International Journal on
"Technical and Physical Problems of Engineering"
(IJTPE)
Published by International Organization of IOTPE

ISSN 2077-3528
IJTPE Journal
www.iotpe.com
ijtpe@iotpe.com

March 2014 | Issue 18 | Volume 6 | Number 1 | Pages 183-186

ENGINEERING DESIGN PROBLEMS

T.H. Dostalizade [1] R.N. Mehdizadeh [2] A.V. Bannikova [1] E.T. Abdullayev [1]

1. Department of Electrical and Instrumentation, Encotec Company, Baku, Azerbaijan
tdostalizade@encotec.az, abannikova@encotec.az, eabdullayev@encotec.az
2. Institute of Physics, Azerbaijan National Academy of Sciences, Baku, Azerbaijan, rauf@physics.ab.az

Abstract- Problem solving is a special kind of skill to learn. It is unlike many other learning outcomes. There are many different kinds of problems that exist, with design problems being kind of problems with their own characteristics. Design problems are characterized by the fact that they are often complex, ill-defined and with no singular process model. Solving design problems requires system, procedural and strategic knowledge that need to develop for contextual thinking and decision-making. This paper formulates a learning approach that assists engineers to develop competencies to solve design problems particularly related to the engineering discipline.

Keywords: Engineering Design, Design Quality Problem Solving, Design Problems.

I. INTRODUCTION

The industrial society develops and generates the new complex and scaled service types, which meets to the industrial recent requirements. Nowadays, to build and start the new factory, in spate of good knowledge of work process, it is need to take a consideration technical discoveries and scientific advantages. Engineering was created as new direction in the consulting service area as a result the necessity of integrated approach during preparation and promotion of construction engineering projects. Every organization is anxious for improve its activity. Quality Management System is ensure a necessities structure for control and improving quality indicators.

The ISO 9001 is the most famous standard in the world for Quality Management System arrangement, which used in most organization in the world. Key task of the modern design engineering to create qualitative, competitive, and merchantable outputs, the competitive and merchantable outputs are provided by:

- The modern design engineering computer technology (CAD, Computer-Aided Design)
- Availability and agile development of professionals' intellectual capability

The problem of increasing outputs quality is topical problem. Quality improvement process combines the activities of many multi-disciplines and is required not only for profit, and most importantly for the community as a whole and its interests.

II. ENGINEERING DESIGN PROCESS

The engineering design process is a series of steps that engineering teams use to guide them as they solve problems (design loop in Figure 1).

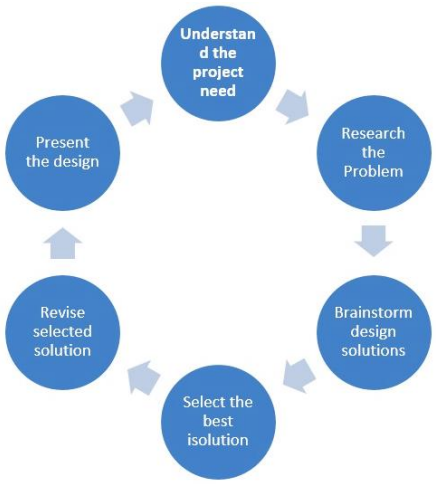

Figure 1. Design loop [1, 2]

A. Identify the Project Need

Identify the problem, the project requirements, the project battery limits.

B. Research the Problem

Gather information and conduct research, examine the current state of the issue as well as the solutions that are presently available. Engineers and designers must be equipped with a diverse range of information in order to produce the best possible solutions. They need to determine if there are products on the market that already solve the problem, and if there are, they must list the advantages and disadvantages of the products. Establishing design requirements is one of the most important elements in the design process. The design requirements control the design of the project throughout the engineering design process.

C. Brainstorm Design Solutions

After conducting research, the engineer as designer must brainstorm potential solutions and make a list of the advantages and disadvantages for each solution.

The engineer then has to think about what could be changed in order to improve each solution.

D. Select the Best Solution

After the brainstorming phase, the engineering group decides which solution it likes best, and meet to the project requirements.

E. Revise the Best Solution

After choosing the best solution the engineer evaluates it to determine if it works and if it meets the original design constraints.

F. Present the Design

The finalized documents package explains how the product solves the project need that was initially defined [1, 2].

III. DESIGN QUALITY

Design quality is the compliance of final result to the client requirements and working standards, at given constraints on resources and time. The main feature of the engineering design company is not only the standard project processes structure, and the standard constraints (time, cost, personnel). Key feature of the all-complex projects is its no contractual quality.

It is impossible to describe in corpora requirements to designed system during prior to contract stage. Mentioned factor is define another key feature of any design project, a large number of risks and a high degree of uncertainty. In addition the design business have the following features:

- Intellectual nature the most of projects
- Strong relationship of project design success from client actions
- Higher risk of completion time and budget, break or stopping project
- High quality requirements
- High degree of the client individualization and the importance organization close to client work
- High probability of new design works, which have not been prepared previously, which methodology and technology is prepared on the fly
- High requirements to the manager and executor professional skill, their high labor cost

The quality project design documentation is presented by two (2) factors:

1. The quality of project design solution is define compliance to client project requirement and working standards. Quality criterion of the project design solution are presented by reliability, safety, efficiency, etc.
2. The quality of project documentation is define compliance to Company Quality Management System and working standards. Quality criterions of the project documentation are presented by defect correction frequency, rate activity, easily to use, correctness, etc. [4].

The time, cost and quality is the most important value of any design project. They are very closely related to each other. This relationship is called "The Iron Triangle" (Figure 2) [5].

Figure 2. The iron triangle [5]

Simplistically, a change in any one of these constraints has a necessary effect on either one or both of the other two. If the three constraints are out of balance with each other at the beginning of the project, then one or more of them must change or the resulting quality of the project is destroyed by artificially meeting the constraints by cutting corners.

IV. QUALITY PROBLEMS OF ENGINEERING DESIGN

A. Uncertainty

Each design project is contains to a greater or lesser degree of uncertainty. These factors produce inaccurate planning time, cost, and quality. Inaccurate of planning time, cost and quality is appeared because:

- Scope of work is not defined correctly by involved personnel, because they dedicate the design time.
- The final result is not correctly imagined. If final project imagine is fuzzy expressed, then difficulty define of work time schedule and costs. In the result design mistakes is appeared and design period is increased.

B. Planning

Planning period is the most important factor that influence to the project design quality. Project tasks, budget and time-schedule are defined at this stage. Very often planning is realized as work schedule preparing, but not taking into consideration resource management, budgeting, and risk analysis and quality management. Actually planning period should contains the following steps:

1. Project objectives definition and its describing
2. Engineering design stages definition
3. Tasks definition for dedicated design stage, Indicate its sequence, relationship and time performance
4. Coordinate project resources. Planning error is very often appeared due to involving scarce resources in to the several projects at the same time
5. Risk analysis is produced new tasks and additional resources involving into the project
6. The budget is defined by labor cost. The one of the typical errors is not considering predictable project cost in to the budget [3, 6].

C. Risk Analysis

Project risk is the fixed possibility of losses origin. First of all losses are influence to a quality.

For the dedicated project, the project losses can be expressed via:
- Insufficient quality of final product
- Increasing of project costs
- Increasing of project period
- Failure in the project objectives

Risk management is the process associated to identification, risk analysis, and decision-making, which include maximizing the positive and minimizing the negative effects of risk events [6]. The project risk analysis management is include performance of general procedure indicated in Figure 3.

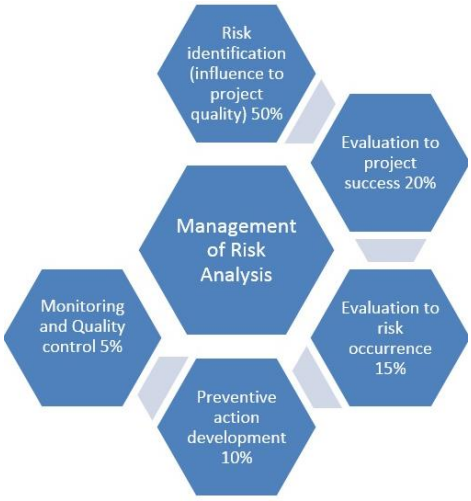

Figure 3. Management of risk analysis [6]

All indicated on Figure 3 procedures are interact to each other and with other procedures of QMS. They have different influence to the project quality implementation. Practice indicates that the identification of potential risks has the strongest impact on the project quality. Non-recognized risk is lead to losses of project quality [6].

V. SOLUTIONS

For improvement of project design quality the following should be taken into consideration:
- Define Client project requirements and expectation of final project.
- Preparing the Quality plan, which is dedicate project risks and project priorities based on it.
- Divide project stage on the main tasks and sub-tasks. This makes planning more accurate and easy.
- Centralize distribution Company resources for projects.
- Interdisciplinary checking, the goal of this action is probable lacks/errors identification, because significant errors can be found at this stage. Errors correction at the project stage is low cost, than error that is not identified end until object commissioning.
- Reserve not less 30% from overall project labor time for project design monitoring and control.
- All changes during the project design should be traced and reflected in the project documentation. Also alterations in working standards should be traced [4, 6].

VI. CONCLUSIONS

Society continues to seek innovation and in striving to progress, the engineering and product design field will continue to grow. The problems of engineering design that are outlined above provide the tools and guidance engineers use in the complex field of product design.

REFERENCES

[1] A. Ertas, J. Jones, "The Engineering Design Process", 2nd Ed., John Wiley and Sons, Inc., New York, 1996.
[2] A. Eide, R. Jenison, L. Mashaw, L. Northup, "Engineering - Fundamentals and Problem Solving", McGraw-Hill Companies Inc., New York City, 2002.
[3] P. Ralph, Y.A. Wand, "Proposal for a Formal Definition of the Design Concept", K. Lyytinen, P. Loucopoulos, J. Mylopoulos, W. Robinson, (Eds.), "Design Requirements Engineering", LNBIP, Vol. 14, pp. 103-136, 2009.
[4] P.Q. Stepchenkov, "Particular Qualities for ISO 9001:2000 Application in Design Organization", Russia, http://quality.eup.ru/MATERIALY14/project--9001.htm.
[5] E. Bethke, "Game Development and Production", p. 65, 2003.
[6] V. Ilyin, "The Concept of Project Quality Management", Russia http://quality.eup.ru/ MATERIALY15/kukp.htm.
[7] Education and Learning Methods (11ELM).

BIOGRAPHIES

Tahir H. Dostalizade was born in Dushanbe, Tajikistan, in May 1975. He received a five-year degree in Electromechanical Engineering from Azerbaijan Technical University, Baku, Azerbaijan in 1997 and the Ph.D. degree in Engineering from the same university, in 2004. He is currently a Senior Electrical and Instrumentation Engineer in Encotec engineering company, Baku, Azerbaijan. He has authored or co-authored of several papers in international conference proceedings.

Rauf Nureddin Mehdizadeh was born in Baku, Azerbaijan, 1943. In 1967 he graduated from Moscow Power Engineering Institute, Moscow, Russia. Since 1967 he works in the Institute of Physics of Azerbaijan National Academy of Sciences, Baku, Azerbaijan in High Voltage Physics and Technology Laboratory. In 1981 he honoured by Ph.D. degree and from 2010 he is a Doctor of Technical Sciences. He is the editor of scientific journal "Power Engineering Problems" and Secretary of International Conferences "Technical and Physical Problems of Power Engineering" (ICTPE). He published about 120 published proceedings in journals of the CIS countries, the Turkey, Iran, USA, Germany, Bulgaria, the United Arab Emirates, 15 patents, reports and appearances at many international conferences.

Alla V. Bannikova was born in Baku, Azerbaijan, in 1979. She received the B.Sc. and the M.Sc. degrees, Diploma of Metrologies Engineer from Azerbaijan Technical University, Baku, Azrbaijan in 2000 and 2002, respectively. Currently she is an Electrical and Instrumentation Engineer in Encotec Company, Baku, Azerbaijan.

E.T. Abdullayev was born in Baku, Azerbaijan, 1983. He received the B.Sc. and the M.Sc. degrees from Department of Electrotechnology and Energy, Azerbaijan Technical University, Baku, Azerbaijan in 2004 and 2006, respectively. Currently, he is an Electrical Engineer in Encotec Company, Baku, Azerbaijan.