prototype of the 3D model, which we had received from the R&D department in Munich.

We decided to take a risk and while preparing for the assessment SPQM, we invested additional effort into the production of the first prototype. We were well aware of the complexity of all the areas of the audit, and the advantages of our business functions as well as our weaknesses. Having enough experts as well as knowledge in the field of rapid prototype technology, we recognized the production of the first prototypes as one of our advantages. Looking back on the then quick decisions, and on today's cooperation with BMW, we can conclude that we acted well.

In its first phase, the future plan included the purchase of the material, all the tubes and sheets of suitable dimensions, and also the material on the basis of the drawing of the frame. Simultaneously with the acquisition of all the materials, from which we had to manually manufacture the individual frame components, we focused on components manufacturing via prototyping technologies.

According to the technologies of rapid prototyping known and available at that time in Slovenia, we decided on the technology of laser sintering, DMLS – direct metal laser sintering, to manufacture both pedals and the exhaust bracket. The device for direct metal sintering of metal powders was owned by the company RTCZ Izlake, which agreed to manufacture all three components. The device enabled a good shape accuracy and mechanical property of the sintered products, which were later welded together. And what was then the most important; we received all three parts three days after sending 3D models to the company RTCZ. The remaining four, production components – pressed parts – were manufactured on a lathe and a milling machine in the tool workshop in Tomos.

A lot of knowledge and experience were invested in the manufacturing of the complex metal sheet components. There are many ways to manufacture a product by reading a drawing. However, due to the time limit, we decided to develop all sheet metal components in 2D shape using the program Catia. This was followed by the cutting of sheet metal with a water-jet technology, which, unlike the technology of laser cutting, maintained the cutting edge without excessive heat load and consolidation of the material. Consolidation of the material could later in the prototype workshop complicate the process of bending and adjusting the products to the requirements of the steel frame drawing.

We managed to purchase and manufacture all the subassemblies needed to build the frame in time. In the prototype workshop a colleague manually shaped all prepared sheet metal parts and other profiles into elements according to the accompanying drawings. Figure 3 shows the process of manufacturing the element, support steel sheet from 3D model to 2D cutting, welding and shaping into the required structure.



Fig. 3 Process of prototyping the complex element.

This was followed by the required phase of adjustment and welding of all components to get the final product. The frame was welded manually using MIG procedure, with 3.5 m of welded joining parts between all the elements. Prototype required a lot of knowledge in the different welding processes between the different materials that we use. Construction of such prototypes is a unique process. Masters of producing such prototypes need a lot of experience, ingenuity and knowledge of modern technologies.



### 3. FMEA analysis

After the functional prototypes were successfully manufactured, the planning and design of individual processes followed, including the acquisition of materials and sub-assemblies, the complex industrialization of the product, and the shipment of the product to Berlin, where the BMW motorcycle is installed.

The planning and management of implementation processes included the planning of the realization, capacities, resources and materials, and the associated integration of external suppliers and partners. The quality manager at Tomos understood the importance of planning the operation and risk analysis and was well aware and capable of managing the opportunities for creating a product value through the FMEA quality system.

The FMEA Failure Mode and Effects Analysis system, or the analysis of methods of cancellation and consequences, enables the use of specific process methods for managing processes of creating a process network.

Process Failure Mode and Effects Analysis (PFMEA) looks at each process step to identify risks and possible errors from many different sources. The sources most often considered are people, methods, material, machinery, measurement, and environment. All the steps in risk assessment and business impact analysis using the PFMEA method are shown in Figure 8 below.

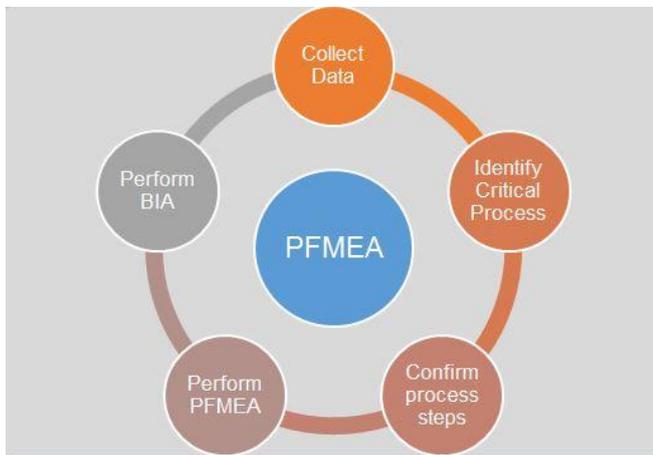


Fig. 8 Steps to conduct Risk assessment and Business Impact Analysis<sup>3</sup>.

A number of people participated in the PFMEA process, including the coordinator of FMEA - the director of quality, the project leader, the sheet metal processing technologist, the welding and surface protection with varnishing technologist, the quality assurance technologist, the purchasing and logistics technologists and the production manager. When manufacturing the BMW frame, the working group identified possible causes of a possible defect and the corresponding sequence of errors (what could happen?).

Figure 9 shows the form into which we entered identified and collectively received information about the process of manufacturing the BMW frame. For each function, we determined the possible method of failure, the potential consequences of errors, and the probability of detecting the cause of errors.

PROCESS FMEA										Zadek sklova K71 0000	
1. Name	2. Date	3. Version	4. Change	5. Change	6. Change	7. Change	8. Change	9. Change	10. Change	11. Change	12. Change
11	11	11	11	11	11	11	11	11	11	11	11
12	12	12	12	12	12	12	12	12	12	12	12
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49	49	49	49	49	49	49	49	49	49	49	49
50	50	50	50	50	50	50	50	50	50	50	50

Fig. 9 PFMEA obrazec, Tomos, 2004.

PFMEA is a methodical approach used for identifying risks on process changes. The Process FMEA initially identifies process functions, failure modes their effects on the process. If there are design inputs, or special characteristics, the effect on end user is also included. The severity ranking or danger of the effect is determined for each effect of failure. Then, causes and their mechanisms of the failure mode are identified. The assumption that the design is adequate keeps the focus on the process<sup>4</sup>.

A high probability of a cause drives actions to prevent or reduce the impact of the cause on the failure mode. The detection ranking determines the ability of specific tests to confirm the failure mode / causes are eliminated. The PFMEA also tracks improvements through Risk Priority Number (RPN) reductions. By comparing the before and after RPN, a history of improvement and risk mitigation can be chronicled.

Risk is the substitute for failure on new processes. It is a good practice to identify risks for each process step as early as possible. The main goal is to identify risk prior to tooling acquisition. Mitigation of the identified risk prior to first article or Production Part Approval Process (PPAP) will validate the expectation of superior process performance. Risks are identified on new technology and processes, which if left unattended, could result in failure.

### 4. Conclusions

People who work in organizations, in the private or public sector, must be aware of the quality policies and their own contribution to effectiveness, including better quality of implementation. The introduction of a quality management system is, of course, the strategic decision of each organization. In order to achieve high customer satisfaction, customer expectations must first be met even when they are not precisely defined, presumed or binding. The challenge is to recognize these requirements, as the expectations of customers change over time. Requirements are today becoming defined expectations. By this, in addition to clearly defined requirements and the application of standards, undefined and unspoken expectations are also referred to. This change of perspective is interpreted by successful organizations as a trend, a direction of development, and a larger focus on customers.

A few years before the new ISO 9001:2015 standard was issued, our project team was already well aware of the fact that risk and uncertainty can only be the result of perceiving the opportunity. At that time, we managed to obtain the nomination for the manufacture of a complex BMW product because of our desire, ingenuity and knowledge that was then more competitive than that of the others. The product – the first prototype – made with different technologies of rapid prototyping was presented to a group of BMW auditors. The effort we had invested into creating the prototype and the successful completion of the assessment SPQM and PFMEA brought us BMW's assurance and official nomination for the serial production of the steel frames BMW F 800 S and BMW F 800 ST. The nomination for the manufacturing of this complex product still guarantees the company the serial production of complex steel components and welded components made from aluminium alloys not only for BMW but also for other well-known motorcycle manufacturers.

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