International Journal of Business and Management Study
Volume 3 : Issue 3 *[ISSN 2372-3955]*
Publication Date : 30 December, 2016

PROCESS-BASED FUZZY RİSK ASSESSMENT: A CASE STUDY OF A STEEL SERVİCE CENTER

[Tulay KorkusuzPolat, Aslı Cebeci, Sebiha Kurt, Berat Elaldı]

Abstract—It is important to provide a competitive advantage by creating a difference and to be able to maintain this advantage in the business world, where change is inevitable. That's why adapting to changes easily, providing the efficient use of resources, offering new products and services, determining opportunities for improvement and fulfilling the conditions for productivity have become more important for firms day by day.

To attain these objectives, the processes should be managed systematically. In this way, firms can more clearly determine those fields which are open to improvement by monitoring the performances of the processes. One of the most important auxiliaries in providing this systematic quality of process management is risk management. Since any factor to negatively affect the performance of a process can be defined as a risk, the risks specified in a process-based fashion will enable the processes to work better as a support for determining those parts in which a process does not work properly.

In the study, the business processes at a Steel Service Center were defined first; process cards were drawn up for each process; and possible risks were specified for each defined process. Fuzzy risk assessment was made as the values of probability and intensity showed uncertainty at the stage of assessing the specified risks. Risk assessment was made by clarifying the values of fuzzy probability and intensity with no certainty by means of the fuzzy toolbox of the MATLAB program. In conclusion, it was intended to enable the processes to work more effectively and productively by proposing different strategies in order to eliminate the specified risks or so as to reduce their sizes.

***Keywords*— process management, risk management, fuzzy logic, MATLAB**

I. Introduction

Such reasons as increased customer expectations, increased uncertainties/crises/risks, the products and services which have become complicated, the changing business world, the activities which have become complicated and are unmanageable, and a decrease in the trust in investors are gradually making the conditions for competition harder.

Keeping up with change is also gradually becoming difficult in today's business world, where competition is provided by producing products/services which are appropriate for customer expectations and which can create a difference rather than producing in large numbers. Therefore, establishments can go ahead of their competitors in taking decisions quickly and providing a competitive advantage by determining the activities which do not create any value added, ensuring customer-oriented management, and determining the responsibilities clearly by developing the relationships between functions.

Process management studies have been widely used in the business world recently in order to obtain a competitive advantage. Whether defined or undefined, the business processes constituting the everyday activities of employees and their ways of working are among the most important elements of establishments. Process-based definition and management of the activities carried out in an establishment are essential in terms of the observability of the flow of activities in the establishment and their relationship with each other. With process management, those processes which consist of the activities that create value added, whose responsible people and implementers have been determined, which are customer-oriented, and whose performance indicators have been determined and are continually being assessed, analyzed, and developed are defined and managed systematically. With process management, the process performance is effectively followed and its necessary improvements are made; dependence on individuals decreases as it eliminates being person-oriented in the systems; the mistakes made decrease and customer satisfaction increases as the operations are standardized; the workloads are distributed in a more balanced fashion on the basis of both units and individuals since the

responsibilities are specified clearly; the speed of taking effective decisions increases since the activities in the processes which do not add any value are eliminated; and the quality of processes and hence products/services increases and a more efficient and productive working environment is provided since it is ensured that the correct task is assigned to the correct person/people.

The absence of a systematic process management system in establishments causes such situations as the failure of the tasks done to be standard, the variation of the task by implementer, the failure to check the tasks done, and the failure to quantify their performance. Similarly, the factors to prevent the processes from attaining their specified targets can be defined as risks for the process within the scope of process management. These risks should be eliminated so as to ensure that the process targets are above specific performance values. Thus, when carrying out process management in establishments, the risks to prevent the targets for each defined process should also be defined, analyzed, and assessed, thereby determining appropriate strategies for managing the risks.

In this study, an overall introduction to process and risk management was made in the first section and then the literature on process, process management, risk management, and fuzzy logic was mentioned in the second section. In the third section, the Steel Service Center, where the application was made, was briefly introduced; the application of process-based risk management was described in detail (a total of 9 main processes and 28 sub-processes were determined); a fuzzy logic application made for the 13 risks whose probability and intensity values could not be determined quantitatively was included. The results of the study were mentioned and the studies likely to be carried out from now on were presented as recommendations in the fourth section, i.e. the conclusion.

II. Literature

A process is a series of activities which convert the specific inputs obtained from a supplier into useful outputs for customers by creating value added, which can be defined and quantified, and which create value interdependently. A process is a chain of operations performed for the completion of the tasks which make up the products or services that an establishment offers to its customer (KorkusuzPolat et al., 2016).

A business process consists of a set of linked activities or elements designed and performed by internal and external suppliers to create valued goods, services and decisions for internal and external customers. Collectively, these processes are the business and need to be managed. Process activities may be performed for instance by suppliers, employees, customers, manufacturing equipment, and computers. Successful processes ultimately keep employees, stockholders, and customers satisfied, creating value for the firm and its products (Wisner and Stanley, 2008).

Process is important for two reasons: producing a better product, and enabling better productivity. A quality product is the output of a quality process. "Only by a miracle can the quality of product be better than that of the process that produced it" (Thomson, 1995). Processes are important because (Madison, 2005): they are major components of organizations; a process-focused organization can use process analysis to diagnose all types of problems (e.g. structure, controls, people, and processes); most organizational problems have their root cause in a process; and organizations can manage work much more effectively and efficiently through a process mindset.

Value-driven business process management (BPM) is the management discipline that uses process as the critical link to translate business strategy into execution. It sets the right focus for initiatives based on the strategic imperatives of an organization and converts business processes into real assets that provide competitive advantage. Value-driven BPM makes a business process more adaptable, enabling more agility in adjusting strategy in response to the dynamic business environment (Franz and Kirchmer, 2013).

When defining the processes, the goal is to reveal the natural flow of the activities of an establishment and their relationships among each other, whereas process management aims to organize this flow in such a way that will enable an establishment to attain its targets.

Process management presents systems, procedures, methods and tools for sustainably securing maximal performance and continual improvement of business processes so as to fulfill determined strategic goals. Successful economic development and market environment development also require – besides the application of traditional methods in business – the application of new modern methods adapted to the contemporary market needs, requirements and conditions (Sujova and Marcinekova, 2015).

For detailed information about process and process management, you can see Palvarini et al. (2014), Panagacos (2012), Dumas et al. (2013), Davenport (1993), Villacreses (2003), Becker et al.(2003), Smith and Fingar (2003), Sharp and McDermott (2001), Armistead and Rowland

(1996), Jorge and Oliveira (2012), Klassen and Menor (2007), Jeston and Nelis (2014), .

Risk is defined as the "cumulative effect of the probability of uncertain occurrences that may positively or negatively affect project objectives". This is unlike uncertainty, which considers only the event and where the probability is completely unknown (Pritchard, 2014). Risk management is a process by which firms identify measure, prioritize and mitigate the adverse effect of uncertainties (Mohammed and Knapkova, 2016). For detailed information about risk and risk management, you can see Coleman (2011), Crouhy et al. (2000), Hillson (2016), Hopkin (2014), Mandal and Maiti (2014), Decker and Galer (2013), Silva et al. (2014).

III. Application

The steel service center where an application was made in this study (Turkey) was founded in 1999. The company is the supplier its Group Companies and carries on its activities with approximately 180 employees in the automotive subsidiary industry in the fields of supply/cutting/slitting/logistic services and the trade of production parts.

Some 9 main processes and 28 sub-processes were determined and process cards were drawn up for all processes in the process management study performed at the company 'X Factory'.

The process card for the Slitting Line process, which is one of the four main production lines at the company and in which metal coils are slit, is provided in Table 1.

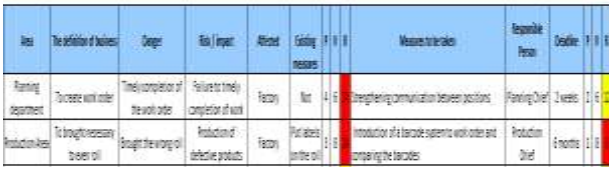
TABLE I. THE PROCESS ID CARD FOR THE SLITTING LINE


Name of the Process: SLITTING LINE Process
People who defined the process: Engr ELALDI, Aslı CEBECİ, and Selahi KURT
Person Responsible for the Process: Production Chief
Implementers of the Process: Main Operator
Aim of the Process: To bring the relevant coil from the depot in line with the information in the work order, to slit it according to the work order and obtain smaller horizontal and vertical coils, and to rewind the remaining coil.
Actions:
1. Arrival of a work order from planning
2. Arrival of the relevant coil from the inventory department to the entrance of the line by means of a crane
3. To compare the work order and the label of the coil
4. To place the coil into the coil car and check its weight
5. To prepare the set of blades according to the measurements in the work order and place it into the line
6. To make the diameter checks and place the coil into the line
7. To open the tip of the coil, attach it to the machine, and send it as far as the blade
8. To carry out the first cutting of the coil and check the cut parts
9. Its continuation throughout the free zone and the oscillation the coil in the pit
10. To attach the parts cut by the separator
11. Pass from the role material compression to be applied
12. To place the material into the second separator and initiate the winding operation
13. To carry it to the packing area by means of the coil car
14. To pack and label the material
15. To carry the material to the inventory area by means of a crane
Inputs of the Process: The Main Coil and the work order
Its Supplier: The Depot and the Companies from which the purchase is performed
Its Outputs: The slit coil, the rewound coil, the completed work order, and Scrap
Its Customer: The Blank Line, the Mini Leveler Line, the Depot, Contracted Firms, and the Foreign Sales Department
Performance Indicators: The measurements and quantities appropriate for the work order as well as appropriateness for the number of coils planned and to be slit
Other relevant processes: The Blank Line and the Mini Leveler Line
Risks:
R1 A delay in the work order from planning
R2 Arrival of the wrong coil from the inventory department to the entrance of the line
R3 To make a wrong comparison between the work order and the label of the coil
R4 To miss the deformation of the coil
R5 To prepare the wrong set of blades
R6 To check the measurement of the cut part wrongly
R7 To place a wrong label onto the product whose work order has been completed
R8 The hand of the worker is cut during the quality control of the first cut part
R9 The steel bands break off during packing

The definitions used in the process card for the slitting line shown in Table 1 were determined as follows. **Person Responsible for the Process:** The person who knows, manages, and conducts the process and who will make the process improvements and the necessary arrangements. **Implementers of the Process:** The operators, technical staff, etc. who run the process. **Actions of the Process:** The activities which create value added and show how the process works. **Inputs of the Process:** All sources provided by the suppliers of the process such as people, machines, materials, capital, and information. **Suppliers of the Process:** People or establishments that provide the inputs of the process. **Outputs of the Process:** Conversion of inputs into goods and services by creating value added in order to meet customer needs and expectations. **Customers of the Process:** Users of the outputs of the process. **Process Performance Indicators:** The quantifiable criteria which indicate the level at which a process meets customer expectations/needs in specific periods. Process cards were likewise prepared for all the other processes too.

Any factor which negatively affected the performance of processes was defined as a risk. A total of 69 risks were determined for 28 sub-processes. Different techniques are used in the literature for risk assessment, and one of the most common and handiest ones is the Matrix method. In this study, the matrix method was preferred as the method of risk assessment. In the matrix method, attention is paid to two dimensions of a risk (the probability of its occurrence and its intensity after its occurrence). The risk size for each risk is calculated by multiplying these two dimensions. To assess the risks objectively with the matrix method, a risk template which shows the equivalents of intensities and probabilities should be prepared. Since expressing the intensities and probabilities of different risks with the same indicators is inappropriate for assessment (for instance, the indicators and equivalents of the production risks and the risks of occupational health and safety in the risk templates differ. Whilst Level 10, the maximum level for intensity in the template prepared for production risks, is "image loss", Level 10 in the risks of occupational health and safety corresponds to "an accident involving more than one death"), the risks were classified in order to make the assessment more objectively. Thus, in the study, the risks were classified under four headings as production, occupational health and safety, financial, and administrative risks. Risk templates indicating the intensity and probability of occurrence of a risk were determined for each class.

TABLE II. PRODUCTION RISK MATRIX



When risk sizes were above the acceptable value determined for the relevant class that the risk belonged to, a risk strategy [*acknowledgement (acknowledging the existence of a risk and preparing a Plan B in order for the process to go on working), reduction (carrying out activities to reduce the size of a risk or to downsize its probability value and/or intensity value), avoidance (not acknowledging a risk and not carrying out the process or activity which will realize that risk) or transfer (having another establishment carry out the relevant process or activity if the risk is not acknowledged but the process or activity cannot be abandoned)*] was determined to eliminate the relevant risk or to reduce its size.

When making the risk assessment, the method of Fuzzy Logic was utilized to assess the risks whose intensities and probabilities could not be expressed quantitatively (The MATLAB-Fuzzy Toolbox was used as the tool). The fuzzy logic consists of three different operations: 1) **The Fuzzification Operation** *(assignment of a membership value to each of the risks and their conversion into a linguistic structure)*. In the fuzzy risk matrix, first of all, the factors causing the occurrence of the risk were addressed qualitatively and their graphs were generated. 2) **The Rule Operation** *(writing the fuzzified risks with their weights within the framework of specific rules)*. Rules which showed different probabilities were organized for these graphs. 3) **The Defuzzification Operation** *(conversion of the fuzzy information into real numbers by making a change in the scale)*. The defuzzification operation was performed by giving weights. In the defuzzification operation, all risk-causing factors are re-converted into qualitative variable values. **In fuzzy inference,** the probability and intensity values of a risk which we had previously failed to express quantitatively were turned into quantitative outputs on the basis of the rules for the current state.

One of the 13 risks subjected to fuzzy risk assessment was described in detail. To determine the size of the risk of "losses of forklift materials", first of all, the factors to cause this risk were specified as the speed of the forklift, the weight of the material, and the clutching power of the forklift. The extent of the losses of materials and which of the risk-causing factors was more effective were determined as a result of the fuzzy risk assessment. An image of the risk-causing factors taken from the MATLAB program is illustrated in Figure 2.

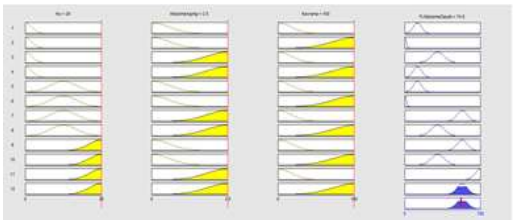


FIGURE 2A. THE RESULTING STATE OF THE FACTORS CAUSING THE RISK OF "LOSSES OF FORKLIFT MATERIALS"

FIGURE 2B. A DIFFERENT COMBINATION OF THE FACTORS CAUSING THE RISK OF "LOSSES OF FORKLIFT MATERIALS"

There are three causing factors for the risk of "Losses of forklift materials" shown in Figure 2a. The first column shows the speed of the forklift. The second and third columns demonstrate the two other factors, respectively. The last column shows how these factors affect the probability of occurrence of the risk for different combinations. The graph shown in Figure 2b contains rules as "for instance, if the speed of the forklift is high, its material weight is high, and the clutching power of the forklift is low, there will be losses of materials so much."

IV. Conclusion and recommendations

All business processes were defined for the company. Within this scope, 9 main processes and 28 sub-processes were defined by preparing their process cards. To manage the business processes more efficiently, the risks to move the processes away from their targets were specified. Although some risks were similar, a total of 69 risks were determined for all processes. Since the probabilities of occurrence and intensities of 13 of these risks could not be defined quantitatively, the assessment of these risks was analyzed in a fuzzy way with the MATLAB package program. Different risk strategies were developed to take measures for all assessed risks.

The company aims to enlarge its current production capacity. Therefore, it is going to put into use the additional factory qualifying as the continuation of its current factory as of August 2016. The process management and risk management studies carried out within the scope of

this study constituted a study to help the company to attain its targets.

References

KorkusuzPolat T., Aksoy G., Konuskan O., Usta S., "Process Management and Process-Based Risk Management: A Case Study From The Furniture Sector", EDSI 2015 Conference - Decision Sciences For The Service Economy, May 31st-June 3rd 2015, Taormina - Italy

[1] Wisner J., Stanley L., (2008), "Process management: Creating value along the supply chain - Text & Cases", Thomson South-Western, 1st Edition, printed in the United States of America

[2] Thomson V., (1995), "Process management in manufacturing", Control Engineering Practice, Vol. 3, No. 4, pp. 537-543

[3] Madison D., 2005, "Process mapping, process improvement and process management", Paton Press, ISBN-10: 1932828044, ISBN-13: 978-1932828047

[4] Franz P., Kirchmer M., 2013, "Value-driven business process management: The value-switch for lasting competitive advantage", McGraw-Hill Education, ISBN-10: 0071825924, ISBN-13: 978-0071825924

[5] Sujova A., Marcinekova K., 2015, "Modern methods of process management used in Slovak enterprises", Procedia Economics and Finance 23, Page 889-893, 2nd Global Conference on Business, Economics, Management and Tourism, 30-31 October 2014, Prague-Czeck Republic

[6] Palvarini B., Gattaz Sobrinho F., Quezado C., 2014, "Process Management – a results – oriented approach", CreateSpace Independent Publishing Platform, ISBN-10: 1496055209, ISBN-13: 978-1496055200

[7] Panagacos T., 2012, "The ultimate guide to business process management: Everything you need to know and how to apply it to your organization", CreateSpace Independent Publishing Platform, ISBN-10: 1477486135, ISBN-13: 978-1477486139

[8] Dumas M., La Rosa M., Mendling J., Reijers H. A., (2013), "Fundamentals of Business Process Management", Springer-Verlag Berlin Heidelberg, ISBN-10: 3642331424, ISBN-13: 978-3642331428

[9] Davenport, T.H., (1993), "Process Innovation" , McGraw-Hill Company , New Jersey

[10] Villacreses, K.F.B., (2003), "A Methodology for Identifying and Eliminating Waste in Office Environtments", The University of Texas at Arlington

[11] Becker J., Kugeler M, Rosemann M., (2003), "Process Management – A Guide for the Design of Business Processes", Springer, 1 edition, ISBN-10: 3540434992 ISBN-13: 978-3540434993

[12] Smith H., Fingar P., (2003), "Business Process Management – the third wave", Meghan Kiffer Pr., 1 edition, ISBN-10: 0929652339 ISBN-13: 978-0929652337

[13] Sharp A., McDermott P., (2009), "Workflow Modeling: Tools for Process Improvement and Applications Development", Artech House Inc., Second Edition, Boston, USA, ISBN-10: 1596931922 ISBN-13: 978-1596931923

[14] Armistead C., Rowland P., (1996), "Managing Business Processes: BPR and Beyond", Wiley, 1 edition, ISBN-10: 047195490X ISBN-13: 978-0471954903

[15] Jorge M. A. G., Oliveira S.B., (2012), "Analysis of challenges for improvements on process management in the perception of professionals acting in a pension fund in Brazil", Procedia Technology 5, page: 283-292, CENTERIS 2012 – Conference on ENTERprise Information Systems / HCIST 2012 – International Conference on Health and Social Care Information Systems and Technologies.

[16] Klassen R.D., Menor L.J., (2007), "The process management triangle: An empirical investigation of process trade-offs", Journal of Operations Management, 25, page 1015-1034.

[17] Jeston J., Nelis J., (2014), "Business Process Management; Practical Guidelines to Successful Implementations", Routledge, Third Edition, NewYork, ISBN-10: 0415641764, ISBN-13: 978-0415641760

[18] Pritchard C.L., 2014, "Risk management: concepts and guidance", Auerbach Publications, ISBN-10: 1482258455, ISBN-13: 978-1482258455

[19] Mohammed H.K., Knapkova A., 2016, "The impact of total risk management on company's performance", Procedia-Social and Behavioral Sciences 220, page 217-277, 19th International Conference Enterprise and Competitive Environment (ECE 2016), 10-11 March 2016, Brno- Czeck Republic

[20] Coleman T. S., 2011, "A practical guide to risk management", Research Foundation of CFA Institute, ISBN-10: 1934667412, ISBN-13: 978-1934667415

[21] Crouhy M., Mark R., Galai D., 2000, "Risk management", McGraw-Hill Education, 1st Edition, ISBN-10: 0071357319, ISBN-13: 978-0071357319

[22] Hillson D., 2016, "The risk management handbook: A practical guide to managing the multiple dimensions of risk", Kogan Page, 1st Edition, ISBN-10: 0749478829, ISBN-13: 978-0749478827

[23] Hopkin P., (2014), "Fundamentals of Risk Management – Understanding, evaluating and implementing effective risk management", The Institute of Risk Management, 2nd Edition, Kogan Page Limited, ISBN-10: 0749465395, ISBN-13: 978-0749465391

[24] Mandal S., Maiti J., (2014), "Risk analysis using FMEA: Fuzzy similarity value and possibility theory based approach", Expert Systems with Applications, 41, page:3527-3537

[25] Decker A., Galer D., (2013), "Enterprise Risk Management; Straight To The Point – An Implementation Guide Function by Function", CreateSpace Independent Publishing Platform, 1st Edition, ISBN-10: 1481287788, ISBN-13: 978-1481287784

[26] Silva M.M., de Gusmao A.P.H., Poleto T., Silva L.C., Costa A.P.C.S., (2014), "A multidimensional approach to information security risk management using FMEA and fuzzy theory", International Journal of Information Management, 34, page: 733-740 ;