System Engineering Methods for Quality Management and Their Effective Applications

Prof.dr Vojislav Stoiljković, CIM College d.o.o.

Predrag Stoiljković, CIM College d.o.o.

Abstract

Competitive pressures force organizations to strive for constant cost reductions while ever more increasing quality of their products and services. It was only 20 years ago when such a scenario was unthinkable. Expert opinion that prevailed was that for a higher quality one needs to pay more money. However, there was a turn point when Phillip Crosby came out with the statement that anybody who works can do the job with no mistake - he proved that quality is actually free. Quality is free because the investment in improvement of processes that are supposed to deliver quality products and services is much lower than the gain that organization can achieve. Organizations that invest in quality improvement can achieve great savings as well as increase profits and customer satisfaction at the same time. It is to be done by simplifying processes and removing activities that add no value, while reducing/eliminating opportunities for defects.

OPISys™ platform developed by CIM College d.o.o. integrates **Quality Tools and Methods** into the concepts aimed at simplifying and improving processes, reducing variation and defects, eliminating/decreasing environmental safety aspects and their impacts, as well as eliminating/decreasing occupational safety hazards. This paper presents **OPISys™** platform and **Quality Tools and Methods** that facilitate process improvement efforts. More details **in Russian language** on **OPISys™** and **Quality Tools and Methods** you can find on: www.cimcollege.co.yu\rus\softver\OPISysHTML\opi1.htm and www.cimcollege.co.yu\rus\softver\spisak.htm, respectively.

1. Introduction

Some companies still believe that improving commercial processes is less important than improving industrial processes or even that those seemingly intangible commercial processes can't be controlled. Organizations like General Electric have shown that improving internal and external commercial processes adds significant value to the bottom line operations as well as to customer satisfaction.

It was more than five decades ago when Deming realized that the key to success lies in process improvement. He not only realized that, but persuaded Japanese managers to pursue his ideas, which finally led to the Japanese economic success. It is possible that a company establishes a product at the Six Sigma (6σ) quality level by incorporating 100% control and by not allowing a defective product to come to the customer. However, there is a question of what are the costs of such a company as well as can it bear competitive pressures that arise thereof.

Long time ago Deming suggested to move the control from output to the process itself, where one can control Critical to Quality Characteristics. By decreasing variation of such characteristics organizations improve output quality, or in other words quality of products/services at customer hands. Improved quality decreases costs of rework and waste. Costs are further decreased because there is no need to control output any more. Companies get higher quality for less money. This practically justifies Crosby's way of thinking stressing that "quality is free, but is not granted".

Improved processes can be further informational supported in order to automate and speed-up their realization. Process automation means cycle time reductions, which further means that organizations become faster than their competition. Information support of a business process without its systematic improvement leads to a faster detection of existing problems due to general variation causes contained in the process. This further leads to unnecessary waste of time, unsatisfied employees, unsatisfied customers, and worsened position in comparison with the competitors.

OPISys™ fully adopts process improvement concepts established by Deming and later extended within the Total Quality Leadership (TQL) and Six Sigma methodologies. The platform is based on the process model, which is a critical requirement of all the excellence models and management standards: ISO 9001:2000, ISO 14001:2004, OHSAS 18001:1999, and ISO 22000:2005. As an **OPISys™** integrated module, we developed *Visual Processes v3.0 .NET* for the purpose of mapping and graphically interpreting processes. By process mapping, one can establish a number of perspectives: 1. Critical to Quality characteristics perspective; 2. Environmental safety aspects perspective; 3. Occupational health and safety hazards perspective; Food safety hazards perspective. Generally speaking, any perspective allows monitoring, measurement, and analysis of critical characteristics by applying basic and advanced quality tools and methods. Advanced quality tools further allow designing new processes and products/services that will completely fulfil customer requirements. As well, these will be able to perform deliveries on the Six Sigma quality level, which means less than 3.4 defects per million opportunities.

2. OPISys™ Platform for Business Process Improvement and Management

OPISys™ is a platform designed for process improvement and management, supporting: ISO 9001:2000, ISO 14001:2004, OHSAS 18001:1999, ISO 22000:2005 standards, as well as innovative concepts: Total Quality Leadership, Six Sigma, Lean. It further allows monitoring of organizational performances from four perspectives, as suggested by the Balanced Scorecard. All in all, **OPISys™** allows establishment of a "bird's eye" perspective on the system, processes within the system, and resources used within processes. By utilizing Quality Tools and Methods integrated in the **OPISys™** platform it is possible to monitor all Critical to Quality Characteristics, environmental safety aspects, occupational health and safety hazards, and process performances.

A global concept that **OPISys™** platform relies upon is depicted in Figure 1. As already mentioned the platform takes into account requirements of the management system standards and innovative concepts aimed at quality improvement. **OPISys™** allows transparent system management. Managing a system as a system involves understanding of all the three integral parts of the extended system, including their mutual fit [2]. Using statistical techniques to analyze the system and process knowledge (the knowledge of people) to understand the results of the analyses will help leaders gain the knowledge necessary to make sound leadership decisions [3]. An understanding of the whole system as well as some insights into the capabilities of its various components will enable a leader to move away from arbitrary goals and objectives towards real, lasting improvement.

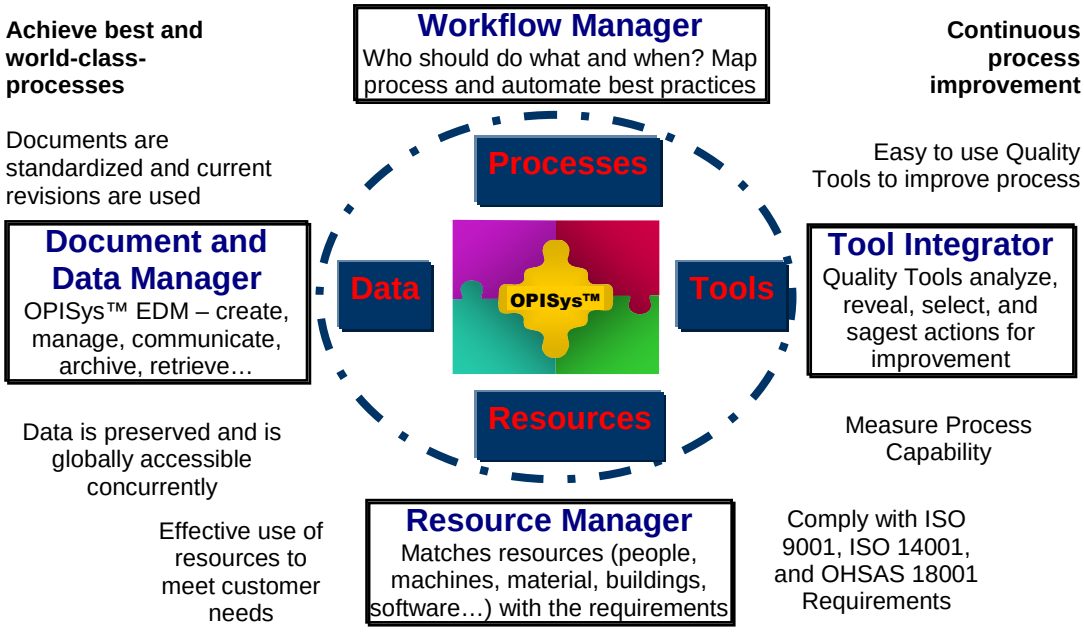


Figure 1: **OPISys™** Concept

OPISys™ model provides a roadmap to guide an organization through a coherent sequence of activities, to achieve process improvement and establish its information support. This sequence of activities has to be followed in order to achieve real process improvement. It will help managers to determine which processes to improve and how to do so.

A system is a network of interdependent components that work together to accomplish a common objective. The most familiar example is the human body. It is a stunning collection of parts that interact with each other in a specific manner as to promote the health and well-being of an individual. Another example is an orchestra. The players support each other to promote the whole; that is, the performance of the orchestra.

Differently put by Deming, a system is a network of connected and interdependent processes that work together in order to achieve goals, meaning to turn inputs into outputs as quickly as possible, with a minimal use of resources, high quality level, and prices acceptable by a customer. Deming said that the aims or goals of the system must

be understood by everyone who works in the organization. People can do their work more effectively if they understand what the organization is trying to accomplish.

The 2000 version of ISO 9000 family standards is based on the understanding that all work (activities) is accomplished in a process. For an organization to function effectively, it has to identify and manage these numerous activities, linked between each other.

Every process has inputs. The outputs are the results of the process. The outputs are products/services – tangible or intangible. The process itself is (or should be) a transformation that adds value. Every process involves people and/or other resources in some way. An output may be, for example, an invoice, computing software, liquid fuel, a clinical device, a banking service or a final or intermediate product of any generic category. There are opportunities to make measurements on the inputs, at various places in the process, as well as on the outputs. These measurement points are called **control points**. **OPISys™** allows organizations to define, monitor, and conduct analyses at the critical points in effective and efficient manner.

The latest version of **OPISys™** is fully developed on innovative .NET technology.

2.1 Workflow Manager

In order people to understand the system, they must understand process at first. The best way to enable understating of a process is to map and describe it using a process flow map. Therefore, the first step on the process improvement journey is **process mapping**. **Process mapping** is a systematic approach for documenting processes and their related cycle times. It also provides a **quick and effective way to develop a visual representation** of the following:

1) **Sequence and interactions** of processes (Level 1 – Macro Process Maps);

2) **Activities** (key steps) occurring within an existing process (Level 2 – Micro Process Maps);

3) **Details** of a process at defined control points (Level 3 – Detailed Process Maps).

The general approach in process mapping is to start with a broad overview of the processes that will constitute the Quality Management System. This will result in the establishment of a macro process map that can be used to comply with the requirements of the standards: ISO 9001:2000, ISO 14001:2004, and OHSAS 18001:1999.

For the purpose of process mapping we in CIM College d.o.o. developed a **Process Mapping Process** that relies on the Supplier Input Process Output Customer (SIPOC) model, depicted below. SIPOC model includes standard question lists aimed at acquiring process knowledge. By interviewing the team that operates the process throughout the whole process flow, we acquire knowledge and identify all the resources that enable it.

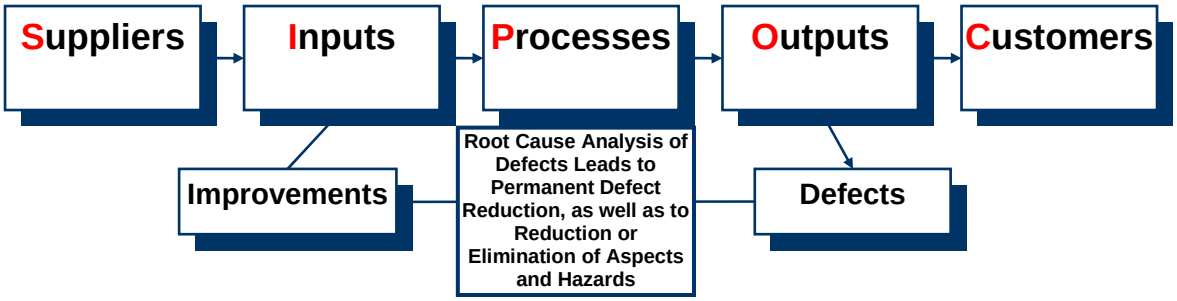


Figure 2: SIPOC Model

Acquired process knowledge including information on resources enables establishment of a process map using *Visual Processes v3.0 .NET* software tool, developed by CIM College d.o.o. (www.cimcollege.co.yu\softver\visproc.htm). Figure 3 illustrates a macro level process map developed by this software tool. A process map depiction is simple and intuitive. A drawing toolbar provides users with all the needed elements aimed at describing the process (process, activity, input document, human resource, material resource, connections, signals etc.). By combining the elements one ends up with a detailed process map.

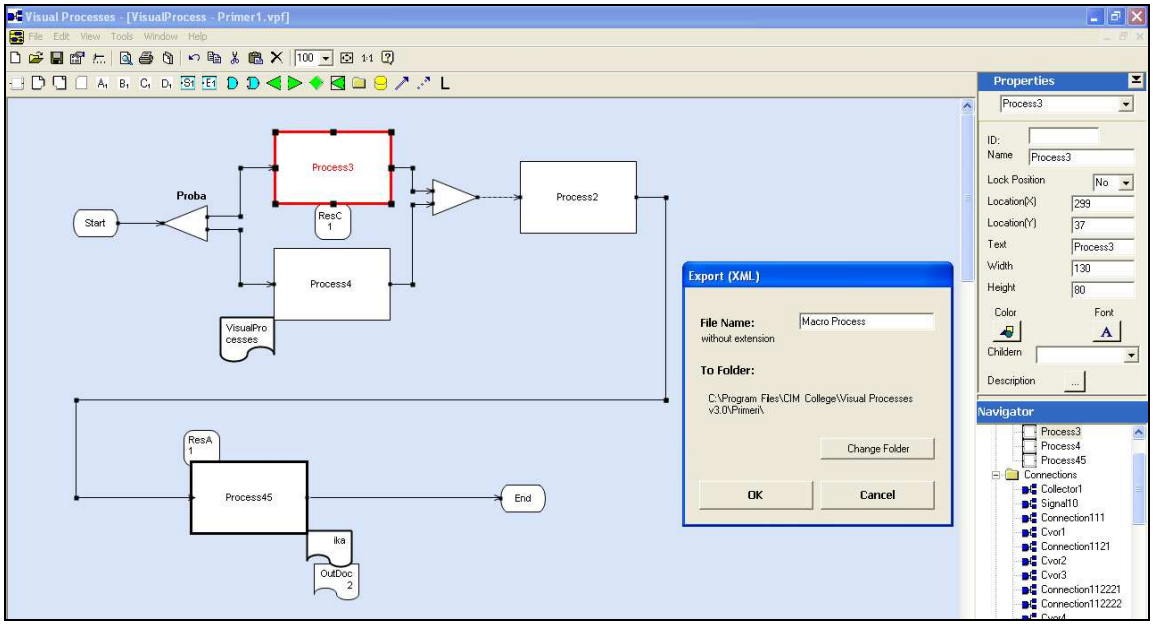


Figure 3: Macro Process Map

Visual Processes v3.0 .NET enables automatic generation of the programming code in XML format. The code interprets the process flow, including logical interrelations between the process elements. Automatically generated code is further used by **OPISys™** for the purpose of developing Business Process Management software applications, which completely automate the process flow. If the process flow is redesigned over time organizations do not need new software support, but only a newly generated XML code. This allows real information supported continuous process improvement, without repetitive investments in software support.

Visual Processes v3.0 .NET further enables establishment of a more detailed process map, at the micro level. It enables defining interconnections between the macro and micro maps by simple mouse moves and clicks. Figure 4 illustrates an example of a micro process map.

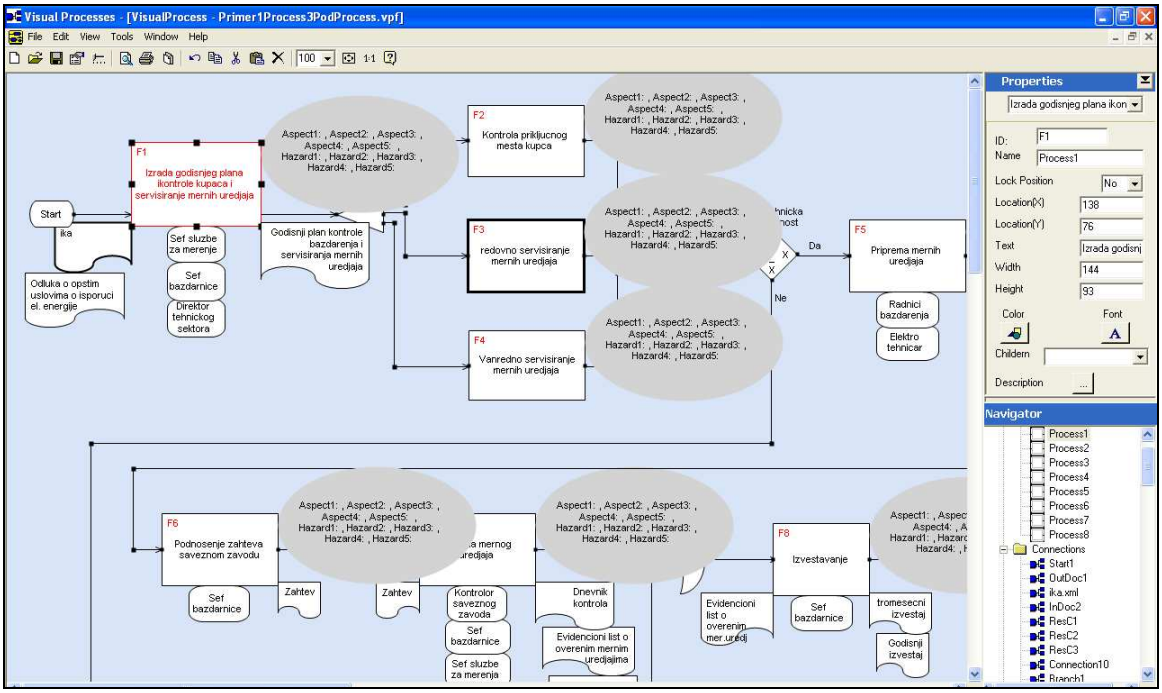


Figure 4: Micro Process Map

ISO 14001:2004 standard asks organizations to define environmental safety aspects that can occur in each and every process activity. On the other hand, OHSAS 18001:1999 asks for identification of occupational health and safety hazards. *Visual Processes v3.0 .NET* takes care of it as well (Figure 4). In the same manner, *Visual Processes v3.0 .NET* connects Critical to Quality Characteristics with the process activities. All the characteristics, aspects, and hazards can further be monitored and analysed using Quality Tools and Methods integrated in the **OPISys™** platform.

3. Tool Integrator

Process improvement asks for **Quality Tools and Methods** and knowledgeable people within the organization. Quality Tools enable: - analysis of all inputs, while detecting and removing potential “viruses”; - improvement of activities; - decrease of variations of Critical to Quality characteristics; - altogether aimed at improving customer satisfaction. Quality Tools help improve process capability within a permanent cycle (on a journey towards excellence – towards Six Sigma process quality level – which means 3.4 defects per million opportunities for a defect). Feigenbaum proved that Six Sigma processes in manufacturing organizations enable savings of 25-40% of gross income, whereas in service sector it goes up to 60-90%.

Information support of processes which are not improved, which contain “viruses”, and which have low capability, can only lead to quicker identification of existing problems, but not to their elimination. In order to avoid losses and increase process capability, the

organization first needs to learn to conduct the process of process improvement. In order to improve processes and reach Six Sigma quality level, the most advanced organizations rely on Design for Six Sigma (DFSS) methodology. This methodology suggests that it is customer requirements that define critical parameters.

Process redesign or process design starts with the identification of customer requirements and their analysis. As process design efforts represent a process themselves we have developed integrated process model on **OPISys™** platform. At a macro level the integrated process model comprises of the following:

- A process of assessing “Voice of Customer”;
- A process of identifying core processes/activities needed to fulfil customer requirements;
- A process of identifying Vital Few activities “responsible for” 80% of customer satisfaction aspects;
- A process of identifying Critical-to-Quality Characteristics that guarantee service delivery that further guarantees customer satisfaction fulfilment.

Acquiring «Voice of Customer» is the first step in the process improvement or design/redesign of a new process with the Six Sigma characteristics. Quality Function Deployment is a tool for transferring «Voice of Customer» into process parameters, using 4 «Houses of Quality». Based on the predefined customer requirements, QFD establishes product/service parameters that are critical for the fulfilment of these requirements. Moreover, it identifies critical spots on the product/service as well as in its development/realization process that are related to identified parameters. At the end, it suggests procedures for realizing improvements on identified critical spots. The more people from the organization work on improvement, the better product/service design/redesign can potentially be achieved. CIM College d.o.o. developed Quality Function Deployment software tool *QFD v2.0 .NET* that largely supports implementation of the QFD method (www.cimcollege.co.yu\softver\qfd.htm).

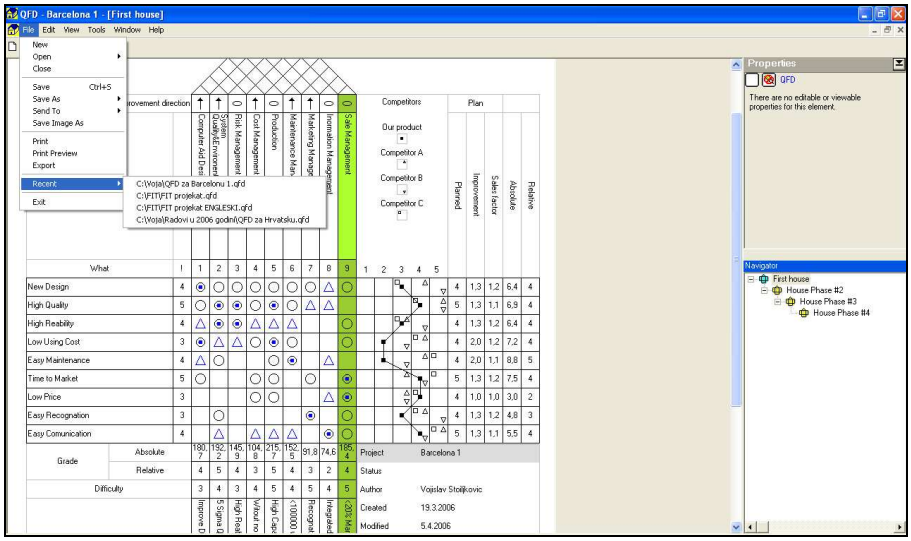


Figure 5: QFD – First House

By applying Lean concepts we can simplify processes, speed them up, while simultaneously reducing variation and potential appearance of defects. In the very essence of Six Sigma we have two fundamental approaches - DMADV (Define Measure Analyze Design Verify) and DMAIC (Define Measure Analyze Improve Control). Both are based on the original Deming's PDCA (Plan-Do-Check-Action) cycle and are widely proven (applicable to any process) from manufacturing to service. As well, DfSS relies on systemic methods, tools, and techniques aimed at facilitating development of services and processes.

The two Illustrations below depict application of Quality Tools we identified as particularly relevant for processes improvement, in different phases of DMAIC.

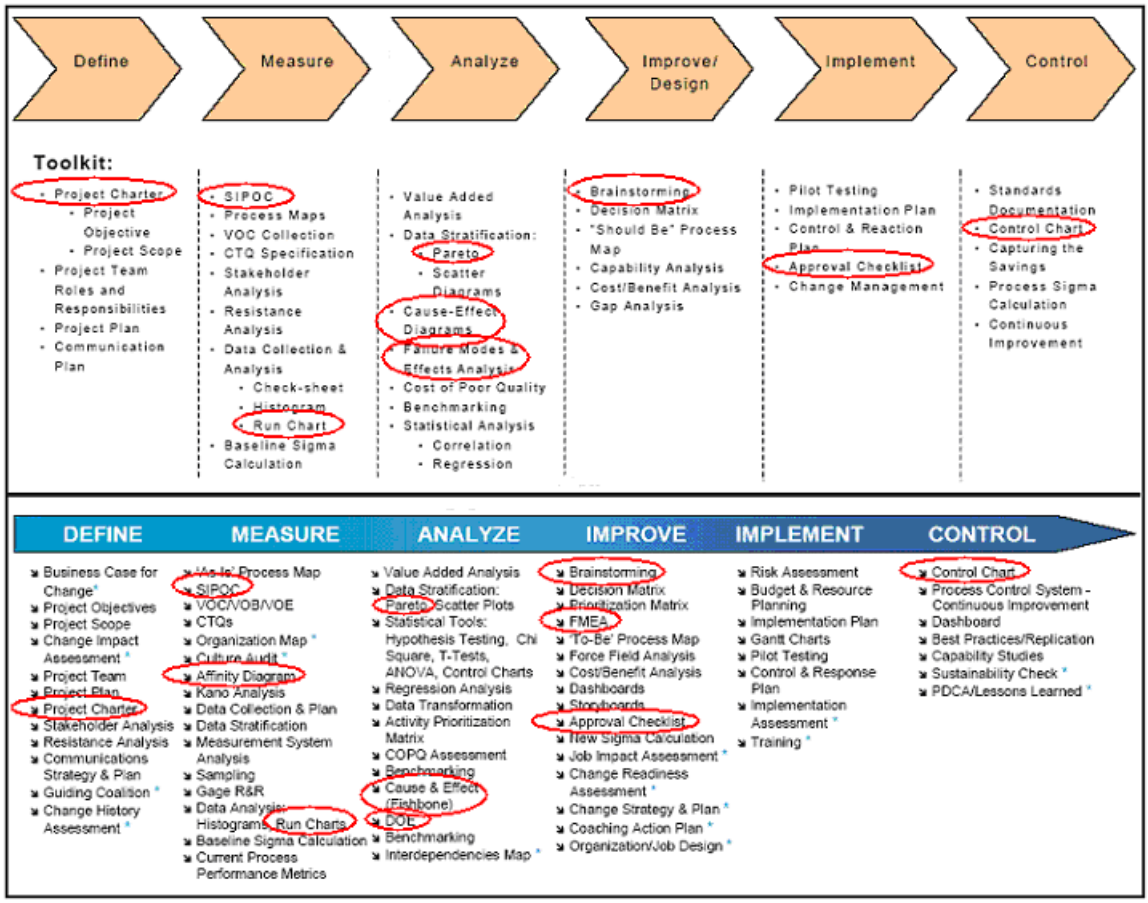


Figure 6: DMIAC Model and Tools

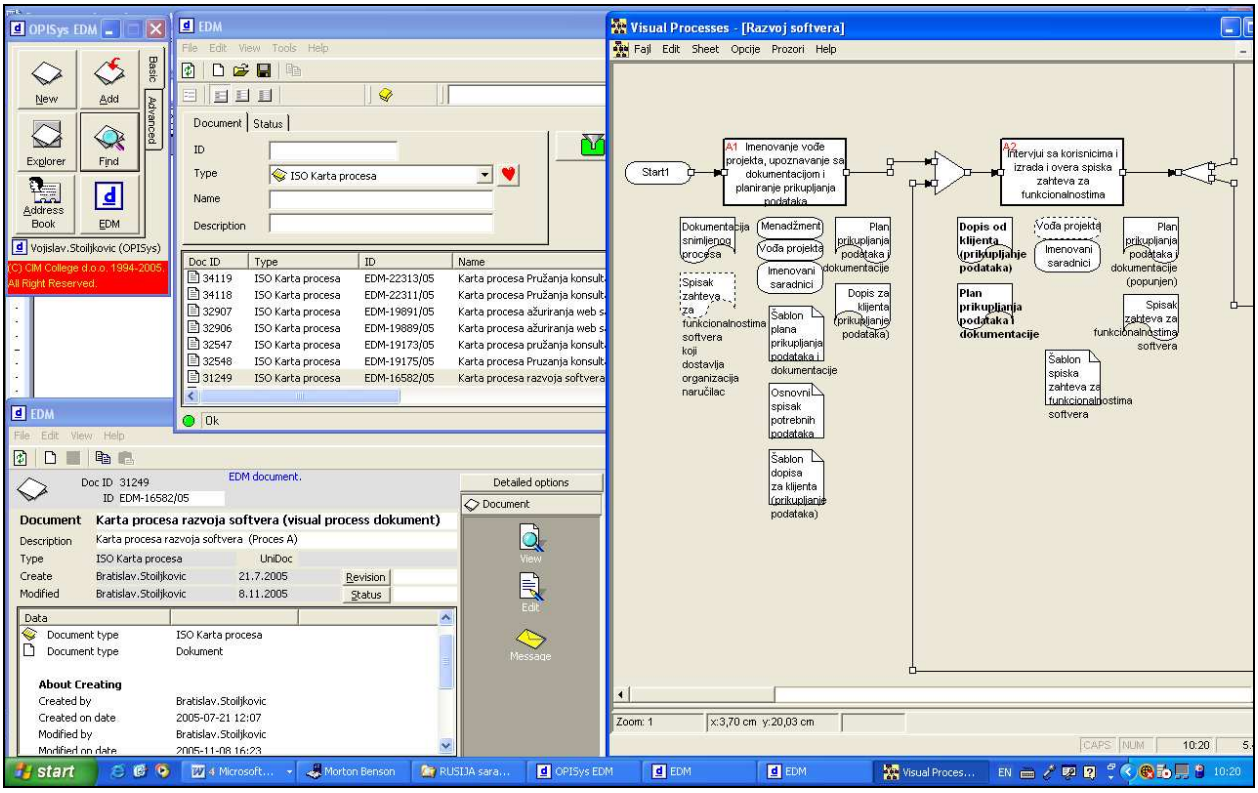
OPISys™ platform integrates Quality Tools needed for applying DMAIC and DfSS methodologies in reaching Six Sigma quality level.

By relying on DfSS, one defines variability of critical parameters in advance, based on estimated performances and product/service reliability. This allows organizations to define product/service and process that guarantees fulfilment of all customer requirements, as early as in design phase. Such results are achievable only with the implementation of Quality Tools.

4. Document and Data Manager

OPISys™ further offers integrated Document and Data Management system. Managing documentation and data is a process, as any other. This means that document and data management process can be improved and automated using **OPISys™** platform. **OPISys™ EDM** is developed to completely support the process of electronic management of documentation and data in the organization of any size, specially taking care of management standards' requirements.

Users have at their disposal a large set of options that facilitate document and data search, generation and management of document types, document archiving, external and internal communication management, process flow check lists, etc. Figure 7 depicts some of **OPISys™ EDM** functionalities. The latest version of **OPISys™ EDM** is fully developed on innovative .NET technology. More details on **OPISys™ EDM** you can find on www.cimcollege.co.yu\softver\opiedm.htm.



Slika 7: EDM – Electronic Document and Data Management

5. Conclusion

More than ten years CIM College d.o.o. continually improves **OPISys™** platform, by closely monitoring innovative IT trends as well as management system standards and excellence models. Business plan and main concepts of **OPISys™** platform are published in our book Process Improvement and Reengineering (*Poboljšanje i reinženjering procesa).* As of 1994 until today our methodology has been practically implemented in a vast number of organizations. Experience that we gained over time

helped us further improve **OPISys™** for our customers. By integrating Quality Tools and Methods we enabled **OPISys™** users to monitor and analyse their processes effectively and efficiently.

Literature

[1] Stoiljković, V. i drugi autori, *Poboljšanje i reinženjering procesa*, CIM College d.o.o. & Mašinski fakultet Niš, Niš, 1998., str.346.

[2] *System Approach to Process Improvement*, Department of Navy, 1997.

[3] Wheeler, D.J., & Chambers, D.S. (1992). *Understanding Statistical Process Control. (2nd Ed.). Knoxville, TN: SPC.* Chapters 1, 12.1, 13.8.