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Procurement Management System with Information Support for the Project

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Abstract

This paper presents the planning of purchase and supply of funds, and other inputs necessary to achieve the objectives of the project, processing products based on practices of public companies under the Law on Public Procurement, the process of acquiring, receiving and issuing goods, and how human resources (candidates) can be selected for initiation, planning, organizing, evaluation and successful realization of a project. To determine the most favourable tender in the bid process, the AHP method and Expert Choice program for decision support were used. This paper presents the alternatives and criteria based on which the final decision-making process for the procurement of funds for the project is carried out. The selection criteria do not only take into consideration extra services and delivery speed of resources that the company provides, but also the characteristics of the equipment for the project realization.

Key words: *AHP, monitoring and management of industrial processes, "PARIS" matrix, P-K matrix, procurement of human resources*

Introduction

This paper, "Procurement Management System with information support for the project", presents: how human resources (candidates) can be selected for initiation, planning, organizing, evaluation and successful realization of a project. It also presents how one can plan purchase and supply of funds and other inputs to achieve the objectives of the project, processing products based on practices of public companies under the Law on Public Procurement, the process of acquiring, receiving and issuing goods. In order to determine the most favourable tender in the bid process, the AHP

method and the Expert Choice program for decision support were used. Decision on public procurement of a product that will be used for the realization of the project shall be based on the established criteria as defined in the Expert Choice tool, as well as on the objective. The decision on choosing the most favourable tender is issued by the Commission for Public Procurement by a majority of votes, and with the help of information support, which in this case is the Expert Choice program. Expert Choice can integrate data from MS Project and thus help with data visualization. A company owned by municipalities and cities will allow a review of the above offer after the tender process has been finished. This paper presents the alternatives and criteria on which the final decision-making process for the procurement of funds for the project is based. The selection criteria are not only extra services and delivery speed of resources that the company provides, but also characteristics of the equipment for the project realization.

Objectives

The objective is to describe the procurement procedure of acquiring goods, work and services for the project, and to display costs caused by company software packages (contracting out), which will be implemented in a company that has announced a public tender in order to realize a project aimed at computerization of the gas consumption reading process (PK matrix, process 2.2.1.), the realization of the gas consumption load of legal entities at a distance by remote reading of gas consumption which is based on the GPRS standard for wireless communication. The final objective is to display a model for the realization of a remote reading and collection of the measured values for energy consumption.

Research Methods

The following research methods were employed while writing this paper: the observation method, the business analysis method, i.e. the content analysis method, the analysis of information on the documents and the data collected by the observed company, and the AHP method based on comparing the alternatives in pairs. To show that priority was given to these criteria while reaching the objective, clustered bar chart, hierarchy chart view of the observed criteria, the Saaty scale, and the ratio of the weight criteria were used. The goal of a procurement system is to obtain the best resources for project work based on the tenders the observed company has collected. Matrix allocation of responsibility or "Paris" matrix was used to establish accountability in the procurement processes for the project and also for the case study, and the matrix of business technology or the PK matrix was used to determine which process within the procurement process for the project creates, reads, deletes or updates class information.

Procurement of Human Resources for the Progress of the Project

During the procurement of human resources for the progress of the project, i.e. gathering the project team, one must respect the human resources plan depending on the type of project and the process that needs to be improved. After gathering the

participants to realize the project, the project team is assembled, and the realization of the project is managed by the project team headed by the project manager.

Observation of employees on the project in terms of the budgeting of the project realization is a resource, but from the aspect of project organization, realization of set goals is a living, thinking being, the initiator of the process that gives the target dynamics to the informational, financial and material resources of the project realization (Zekić, 2010, p. 146).

Identifying Roles on the Project

Organization design of the project management creates the basis for identifying and assigning project roles, authority, responsibilities and relationships of communication between individuals and project teams. Identifying roles and responsibilities is a process of conversion of an action plan of the project into an operable, enforceable schedule. Identifying roles and responsibilities creates a kind of basis for process monitoring and control, and together with the project plan and budget it is one of the main tools for project management (Omazić, 2005, p. 214).

The "PARIS" Matrix

The operational project manager should closely link project roles and responsibilities with the definition of the project content and scope of the project, for which the "PARIS" matrix or the responsibility assignment matrix (RAM) is often used as a tool (Zekić, 2010, p. 145). The larger the project, the more numerous resources are used in the project (machinery and human resources), and consequently the "Paris" matrix becomes more complex.

The "PARIS" matrix (Table 1) shows the identified processes and sub-processes as well as human resources used exclusively for the project. The responsibility assignment matrix shows the following human resources: the director who is also the project manager, group members including the financial and commercial manager, sales and purchasing officer, the operator of the calculation of communal billing services, the personnel manager, the head accountant, the future users of the implemented system (remote meter reading), external associates 1 (developers), external associates 2 (subcontractors) and others.

The project manager must control the resources of the company in terms of time, costs and efficiency. Most companies have six resources for the project: money, manpower, equipment, facilities, materials and information technology, but the project manager does not control all these resources directly, except for, sometimes, controlling the money. Resources can be controlled by the top and functional managers (Kerzner, 2006, p. 8). The "PARIS" acronym means: Participant, Accountable, Review required, Input required, Sign-off required. Based on the responsibility assignment matrix, the project manager and other internal team members are responsible for the procurement of funds necessary for the project. The team for the realization of procurement for the

Table 1. *The responsibility assignment matrix*

Resources / Process, sub process and activities	Project Manager	Members of the team for the procurement of resources for the project					Users	External associates 1	External associates 2	Other
	Director	Financial and Commercial Manager	Sales and Purchasing Officer	Operator of calculation	Personnel Manager	Main accountant				
1.1. Development of project proposal	A	P								
1.2. Development of project plan	A									
1.3. Contacting foreign participants	P	A	P	P	P		P	A	A	R
2.1.2. Announcing public tender	A	A	P	P	P	P				R
2.1.3. Processing bids	A	A	P	P	P	P		P		R
2.1.3.1. Submission of Bids	A	A	P	P	P	P		P		R
2.1.3.2. Deciding on the best offer	A	A	P	P	P	P		P		R
2.1.4. Purchasing of goods and materials	A	A	P	P	P	P		P		R
2.1.4.1. Formatting documents	R	A,R	R	R	R	R		P		R
2.1.4.2. Completing the documents	R	A,R	R	R	R	R		P		R
2.1.4.3. Contracting	A	A,R	R	R	R			P	P	
2.1.4.4. Sending documents			R,A	R	R			A		R
2.1.5. Receipt of goods and materials			R,A	R	R	R	I			R
2.1.6. Issuance of goods and materials			A	R	R	R		A	P	R

Source: *Created by the authors of the article based on the business logic of the observed company, established processes, resources and responsibility assignment matrix from the textbook: Zekić, Z. (2010). Projektni menadžment – upravljanje razvojnim promjenama. Rijeka: Ekonomski fakultet. p.145*

project, besides the project manager, comprises: financial and commercial manager, sales and purchasing officer, the operator of communal billing services, personnel manager and the main accountant. The expert commission for the procurement of the observed company consists of five members. External Associate 1 (contracting) is a company which is developing and implementing information systems, i.e. software modules for remote meter reading, and which controls spending and manages consumption for eligible customers.[1] External Associate 2 (subcontracting) possesses

[1] Documentation of the observed company which procures the means and work for the project realization.

the resources needed for the complete project activities. External associate 2 is familiar with the operation of X GTL2222AD devices and the implementation of such devices in the distribution system.

Public Procurement of Goods, Works and Services for the Project

Public procurement is defined as a set of procedures which the client who does not acquire own funding, but is the direct or indirect beneficiary of the state or local budget, must carry out before concluding the procurement contract of goods, work and services for the project. Public procurement legislation is defined as a set of regulations that the mentioned entity must comply with during the procurement process (Ivanušec, 2007, p. 16). The public procurement system for the project is based on the principles of competitiveness, the prohibition of discrimination, incorruptibility, impartiality, transparency, because otherwise one might question the existence of the entire system. In the procurement procedure it is necessary to prevent making a decision on the project of a contractor or the seller of goods, works and services whose value is higher than 70,000.00 HRK, if the contractor is the only bidder. A public company that issues a public tender must take all actions (and adequately inform all potential bidders to conduct the procedure of public procurement with a value higher than 70,000.00 HRK) to receive a minimum of at least two tenders.

The observed company begins the implementation of public procurement for the project by providing funds for the acquisition of goods, performance of works and services. After the provision of funds for the procurement of goods, performance of works or services for the project, the development of the procurement plan whose value is higher than 70,000.00 HRK and the procurement plan whose value is less than 70,000.00 HRK begins.

Then the decision on the establishment of the commission follows. The document entitled "Decision on the establishment of a commission" contains the following attributes: record number of the procurement, procurement subject, method and deadline for the implementation of procurement procedures that were defined by the company observed, the planned procurement value and method of securing funds. After the decision has been made by the Director of Administration who also, on the exact day that the decisions has been made and recorded, represents the board, the decision is sent to the head of the commission and all other members of the Commission for Public Procurement for the project.

After the decision has been made, the procurement is published in the Official Gazette ("Narodne Novine"). In the Public Procurement Directory of Croatia it is exactly defined what the company wants to acquire. Based on its publication in the Official Gazette, all interested companies can raise the documentation and must pay for the raising of documents, if they want to participate in the process of procurement for the project. Bidding Documents prepared by the company observed, according to the Law on Public Procurement, must be conducted in a way that enables the

bidder to determine the price for the group tender or parts of the tender. The tender documentation must contain detailed information, data and the conditions that a company must meet in order for an offer to be accepted.

Matrix Business Technology Procurement System

Matrix Business Technologies is a strictly defined 2D mathematical structure over which formal operations such as checking the consistency of business technology optimization, or organization can be conducted, and which describes the relationships between different factors. The matrix must be structured in such a way that there is no process which only generates and does not use any data class (Brumec, 2007). P-K matrix is a mathematical display of the number of processes and data classes. The process is a set of activities that occur in a particular order. The formula for calculating the efficiency of the process within the procurement system (Ferišak, 2006, p. 45) is:

$$\text{Effectiveness Of Procurement} = \frac{Output}{Input}$$

Class data is a logically formatted and linked data set, which refers to one occurrence or entity. Class data are used or created in the process. Matrix Business Technology can be used for the design of data flow diagrams, although for the display of large information systems the PK matrix is more appropriate.

Figure 1 shows the defined processes and data classes ordered by the stages of the public procurement of goods, works and services for the smooth operation and implementation of the project. In our case, goods and works are procured for the project of computerization of the process of consumption reading. Based on the business technology matrix, it can be observed that the implementation of the computerization process of the project 2.2.1. Consumption reading will cause the existing mobile office and one office job to cease to exist. Gas consumption in m^3 of legal entities which are trying to implement a new system is determined by the X GTL2222AD remote reading device.

X GTL2222AD is a device used for remote monitoring and management of industrial processes. The device is equipped with two digital inputs, two digital outputs, two analogue inputs and two analogue outputs that can be configured and used in the system. The device is also equipped with two serial ports. One serial port is adapted for communication with the gas meter/corrector-type flow lnstromet333 and lnstromet444, which makes the device the ideal choice for installation in remote control systems, and readings of gas consumption at high gas installations (pipelines, monitoring of the consumption of large consumers).[2] For this reason, the observed company seeks to implement the system (which is the goal of the project) in companies that have a higher consumption of gas per m^3, i.e., which are legal entities.

[2] Holosys Telemetry Logger. (2008). Holosys integrated systems. Instruction manual. Zagreb: Holosys d.o.o.

Processes /Data classes	1. Raw material records	2. Entry	3. Call for proposals	4. Expenditure lists for public procurement	5. Bid	6. Evaluation of Bids / Notification of Award	7. Records of selected bids	8. Contract	9. Order	10. Notification of contract	11. Complaints	12. Warehouse entry note	13. Warehouse exit note	14. Dispatch note / Invoice	15. Invoice / Delivery note	16. Request	17. Payment slip / 18. Receipt slip	19. Request for bidding documents	20. Basic financial report and evidence of business ability	21. Statement of independent works
2.1.1. Establishing current inventories PPN_1	CRUD																			
2.1.2. Announcing public call for proposal and sending enquiries PPN_2	R	CRUD	CRUD	CRUD	CRUD									R			R	R		
2.1.3. Processing Bids PPN_3		R	R		R	CRUD	CRUD							R					R	R
2.1.4. Procurement of materials and energy PPN_4	R					RUD	R	CRUD	CRUD	CRUD										
2.1.5. Materials and energy reception PPN_5	RU							R	R		CRUD	CRUD			R					
2.1.6. Material allocation and invoicing PPN_6	RU				R			R					CRUD	CRUD		R				
2.2.1. Consumption upload PPP_7	Mobile office							R						R						
2.3.2. Ledger records PPR_{13}	R										R									

Figure 1. *Display of P-K matrix of the procurement system*

Source: *Created by the authors of the article and based on the business logic of the observed and established processes and class data using analytical tools for data processing.*

X GTL2222AD is a device that has an integrated GPRS modem for data transmission and, of course, a SIM card slot of the GSM and GPRS service providers, which allow users to send data from a meter. The device can receive commands via SMS. Executing commands via SMS is allowed only to incoming SMS messages from mobile numbers that have been configured with the precise instructions. Each number can

be configured to commands that are allowed to be executed. The device itself can send an SMS as well, in case of an emergency. SMS notification of emergency is sent by selecting the type of emergency that you want to receive, and for the mobile number that will receive the emergency messages. The selected alarm status and the phone number make up one SMS alarm channel. The system has the option of configuring three independent alarm SMS channels. Without a SIM card and the properly configured device, the device cannot be connected to the GSP/GPRS network. Your SIM card needs to be configured to connect to a GSM network. The device can send readings at intervals by FTP in the XML format and provide a direct access via a fixed IP address.

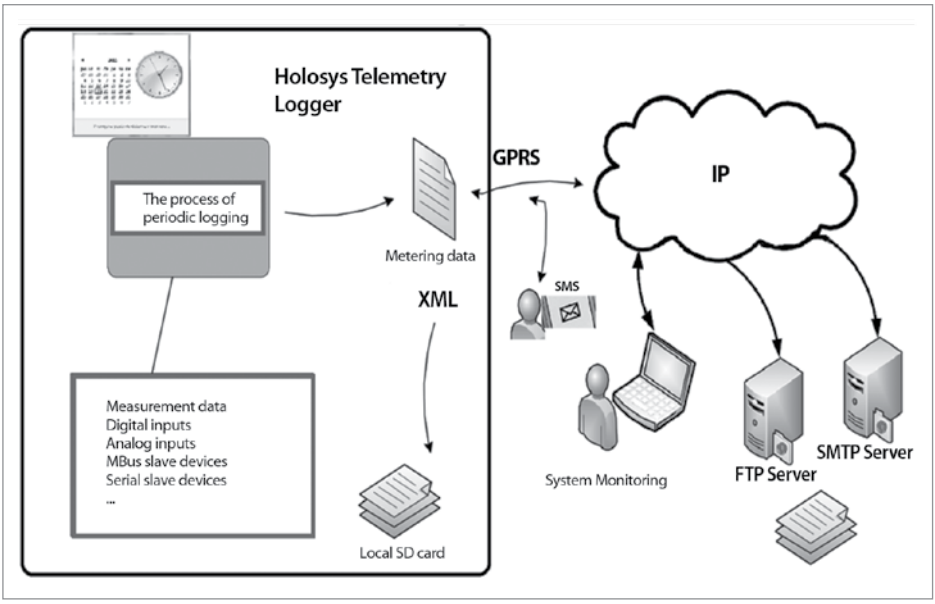


Figure 2. *Display of a remote control model and the collection of measured values for consumption in m³.*

Source: *Created by the authors and based on images from the Holosys Telemetry Logger material (2008). Holosys integrirani sustavi. Upute za upotrebu. Zagreb: Holosys d.o.o. pp. 5 and 15. (Modified).*

Figure 2 shows the remote control and the collection of the measured values for the consumed gas in m³. Figure 2 is a model of the functioning of load consumption computerized process. Device X Telemetry Logger collects data obtained by measuring at time intervals and stores them in memory, SD card, and sends them to a remote FTP server as a file and the SMTP server in the form of electronic mail. If the primary FTP server is not available, you can set a secondary FTP server. The GPRS system (GPRS modem, to be more precise) and the SIM card in the slot of GTL2222AD devices are used to send the collected data obtained by measurement. The record of the read counters can be made in XML format which allows easy import of data retrieved from a meter into the information systems of the observed companies. A built-in GPRS

modem enables the device to operate in the regime of static IP addresses. Control of the unit is enabled with remote computers via TCP/IP connections by initiating connections on remote computers. In addition to these protocols, network services and DNS, POP3, HTTP protocols are supported as well.

Receipt of Offers

While preparing the tender, the bidders must comply with the client's requirements specified in the tender documents, and while preparing tender documents, entities must comply with the relevant provisions of the legislation and thus form a valid basis for the bidders (Franjković, 2010, p. 358). All the interested companies that can provide the requested service, carry out work for the project or sell the material which is defined in the Public Procurement Directory of Croatia, can make their tenders. The legal capacity of the company can be proved by the following evidence that the company sends with the offer: the balance sheet, income statement, notes on financial statements, the documents issued by banking institutions, the Report on the total income of the economic entity, proof of no criminal record, proof of technical and professional skills, a statement that the bidder will independently perform the work and receipt of tax administration that the bidder has been paying taxes regularly. The company which is bidding may submit a standard of quality assurance and environmental management standards. Upon the receipt of all necessary documentation the tenders are opened, which is a part of the offer treatment process. At the opening of the tenders at least two representatives of the contracting authority must be present.

In the observed company five representatives of the contracting authority and all other representatives of the interested bidders are participating in the opening of tenders. Also, other interested bidders without status can participate as well. At the end of the opening, the decision on the selection of bidders in the tendering process is made.

Cost of Software and Equipment Procurement for the Project Realization

Cost is a financial term expressing the expenditure of elements during the procurement process and other processes. According to the contract awarded for the development of programs for: remote meter reading, control of spending and managing consumption of eligible customers between the contractor and the observed company, we can see a great part of the project cost. In the plan for the project implementation and the signed contract between these business partners, it can be read that the project includes the implementation of software for 300 eligible customers and all the necessary equipment for an eligible customer. According to the plan for the future implementation of the project of computerization of the load consumption process (PK matrix), the parties have entered into a contract to

perform work and purchase of the necessary equipment after the announcement on the selection of suppliers (contractors) went into effect.

Table 2. *The prices for work and necessary equipment*

R.B.	Goods, Works and Services	The points of agreement	Amount in HRK
1.1.	Software for 300 privileged customers	4.1.	107,800.00 HRK
1.2.	Equipment needed for 1 eligible customer	4.2.	12,200.00 HRK
2.	Program for remote download spending control and managing the consumption of eligible customers (entities)	4.	120,000.00 HRK
VAT:			27,600.00 HRK
Total sum:			147,600.00 HRK
3.	Procurement calculator	No contract	1,008.60 HRK+ VAT
The total amount of procurement costs for the project of computerization of the reading consumption process:			148,608.60 HRK

Source: *Created by the authors and based on the contract for the development of programs for remote loading and plan for the project realization.*

Table 2 shows the determined price for the work on the project and the necessary equipment. The software implementation price for 300 eligible customers who are also legal entities without VAT amounted to 107,800.00 HRK, while the price of procurement of the necessary equipment for eligible customer amounted to 12,200.00 HRK, VAT excluded. The total price for the partial computerization of the load consumption process amounted to 120,000.00 HRK, VAT excluded. The total amount including VAT amounted to 147,600.00 HRK, which can be seen in Table 2.

Decision-Making in Public Procurement for the Project

Decision-making in the procurement system influences the success of the project directly. Procurement business system becomes more complicated and requires professionalism. The consequences of decisions in procurement resources for the project can be long term, and are characterized by increasing complexity of the conditions on which they depend. For this reason requirements for the application of methodical and structured thinking are placed on decision-makers. When it comes to the methodical thinking and decision-making, Expert Choice (AHP) can be used for information support when at least two bids are received.

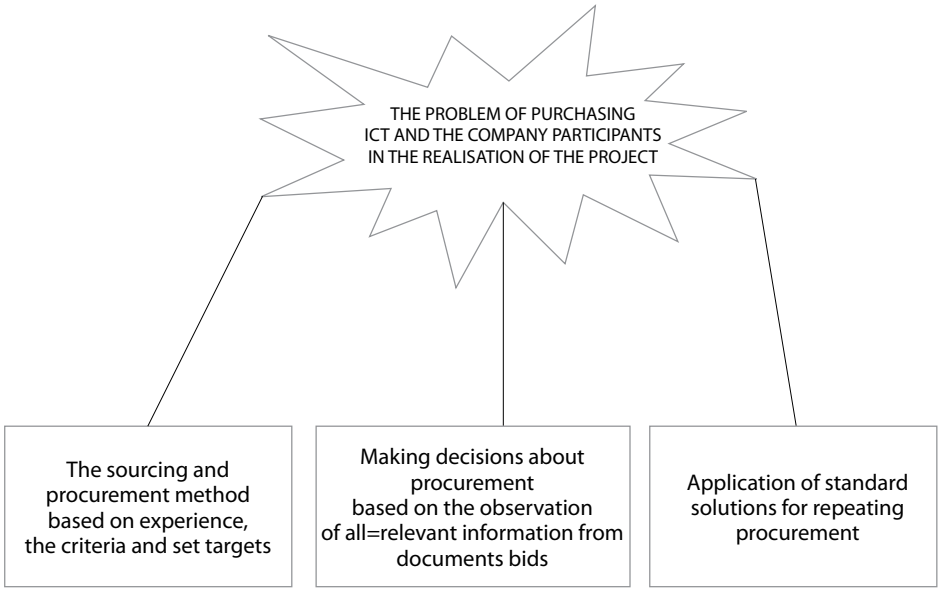


Figure 3. *Methods for solving the problem of procurement resources for project realization*

Source: *Ferišak, V. (2000). Elementi managementa nabave. Zagreb: 2.dopunjeno izdanje. p 9. (Modified by the authors).*

Figure 3 (Ferišak, 2000, p. 9) shows that decisions are made based on experience and intuition, the standard of conduct or the methodical collection and monitoring of the required information. Decisions made on the basis of intuition are wrong in most cases. Decisions made based on experience and intuition are associated with high risks. The simplest way is to make decisions for repeating procurement for the project, although it is unlikely that for the realization of two different projects the funds are procured for the same type of work or IT. When making decisions on the choice of new suppliers, it is necessary to consider all the available information on suppliers in order to make the best decision. More than one person participates in making the decision during the procurement. If there is no alternative solution, it is impossible to make a decision. Decision-making is related to uncertainties and risks.

The document called "selection decision" keeps records of the total number of the received tenders, bidders who have made them, the best bidder, the selected bidder, the reason for choosing the selected suppliers and the instruction on legal remedy. The company sends the decision on the chosen tender to all bidders by registered mail or in another appropriate way, and the decision is signed by the manager of the company.

Preparing a report on the selected tender follows after the decision has been made. The records of the selected tender state all the participants at the tenders opening, the most favourable tender, the price of the most favourable tender, the evidence of business skills the bidder presented, as well as the names of everyone who participated by sending an offer. At the bottom of the record, all members of the expert committee

for the preparation and implementation of public procurement have to sign their names. After the notification of the chosen tender has been delivered to all the bidders and the record of the selected tender has been drawn up, there comes a standstill period, during which the client of the project is not allowed to sign a contract on public procurement. In cases of great financial value the standstill period lasts fifteen days from the day each bidder has received the decision, and in cases of lower financial value the standstill period is five days from the date of receiving the decision. During the procurement of lower financial value, the standstill period is five days from the receipt of the decision by all bidders (Franjković, 2010, p. 362). The decision on selecting the best bidder becomes valid upon expiry of the standstill period, except in the case of legal protection procedure, or if the appeal launched by the State Commission for Control of the public procurement process has been rejected.

When deciding on performing the work or choosing the most suitable bidder for a public company for the project, it is best to engage more employees with different areas of education to form a committee for the selection of contractors, as well as include participants who make up the team for the project realization.

The Theoretical Foundation of the AHP Method

The development of hierarchical models in which the top hierarchy presents the main goal and then the main criteria that can be deconstructed are listed, is in line with the usual way people deal with complex decision problems. The purpose of this procedure is that due to the inability to simultaneously analyse the relationships of a large number of elements that make up the complex problem (according to the results of research in cognitive psychology, man is able to simultaneously process information on the 7 ± 2 objects), the problem is broken down in a controlled manner that allows focused thinking on a smaller number of its components as well as the synthesis of the results of such partial analysis into the final decision (Franjković, 2010, p. 335). The AHP is a multi-criteria decision-making method in which it is necessary to assess the value of the ratio of criteria relevance and the importance of certain alternatives. The values of the criteria specified in the method are expressed quantitatively, qualitatively and in specific measurement units. In this case, it is necessary to use the Saaty scale which is presented in Table 3.

Table 3 shows a post hoc analysis of the Saaty scale and has five degrees of intensity and four intermediate values, each of which corresponds to the value judgments about how much one criterion is more important than another. The Saaty scale is used when comparing two alternatives, but in that case, the scale values are interpreted as an evaluation of how much one alternative is preferred over the other.

Table 3. *The Saaty scale*

INTENSITY OF IMPORTANCE	DEFINITION	EXPERT CHOICE	EXPLANATIONS
1	Equal importance	equal	Two factors contribute equally to the objective
3	Slight importance of one over the other	moderate	Experience and judgment slightly favour one over the other.
5	Strong importance	strong	Experience and judgment strongly favour one over the other.
7	Demonstrated importance	very strong	Experience and judgment very strongly favour one over the other. Its importance is demonstrated in practice.
9	Absolute importance	extreme	The evidence favouring one over the other is of the highest possible validity.
2, 4, 6, 8	Intermediate values between the two adjacent judgments		

Source: *Created by the authors and based on the Saaty scale from the book by Franjković, I., Hunjak, T., Ivanušec, D., Jurasović, V., Kitter, T., Kolar, T., Lerman, B., Loboja, A., Matokanović, M., Nikić, J., Petrović, K., Šuler, I., Terek, D., Vuić, Z. (2010). Sustav i praksa javne nabave. Zagreb: Hrvatska zajednica računovođa i financijskih djelatnika. p.335. (Modified by the authors.)*

Selecting the Best Tender Using AHP Method

The AHP method is suitable for the analysis of decisions in which a number of conflicting criteria emerge, and are based on estimates gained by the experience and knowledge of suppliers and products. This method is used as an analysis method because there is Expert Choice, a high quality program, which allows a clear interpretation of the results through charts. In the follow-up the application software is displayed as a part of information technology for decision support.

The observed company aims to acquire two quality office printing calculators for the project. The observed company has received two offers by different suppliers, and selects the more favourable one. Having received two offers for the same type of office calculator, the problem is easily solved. The observed criterion is price including VAT, as the above criteria differed in the two offers as indicated in Figure 4.

Figure 4[3] shows the goal. The goal of the observed company is to select a cost-effective office calculator based on the received bids. The above criteria on which to choose the office calculator are: price, type of display, print speed, print mode and

[3] ExpertChoice tool. (2011). Retrieved on 22 July 2011 from http://www.expertchoice.com

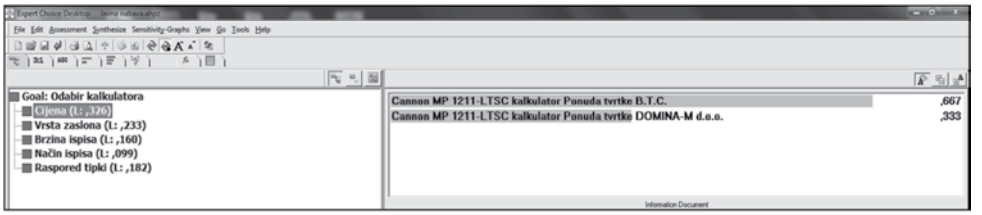


Figure 4. *The selection of calculators with the criteria and their weight*
Source: *Created by the authors based on literature Usporednik proizvoda. (2011). Retrieved on 25 July 2011 from http://www.canon.hr/for_home/compare_products/LoadComparator.asp and Expert Choice Trial software.*

layout. Based on the bids received, the applied AHP method and Figure 4, it can be seen that for the observed company BTC made a better offer because of the lower price of the device.

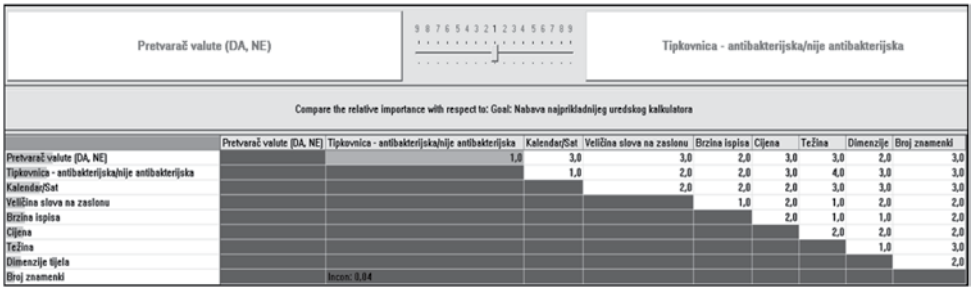
Procurement of the Most Appropriate Office Calculator with Conflicting Criteria for the Project Implementation

Taking into account the needs of the project team we will consider offers of office calculators that are more expensive than 1,000.00 HRK. In the second procedure of the procurement process Office Calculators of manufacturer Z will be observed: MP25-MG, MG-MP37, MP1411-LTS, MP1211-LTS, LTS-MP120, MP121-DTS. The main goal of the system in this case is to obtain the most suitable office calculator. The properties of the office calculator must satisfy the needs of users who participated in the selection process regarding the following options: currency conversion, a keyboard (with respect to whether the keyboard is a bacterial or anti-bacterial one), browsing of the calendar and time, size of letters on the screen, print speed, cost, weight, dimensions and the number of digits.

Figure 5. *Display of priority with respect to the above mentioned criteria in achieving the goal*
Source: *Created by the authors based on literature Usporednik proizvoda. (2011). Retrieved on 25 July 2011 from http://www.canon.hr/for_home/compare_products/LoadComparator.asp and Expert Choice Trial software.*

Figure 5 shows the criteria and their order of priority. Based on Figure 5 we can determine the most important criterion for decision-making. At the bottom of

the image there is inconsistency of 0.04 (Inconsistency=0.04), which represents inconsistency of 4%, lower than the 10% limit, indicating that the relevance criteria model is well-structured. The currency converter is the most important criterion. The office calculator which has the ability to convert the currency is more convenient for the user. Another criterion by which users can select the calculator is a keypad. Participants in decision-making process emphasize the importance of choosing an anti-bacterial keyboard. The third criterion that is taken into account is the date and time display option. The fourth criterion is the font size on the screen. The fifth criterion is the speed of printing. The sixth criterion is the price. The seventh criterion is the weight of the device. The eighth criterion is the calculator dimensions and the last criterion that influences the decision-making is the number of digits. Indicating the importance of criteria, i.e. the priority criteria, it was concluded that the price is not always the key factor based on which decisions in the procurement process are made.



	Pretvarač valute (DA, NE)	Tipkovnica - antibakterijska/nije antibakterijska	Kalendar/Sat	Veličina slova na zaslonu	Brzina ispisa	Cijena	Težina	Dimenzije	Broj znamenki
Pretvarač valute (DA, NE)		1,0	3,0	3,0	2,0	3,0	3,0	2,0	3,0
Tipkovnica - antibakterijska/nije antibakterijska			1,0	2,0	2,0	3,0	4,0	3,0	3,0
Kalendar/Sat				2,0	2,0	2,0	3,0	3,0	3,0
Veličina slova na zaslonu					1,0	2,0	1,0	2,0	2,0
Brzina ispisa						2,0	1,0	1,0	2,0
Cijena							2,0	2,0	2,0
Težina								1,0	3,0
Dimenzije tijela									2,0
Broj znamenki		Incon: 0,04							

Figure 6. *The ratio of the matrix of priorities important when selecting the most appropriate office calculator*
Source: Created by the authors based on literature Usporednik proizvoda. (2011). Retrieved on 25 July 2011 from http://www.canon.hr/for_home/compare_products/LoadComparator.asp and Expert Choice Trial software.

Figure 6 shows the estimates of the ratio of criteria importance when selecting the most suitable office calculator. The estimates are determined and based on the experience of the authors of this paper. The currency converter is the most important criterion, while the number of digits is the least important criterion. Inconsistency is 0.04 and does not exceed the limit.

By defining a model to select the most appropriate office calculator and determining the importance of criteria and sub-criteria, conditions have been met for prioritizing alternatives by comparing the individual criteria and sub-criteria in order to select the most appropriate office calculator.

Figure 7 shows the assessment of ratio priorities of alternatives for a specific criterion when selecting the most suitable office calculator. The estimates are determined based on the experience of the authors. Inconsistency in any case does not exceed 0.04. In the present case the option RATINGS is used. RATINGS formula is a ranking formula by which discrete importance is assigned to alternatives.

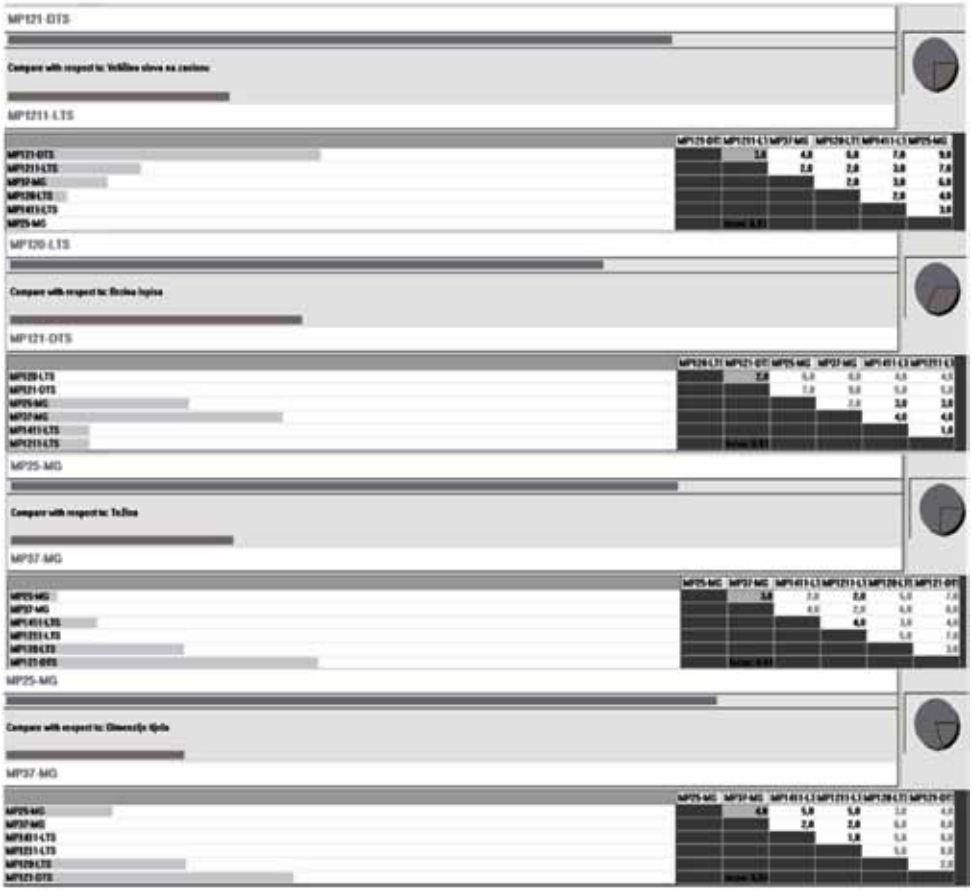


Figure 7. *An overview of alternative priorities regarding the criteria which are relevant for comparison*

Source: *Created by the authors and based on literature Usporednik proizvoda. (2011). Retrieved on 25 July 2011 from http://www.canon.hr/for_home/compare_products/LoadComparator.asp and Expert Choice Trial software.*

Figure 8 shows the priorities of alternatives by the criteria. In this case MP37-MG office calculator has the highest priority, which means that it will be most suitable for procurement for the project, and users will be satisfied with it. In this way, the procurement objective, "Choosing the most appropriate office calculator", has been achieved.

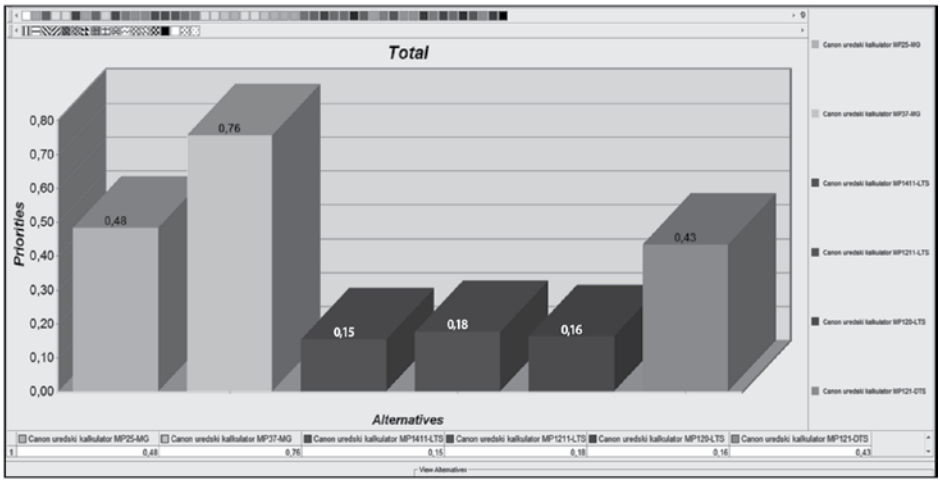


Figure 8. *Alternative view of priorities according to the criteria*

Source: *Created by the authors based on literature Usporednik proizvoda. (2011). Retrieved on 25 July 2011 from http://www.canon.hr/for_home/compare_products/LoadComparator.asp and Expert Choice Trial software.*

Closure of the Contract and the Importance of the Project Realization within the Given Period

After the decision on selecting the best bidder has come into effect, the next step is making a contract with the selected bidder and the signing of the contract for the project. After the contract has been signed it is published in the Official Gazette. The contract is binding for both parties to perform all obligations which are defined in the agreement on the design of programs for remote meter reading, monitoring consumption, consumption management and settlement of works performed, and implementation of a new information system. Within other articles of the observed agreement there is a clearly defined deadline that must be met for the computerization project of the load consumption process, and there is also a precisely defined deadline by which the digital spending control and consumption management must be set up for eligible customers in order to avoid opportunity costs.[4]

Projects have a firm completion date –combining all the elements of the environment that appear in the project and bringing the project to a safe completion requires a combination of leadership, skill, madness and magic (Šimović, 2011, p. 67). The project deadline is 5 months and 27 days after signing the contract with "an outside collaborator." If the project is not fully realized by the due date, the observed company will not be able to generate investment income, that is, it will not have control over the consumption and there is still a possibility of loss of gas in certain parts of the entire distribution network.

[4] Opportunity costs arise when the objective of the project has not been realized in due time, i.e. when the project "product" is not in use and does not deliver benefits that were planned.

An interesting relationship among time-cost-quality variables occurs in computer projects which show that by increasing the coverage of the project, the costs rise two times. These costs increase on software projects due to the increased needs of the project team members to communicate and coordinate solutions. Another interesting thing is the ratio within which the reduction of the duration of software projects increases costs four times, and if one wants to shorten the deadline period by half, then the costs increase sixteen times (Omazić, 2005, p. 218). When making decisions about selecting the best tender for the introduction of remote reading and gas consumption control it was not necessary to apply the AHP method because only one offer was received as opposed to the procurement of the office calculator.

Recommendations for Improving the Procurement Process for the Project

In the system of procurement for the project purposes conflicts which impede the standard performance of the procurement process often arise. Conflicts arise during the decision-making on the most favourable bid. The term conflict implies having differences in goals, decisions, relationships, expectations, opinions, knowledge, attributes, hierarchies, functioning, behaviour and the decisions made in order to impose changes, to prove the correctness of one's thoughts and decisions, or to provide resistance to the implementation of unilateral decisions about the set goals, expectations, or certain behaviour (Ferišak, 2000, p. 34). Acting in accordance with the Public Procurement Act while implementing public procurement neutralizes the chance of conflicts between participants in the procurement process. The recommendation is to follow the law on public procurement when acquiring funds for the project. The procurement procedure is used to examine the tenders and to select the most favourable one. The procedure involves a larger number of members constituting the Committee for public procurement, and who examine the offer, which is why it is less likely that a conflict, that is, a disagreement between the committee members in the process of public procurement for the project purposes, would arise. In case of the latter (in the procurement process for the project purposes), in which a number of conflicting criteria emerge and where decisions are made based on estimates, it is recommended to apply the AHP method which is suitable for making management decisions in such cases. The third recommendation for process improvements in the procurement system for the project purposes of computerization is to ask the party that will perform the work for a detailed breakdown of the tender, especially if it comes to IT projects, development of applications for which the assumed value is to be greater than 70,000.00 HRK. Elaboration of bids should include (in addition to extensive evidence on appropriate conduct, business, legal, economic and financial capacity): (1) defining the time it takes to create a program module which is planned to be implemented, (2) the number of developers involved in developing applications i.e., a program module, (3) documenting the evidence of qualifications and formal

education of programmers who participate in the development of applications, i.e. on the implementation of the project and their work experience, (4) planning the costs that are increased by programmers (human resources) who directly participate in the development of applications, (5) the amount of payment per hour of developer's work, (6) certificate (reference) that the bidder's module has been implemented in another company, if applicable, (7) a tenderer's statement that the company itself is able to create a program module without cooperation with a third company, (8) statement of the bidder which states what programming language and/or module programming tool will be developed, (9) implementation plan by day, for every day from the first scheduled day to the final day of schedule and expected results of making an application at the end of each working day, (9.1) (in the implementation plan the bidder should specify) how many employees would work on the specific date on the project and how many hours; (9.2) a detailed breakdown of prices for all computer components (hardware) i.e. equipment that will be implemented in the system; (10) a statement that the bidder has an organized emergency service programmers who are able to intervene in the minimum time.

Conclusion

The public procurement procedure for projects implemented by the Act of Law, allows fair competition between market participants. The goal of procurement of goods, works and services for the project purposes is a rational spending of funds earmarked for realization of the project objectives. The goal is to achieve the best possible value for money. Expert committee of several members who make decisions in the procurement process exists to prevent possible corruption. Studying the processes of public procurement and the procurement system, a definition can be confirmed that the procurement process for the project purposes generates a profit.

The AHP method can be used in the system of public procurement during the procurement for the project purposes because it is suitable for the analysis of decisions in which a number of conflicting criteria based on estimates emerge. Another reason for the application of the AHP method is the Expert Choice program which provides a comprehensive interpretation of the results.

Based on the document "Select Client List" by Expert Choice, one can extract information that the Expert Choice tool for decision-making is used by banks (banking sector), government agencies, pharmaceutical companies, telecommunications companies, IT companies (HP, IBM) and utility companies. Expert Choice was used in the production department of Ford, which is another reason why the use of the AHP method is recommended. It is useful and very helpful in the purchasing system and serves as a support for decision-making in the planning and execution of projects.

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Upravljanje sustavom nabave pomoću informacijske potpore za potrebu projekta

Sažetak

Rad prikazuje kako se planira kupovina i nabava sredstva te ostalih inputa za ostvarenje ciljeva projekta, proces obrade ponuda na temelju prakse javne tvrtke po Zakonu o javnoj nabavi, proces nabavljanja, zaprimanja i izdavanja robe, način na koji se odabiru ljudski potencijali za iniciranje, planiranje, organiziranje, evaluiranje i uspješno realiziranje projekta (kandidati). Za određivanje najpovoljnije ponude u procesu obrada ponuda korištena je AHP metoda i primjenski program Expert Choice za potporu kod donošenja odluke. U radu se prikazuju alternative i kriteriji na temelju kojih se donosi konačna odluka za nabavu sredstva za realizaciju projekta. Kriteriji za odabir nisu samo dodatne usluge i brzina isporuke sredstava koje tvrtka pruža, nego i karakteristike samih uređaja za realizaciju projekta.

Ključne riječi: *AHP, kontrola i upravljanje industrijskim procesima „PARIS" matrica, P-K matrica, nabava ljudskih resursa*

Uvod

Rad na temu „Upravljanje sustavom nabave pomoću informacijske potpore za potrebu projekta" prikazuje: način na koji se odabiru (kandidati) ljudski potencijali za iniciranje, planiranje, organiziranje, evaluiranje i uspješno realiziranje projekta. Rad prikazuje kako se planira kupovina i nabava sredstva te ostalih inputa za ostvarenje ciljeva projekta, proces obrade ponuda na temelju prakse javne tvrtke po Zakonu o javnoj nabavi, proces nabavljanja, zaprimanja i izdavanja robe. Za određivanje najpovoljnije ponude u procesu obrade ponuda korištena je AHP metoda i primjenski program Expert Choice za potporu u donošenju odluke. Odluka o javnoj nabavi određenog proizvoda koji će se koristiti za ostvarenje projekta donosi se na temelju postavljenih kriterija koji su definirani u alatu Expert Choice i cilja projekta. Odluku o odabiru najpovoljnije ponude donosi povjerenstvo za javnu nabavu većinom glasova, te uz pomoću informacijske potpore koju čini u prikazanom slučaju primjenski

program Expert Choice. Expert Choice može integrirati podatke iz MS Projecta i na taj način pomoći kod vizualizacije podataka. Uvid u ponude prikupljene nakon završetka procesa raspisivanja javnog natječaja omogućit će promatrana tvrtka koja je javna i u vlasništvu je općina i gradova. U radu se prikazuju alternative i kriteriji na temelju kojih se donosi konačna odluka za nabavu sredstva za realizaciju projekta. Kriteriji za odabir nisu samo dodatne usluge i brzina isporuke sredstava koje tvrtka pruža, nego i karakteristike samih uređaja za realizaciju projekta.

Zadaci rada

Prikazati postupak javnog nabavljanja robe, radova i usluga za potrebe projekta. Prikazati troškove koje izazivaju paketi softverske opreme tvrtke (contracting out), koji će biti implementirani u tvrtku koja je raspisala javni natječaj u svrhu ostvarenja projekta čiji je cilj informatizacija procesa očitavanja potrošnje plina (P-K matrica, proces 2.2.1.), ostvarenje i realizacija učitavanja potrošnje plina pravnih subjekata na daljinu pomoću uređaja za daljinsko očitavanje potrošnje plina koji se temelji na GPRS standardu za bežičnu komunikaciju. Prikazati model za ostvarenje daljinske kontrole i prikupljanja mjernih veličina za potrošnju energenta.

Istraživačke metode

Za izradu rada na temu „Upravljanje sustavom nabave pomoću informacijske potpore za potrebu projekta" koriste se istraživačke metode: metoda promatranja, metoda opažanja, metoda analize poslovanja, tj. metoda analize sadržaja, te informacija na dokumentima kao nositeljima podataka prikupljenih od strane promatrane tvrtke i AHP metoda temeljena na uspoređivanju alternativa u parovima. Za prikaz respektiranja prioriteta za navedene kriterije kod ostvarenja cilja koriste se grupirani trakasti grafikoni, hijerarhijski dijagram pogleda promatranih kriterija, Saatyeva skala te omjer težina kriterija. Cilj sustava nabave je nabaviti najbolja sredstva za rad na projektu na temelju prikupljenih ponuda od strane promatrane tvrtke. Za utvrđivanje odgovornosti u procesima nabave za potrebe projekta te ujedno za istraživanje slučaja koristi se matrica dodjele odgovornosti ili „PARIS" matrica, dok se za utvrđivanje slučajeva koji proces unutar nabave za potrebe projekta kreira, čita, briše ili ažurira klase podataka koristi matrica poslovne tehnologije ili P-K matrica.

Nabava ljudskih resursa za ostvarivanje projekta

Prilikom nabave ljudskih resursa za ostvarivanje projekta, tj. prikupljanja projektnog tima, mora se poštivati plan ljudskih resursa koji je planiran ovisno o vrsti projekta i procesu koji se želi unaprijediti. Nakon okupljanja sudionika za realizaciju projekta slijedi razvoj projektnog tima, a projektni tim u realizaciji projekta vodi voditelj projekta.

Promatranje zaposlenika na projektu s aspekta budžetiranja realizacije projekta jest resurs, ali s aspekta upravljanja projektnom organizacijom realizacije postavljenih ciljeva je živo misaono biće, pokretač procesa koji daje ciljnu dinamiku informacijskim, financijskim i materijalnim resursima projektne realizacije (Zekić, 2010, str. 146).

Identificiranje uloga na projektu

Oblikovanjem organizacije projektnog upravljanja stvara se osnovica za identificiranje i dodjeljivanje projektnih uloga, ovlasti, odgovornosti te odnosa izvještavanja pojedinca i projektnih timova. Identificiranje uloga i odgovornosti je proces konverzije plana akcije projekta u operabilni, provedivi raspored. Identificiranje uloga i odgovornosti čini svojevrsnu bazu za proces nadgledanja i kontroliranja te je zajedno s projektnim planom i budžetom jedan od glavnih alata menadžmenta na projektu (Omazić, 2005, str. 214).

„PARIS" matrica

Projektne uloge i odgovornosti operacijski projektni menadžer treba usko povezati s definicijom projektnog sadržaja, odnosno s projektnim obuhvatom, za što se često kao alat koristi „PARIS" matrica ili matrica dodjele odgovornosti (RAM) (Zekić, 2010, str. 145). Što je projekt veći, više se projektnih resursa koristi i sudjeluje u realizaciji projekta (strojevi i ljudski resursi) te je i „PARIS" matrica kompliciranija.

Tablica 1.

„PARIS" matrica (tablica 1) prikazuje identificirane procese i potprocese te isključivo ljudske resurse koji se koriste za realizaciju projekta. Matricom dodjele odgovornosti prikazani su ljudski resursi: direktor tvrtke koji ima ujedno ulogu voditelja projekta, grupa članova koju čine financijsko-komercijalni rukovoditelj, referent prodaje i nabave, operater obračuna komunalnih usluga, kadrovnik, glavni knjigovođa, budući korisnici implementiranog sustava (daljinskog očitanja brojila), vanjski suradnici 1 (programeri), vanjski suradnici 2 (subcontracting) i ostali.

Voditelj projekta mora kontrolirati resurse tvrtke po vremenu, troškovima i učinkovitosti. Većina tvrtki za realizaciju projekta ima šest resursa: novac, radnu snagu, opremu, objekt, materijal i informacijsku tehnologiju, ali projektni menadžer ne mora kontrolirati sve navedene resurse direktno, osim ponekad novac. Resurse mogu kontrolirati linijski i funkcijski menadžeri. (Kerzner, 2006, str. 8). Oznake koje čine naziv matrice „PARIS" označavaju sudionike, odgovornost sudionika, pregled, zahtjev za ulaz i zahtjev za odjavu. Na temelju matrice dodjele odgovornosti direktor je ujedno voditelj projekta, a ostali interni članovi tima su zaduženi za nabavu sredstava potrebnih za realizaciju projekta. Tim za realizaciju nabave za potrebe projekta čine osim voditelja projekta: financijsko-komercijalni rukovoditelj, referent prodaje i nabave, operater obračuna komunalnih usluga, kadrovnik i glavni knjigovođa. Stručno povjerenstvo za javnu nabavu promatrane tvrtke sastoji se od pet članova. Vanjski suradnik 1 (contracting) je tvrtka koja radi na izradi i implementaciji informacijskog sustava, tj. programskog modula za daljinsko očitanje, nadzor potrošnje i upravljanje potrošnjom povlaštenih kupaca.[5] Vanjski suradnik 2 (subcontracting) posjeduje

[5] Dokumentacija promatrane tvrtke koja nabavlja sredstva i rad za realizaciju projekta.

resurse potrebne za obavljanje kompletne aktivnosti na projektu. Vanjski suradnik 2 je upoznat s funkcioniranjem X GTL2222AD uređaja te samom implementacijom takvog uređaja u distributivni sustav.

Javna nabava robe, radova i usluga za potrebe projekta

Javna nabava se može definirati kao skup postupaka koje naručitelj, koji samostalno ne stječe financijska sredstva već je neposredni ili posredni korisnik državnog ili lokalnog proračuna, mora provesti prije zaključivanja ugovora o javnoj nabavi roba, radova i usluga za potrebe projekta, a javno nabavno zakonodavstvo se definira kao skup propisa kojeg se spomenuti naručitelj mora pridržavati tijekom postupka nabave (Ivanušec, 2007, str. 16). Sustav javnih nabava za potrebe projekta temelji se na načelima konkurentnosti, zabrane diskriminacije, nepotkupljivosti, nepristranosti, transparentnosti, jer se u protivnom može postaviti pitanje smisla postojanja cjelokupnog sustava. Kod postupka javne nabave potrebno je onemogućiti donošenje odluke o izvođaču projekta ili prodavatelju robe, radova i usluga čija je vrijednost viša od 70.000,00 kuna, ukoliko je jedini dao ponudu. Javna tvrtka koja raspisuje javni natječaj mora poduzeti sve (i na odgovarajući način informirati sve potencijalne ponuđače da se provodi postupak javne nabave čija je vrijednost viša od 70.000,00 kuna) kako bi zaprimila minimalno dvije ponude.

Promatrana tvrtka započinje provođenje javne nabave za potrebe projekta osiguranjem financijskih sredstava za nabavljanje roba, obavljanje radova i usluga. Nakon što se osiguraju sredstva za nabavu robe, obavljanje radova ili usluga za potrebe projekta, počinje se s izradom plana nabave čija je vrijednost viša od 70.000,00 kn i izradom plana nabave roba, radova i usluga čija je vrijednost manja od 70.000,00 kn.

Nakon toga slijedi donošenje odluke o osnivanju stručnog povjerenstva. Na dokumentu pod nazivom „odluka o osnivanju stručnog povjerenstva" nalaze se slijedeći atributi: evidencijski broj predmeta nabave, predmet nabave, način i rok provedbe postupaka nabave koji je definirala promatrana tvrtka, planirana vrijednost nabave i način osiguranja novčanih sredstava. Nakon donošenja odluke koju donosi direktor tvrtke koji je ujedno uprava na točno određeni dan i evidentiranja donesene odluke, odluka se šalje voditelju povjerenstva i svim ostalim članovima povjerenstva za javnu nabavu za potrebe projekta.

Poslije odluke slijedi objavljivanje u Narodnim novinama. U oglasniku javne nabave Republike Hrvatske je točno definirano što tvrtka želi nabaviti. Na temelju objave u Narodnim novinama sve zainteresirane tvrtke mogu podignuti dokumentaciju te moraju platiti za podizanje dokumenata, ako žele sudjelovati u procesu javne nabave za potrebe projekta. Dokumentacija za nadmetanje, koju izrađuje promatrana tvrtka po Zakonu o javnoj nabavi, mora biti izrađena na način da ponuditelj može odrediti cijenu za grupe ili dijelove ponuda. Dokumentacija za nadmetanje mora sadržavati detaljne informacije, podatke i uvjete koje tvrtka mora zadovoljavati da bi ponuda mogla biti prihvaćena.

Matrica poslovne tehnologije sustava nabave

Matrica poslovne tehnologije je strogo definirana 2D matematička struktura nad kojom se mogu provesti formalne operacije poput provjere konzistentnosti poslovne tehnologije ili optimizacije ustroja, te opisuje odnose između različitih čimbenika. Matrica mora biti strukturirana tako da ne postoji proces koji samo generira, a ne koristi niti jednu klasu podataka (Brumec, 2007). P-K matrica je matematički prikaz broja procesa i klasa podataka. Proces je skup aktivnosti koje se odvijaju određenim redoslijedom. Formula za izračunavanje efikasnosti procesa unutar sustava nabave (Ferišak, 2006, str. 45) je:

$$EfikasnostNabave = \frac{Izlaz}{Ulaz}$$

Klasa podataka je logički oblikovan i povezan skup podataka, koji se odnosi na jednu pojavnost ili entitet. Klasa podataka se u procesu stvara ili koristi. Matrica poslovne tehnologije može poslužiti za projektiranje dijagrama tijeka podataka iako je za prikaz velikih informacijskih sustava prikladnija P-K matrica.

Slika 1.

Slika 1. prikazuje utvrđene procese i klase podataka po redoslijedu faza javnog nabavljanja robe, radova i usluga za nesmetano ostvarivanje projekta. U promatranom slučaju roba i radovi se nabavljaju za projekt informatizacije procesa očitavanje potrošnje. Temeljem matrice poslovne tehnologije može se uočiti da će realizacijom projekta informatizacije procesa 2.2.1. Očitavanje potrošnje, nestati postojeći mobilni ured te radno mjesto u uredu. Potrošnja plina u m^3 kod pravnih subjekata gdje se nastoji implementirati novi sustav se utvrđuje pomoću uređaja za daljinsko očitavanje X GTL2222AD.

X GTL2222AD je uređaj koji služi za udaljeni nadzor i upravljanje industrijskim procesima. Uređaj je opremljen s dva digitalna ulaza, dva digitalna izlaza, dva analogna ulaza i dva analogna izlaza koji se mogu konfigurirati i koristiti u sustavu. Uređaj je također opremljen s dva serijska priključka. Jedan serijski priključak je prilagođen za komunikaciju s plinomjerima/korektorima protoka tipa lnstromet333 i lnstromet444, te je uređaja idealan izbor za ugradnju u sustave daljinske kontrole i očitanja potrošnje plina kod velikih plinskih instalacija (plinovodi, praćenje potrošnje velikih potrošača).[6] Zbog tog razloga promatrana tvrtka nastoji implementirati sustav (što je cilj projekta) u tvrtke koje imaju veću potrošnju plina po m^3 tj. kod pravnih subjekata.

X GTL2222AD je uređaj koji ima integriran GPRS modem za prijenos podatka i naravno utor za SIM karticu pružatelja GSM usluge i GPRS usluge preko kojih se mogu slati podaci s brojila. Uređaju je moguće slati naredbe putem SMS-a. Izvršavanje naredbi putem SMS-a se dozvoljava samo SMS porukama pristiglim s mobilnih brojeva koji su konfigurirani točno određenom naredbom. Svakom broju se mogu

[6] Holosys Telemetry Logger. (2008.). Holosys integrirani sustavi. Upute za upotrebu. Zagreb: Holosys d.o.o.

konfigurirati naredbe koje se smiju izvršavati. SMS može poslati i sam uređaj u slučaju alarmnog stanja. SMS notifikacija alarmnih stanja obavlja se na način da se odabiru alarmna stanja koja se žele primati te mobilni broj na koji će slati alarmne poruke. Odabrana alarmna stanja i željeni telefonski broj čine jedan SMS alarmni kanal. Sustav ima mogućnost konfiguriranja tri neovisna SMS alarmna kanala. Bez umetnute SIM kartice i pravilno konfiguriranog uređaja uređaj se ne može spojiti na GSP/GPRS mrežu. Za spajanje na GSM mrežu je potrebno konfigurirati PIN kartice. Uređaj omogućuje slanje očitanja po vremenskim periodima putem FTP-a u XML formatu i daje mogućnost direktnog pristupa uređaju putem fiksne IP adrese.

Slika 2.

Slika 2. prikazuje daljinsku kontrolu i prikupljanje mjernih veličina za potrošeni plin u m^3. Slika 2 je ujedno model funkcioniranja informatiziranog procesa učitavanje potrošnje. Uređaj X Telemetry Logger prikuplja u vremenskim razmacima podatke dobivene mjerenjem te ih sprema u memoriju SD kartice, šalje ih na udaljeni FTP server u obliku datoteke i SMTP server u obliku elektroničke pošte. Ukoliko primarni FTP server nije dostupan može se postaviti sekundarni FTP poslužitelj. Za slanje prikupljenih podataka dobivenih mjerenjem koristi se GPRS sustav i SIM kartica u utoru GTL2222AD uređaja, točnije GPRS modema. Zapis očitanog brojila može biti u XML formatu koji omogućuje jednostavan uvoz učitanih podataka s brojila u informacijski sustav promatrane tvrtke. Ugrađeni GPRS modem omogućuje rad u režimu statičke IP adrese. Omogućena je kontrola jedinice s udaljenog računala putem TCP/IP konekcije uz iniciranje konekcije udaljenog računala. Osim navedenih protokola još su podržani mrežni servisi i protokoli DNS, POP3, HTTP.

Prikupljanje ponuda

Ponuditelji pri izradi ponuda moraju udovoljiti zahtjevima naručitelja navedenih u dokumentaciji za nadmetanje, a naručitelji moraju prilikom izrade dokumentacije za nadmetanje poštivati relevantne odredbe pozitivnog zakonodavstva i na taj način stvoriti valjanu podlogu za ponuditelje (Franjković, 2010, str. 358). Sve zainteresirane tvrtke koje mogu pružati traženu uslugu, obavljati određene radove za potrebe projekta ili prodati materijal koji je definiran u oglasniku javne nabave Republike Hrvatske mogu se javiti na natječaj. Uz ponudu koju šalje tvrtka nerijetko mora poslati i dokaz o poslovnoj sposobnosti što se vidi iz matrice poslovne tehnologije. Poslovna sposobnost tvrtke može se uočiti na temelju slijedećih dokaza koje tvrtka šalje s ponudom, a to su bilanca, račun dobiti i gubitka, bilješke uz financijske izvještaje, dokument izdan od bankarskih institucija, izvještaj o ukupnom prihodu gospodarskog subjekta, dokaz o nekažnjavanju, dokaz tehničke i stručne sposobnosti, izjavu da će ponuditelj samostalno izvoditi radove i potvrdu porezne uprave da je ponuditelj plaćao redovito porez. Tvrtka koja se javlja na natječaj može dostaviti norme o osiguranju kvalitete i norme upravljanja okolišem. Nakon primitka sve potrebne dokumentacije

tvrtka otvara ponude, što se zbiva u procesu obrade ponude. Otvaranju ponude trebaju sudjelovati najmanje dva predstavnika javnog naručitelja.

U promatranoj tvrtki u otvaranju sudjeluje pet predstavnika javnog naručitelja i svi ostali predstavnici zainteresiranih ponuđača. U otvaranju ponuda mogu sudjelovati i ostali ponuđači bez statusa zainteresiranih. Na kraju otvaranja slijedi donošenje odluka o odabiru ponuditelja u postupku javnog nadmetanja.

Troškovi nabave softvera i opreme za realizaciju projekta

Trošak predstavlja novčani izraz utroška elemenata unutar radnog procesa nabave i ostalih procesa. Prema sklopljenom ugovoru za izradu programa za: daljinsko očitanje, nadzor potrošnje i upravljanje potrošnje povlaštenih kupaca između vanjskog suradnika 1 i promatrane tvrtke vidi se dobar dio troškova projekta. U planu za realizaciju projekta i sklopljenom ugovoru između navedenih poslovnih partnera može se pročitati da projekt obuhvaća implementaciju softvera za 300 povlaštenih kupaca i svu potrebnu opremu za jednog povlaštenog kupca. Prema planu za buduću realizaciju projekta informatizacije procesa učitavanje potrošnje (P-K matrica) ugovorne strane su sklopile ugovor za obavljanje radova i nabavu potrebne opreme nakon što je objava o odabiru najpovoljnijeg dobavljača (izvoditelja) počela vrijediti.

Tablica 2.

Tablica 2. prikazuje utvrđene cijene za radove na projektu i potrebnu opremu. Cijena implementacije softvera za 300 povlaštenih kupaca koji su ujedno pravni subjekti, bez PDV-a iznosi 107.800,00 kuna, dok cijena nabave potrebne opreme za povlaštenog kupca iznosi 12.200,00 kuna bez PDV-a. Ukupna cijena za djelomičnu informatizaciju procesa učitavanje potrošnje iznosi 120.000,00 kuna bez PDV-a. Ukupan iznos s PDV-om iznosi 147.600,00 kuna što se vidi iz tablice 2.

Odlučivanje u javnoj nabavi za realizaciju projekta

Odlučivanje u sustavu nabave utječe na uspjeh realizacije projekta. Poslovanje sustava nabave postaje sve složenije i zahtijeva profesionalnost. Posljedice odluka u procesima nabave sredstava za realizaciju projekta mogu biti dalekosežne, a karakteristična je sve veća kompleksnost uvjeta o kojima ovise. Zbog toga se postavljaju na donositelje odluka zahtjevi primjene metodičkog i strukturnog razmišljanja. Kada je riječ o metodičkom razmišljanju i donošenju odluka donositelja, može se koristiti za informacijsku potporu primjenski program Expert Choice (AHP metoda) kada su pristigle najmanje dvije ponude.

Slika 3.

Slika 3. (Ferišak, 2000, str. 9) prikazuje da se odluke donose na temelju iskustva i intuicije, nekog standardnog ponašanja ili na temelju metodičkog prikupljanja i promatranja potrebnih informacija. Odluke donesene na temelju intuicije su u većini slučajeva pogrešne. Odluke donesene na temelju iskustva i intuicije su povezane s

visokim rizicima. Najjednostavnije je donositi odluke kod ponavljajuće nabave za potrebe projekta, iako je mala vjerojatnost da se za realizaciju dva različita projekta nabavljaju ista sredstva za rad ili IT. Kada se odlučuje o novim dobavljačima, potrebno je razmotriti sve informacije koje imamo na raspolaganju glede dobavljača kako bismo donijeli najpovoljniju odluku. U odlučivanju za vrijeme nabave sudjeluje više osoba. Ako nema alternativnih rješenja, nije moguće odlučivanje. Odlučivanje je vezano uz neizvjesnosti i rizike.

U dokumentu „odluka o odabiru" zabilježeno je koliko je bilo zaprimljenih ponuda, od kojih ponuđača, koji je najpovoljniji ponuđač, tko je odabrani ponuđač, razlog odabira odabranog ponuđača i pouka o pravnom lijeku. Odluku o odabiru tvrtka dostavlja svim ponuditeljima preporučenom poštom s povratnicom ili na drugi dokaziv način, a potpisuje ju direktor tvrtke.

Sastavljanje zapisnika o odabranoj ponudi slijedi nakon donesene odluke. Na zapisniku o odabranoj ponudi je zabilježeno tko je sve sudjelovao na otvaranju ponude, koja je najpovoljnija ponuda, koliko iznosi cijena najpovoljnije ponude, koje je dokaze o poslovnoj sposobnosti donio ponuditelj i tko je sve poslao ponudu. Na kraju se potpisuju sve osobe koje su bile u stručnom povjerenstvu za pripremu i provedbu postupka javne nabave. Nakon dostavljene odluke o odabiru i sastavljanja zapisnika o odabranoj ponudi slijedi rok mirovanja, što znači da naručitelj za potrebe projekta za vrijeme trajanja roka mirovanja ne smije potpisati ugovor o javnoj nabavi. Rok mirovanja u postupcima velike vrijednosti iznosi petnaest dana od dana dostave odluke o odabiru svakom ponuditelju, a u postupcima male vrijednosti pet dana od dana dostave odluke. Pri nabavama male vrijednosti rok mirovanja je pet dana od dana dostave odluka svim ponuditeljima (Franjković, 2010, str. 362). Odluka o odabiru najpovoljnijeg ponuđača počinje vrijediti istekom roka mirovanja ako nije pokrenut postupak pravne zaštite ili ako je odbačena pokrenuta žalba od Državne komisije za kontrolu postupaka procesa javne nabave.

Kod odlučivanja o izvođenju radova ili najboljem ponuđaču za javnu tvrtku za potrebe projekta najbolje je da sudjeluje više zaposlenika različitog obrazovanja koji će činiti povjerenstvo za odabir izvođača radova te sudionici koji čine tim za ostvarenje projekta.

Teorijska utemeljenost AHP metode

Razvoj hijerarhijskog modela u kojem je na vrhu hijerarhije cilj, a zatim se navode glavni kriteriji koji se mogu dekomponirati, sukladan je uobičajenom načinu na koji ljudi rješavaju kompleksne probleme odlučivanja. Svrha tog postupka je da se zbog nemogućnosti istovremenog analiziranja odnosa velikog broja elemenata koji čine složeni problem (prema rezultatima istraživanja iz kognitivne psihologije čovjek je u stanju istovremeno procesirati informacije o 7 ± 2 objekata) taj problem dekomponira na kontroliran način koji omogućuje usmjereno razmišljanje o manjem broju njegovih komponenata i sintezu rezultata takvih djelomičnih analiza u konačnu

odluku (Franjković, 2010, str. 335). AHP metoda je metoda višekriterijskog odlučivanja kod koje je potrebno procijeniti vrijednost omjera težine kriterija i važnost određenih alternativa. Vrijednosti kriterija u navedenoj metodi se izražavaju kvantitativno, kvalitativno te određenim mjernim jedinicama. U tom je slučaju potrebno koristiti Saatyevu skalu koja je prikaza u tablici 3.

Tablica 3.

Tablica 3. prikazuje Saatyevu skalu koja je omjerna skala te ima pet stupnjeva intenziteta i četiri međustupnja, a svakom od njih odgovara vrijednosni sud o tome koliko puta je jedan kriterij važniji od drugog. Skala se koristi kod uspoređivanja dviju alternativa, ali u tom slučaju se vrijednosti skale interpretiraju kao prosudbe koliko se puta veća prednost daje jednoj alternativi u odnosu na drugu.

Odabir najpovoljnije ponude AHP metodom

AHP metoda je pogodna za analizu odluka u kojima se javlja veći broj konfliktnih kriterija i koje se temelje na procjenama na temelju iskustva i poznavanja ponuđača i proizvoda. Ova metoda se koristi za analizu iz razloga jer postoji kvalitetan program Expert Choice koji omogućuje jasnu interpretaciju rezultata grafikonima. U nastavku se prikazuje primjena softvera kao dijela informacijske tehnologije za potporu u odlučivanju.

Promatrana tvrtka za realizaciju projekta nastoji nabaviti dva kvalitetna uredska kalkulatora s ispisom. Promatrana tvrtka je zaprimila dvije ponude različitih ponuditelja, te odabire povoljnijeg. Pošto su pristigle dvije ponude s istim tipom uredskog kalkulatora, problem je bilo jednostavno riješiti. Promatrao se kriterij cijena s PDV-om, jer se navedeni kriterij razlikovao u ponudama kao što pokazuje slika 4.

Slika 4.

Slika 4.[7] prikazuje cilj. Cilj promatrane tvrtke je odabrati na temelju pristiglih ponuda isplativ uredski kalkulator. Navedeni kriteriji na temelju kojih se odabire uredski kalkulator su: cijena, vrsta zaslona, brzina ispisa, način ispisa i raspored tipki. Na temelju pristiglih ponuda, primijenjene AHP metode i slike 4. može se vidjeti da je za promatranu tvrtku bolja ponuda tvrtke B.T.C. jer je manja cijena ponuđenog uređaja.

Nabava najprikladnijeg uredskog kalkulatora uz pojavu konfliktnih kriterija za potrebu projekta

Na temelju potreba tima za realizaciju projekta promatrat će se ponude uredskih kalkulatora koji nisu skuplji od 1.000,00 kuna. U drugom postupku u procesu nabave promatraju se uredski kalkulatori proizvođača Z: MP25-MG, MP37-MG, MP1411-LTS, MP1211-LTS, MP120-LTS, MP121-DTS. Glavni cilj u sustavu u ovom slučaju je nabaviti najprikladniji uredski kalkulator. Uredski kalkulator svojim osobinama mora

[7] ExpertChoice alat. (2011.). Preuzeto: 22. srpnja 2011 s adrese http://www.expertchoice.com

zadovoljiti korisnike koji su sudjelovali kod odabira u pogledu mogućnosti pretvaranja valute, tipkovnice(s obzirom da li je tipkovnica bakterijska ili antibakterijska), mogućnosti pregledavanja kalendara i vremena, veličine slova na zaslonu, brzine ispisa, cijene, težine, dimenzije tijela i broja znamenki.

Slika 5.

Slika 5. prikazuje kriterije i njihov poredak po prioritetima. Na temelju slike 5 možemo odrediti koji je kriterij najznačajniji za donošenje odluke. Na dnu slike se može vidjeti inkonzistentnost od 0.04 (Inconsistency=0.04), što predstavlja inkonzistenciju od 4% koja je manja od graničnih 10%, što ukazuje da je model težina kriterija dobro strukturiran. Pretvarač valute je najvažniji kriterij. Uredski kalkulator koji ima mogućnost pretvaranja valute je prikladniji za korisnika. Drugi kriterij po kojem korisnici odabiru kalkulator je tipkovnica. Sudionici u odlučivanju prilikom odabira ističu važnost da tipkovnica bude antibakterijska. Treći kriterij koji se uzima u obzir je postojanje opcije za prikaz datum/vrijeme. Četvrti kriterij za odabir je veličina slova na zaslonu. Peti kriterij je brzina ispisa. Šesti kriterij je cijena. Sedmi kriterij na temelju kojeg se vrši odabir je težina samog uređaja. Osmi kriterij je dimenzija tijela uredskog kalkulatora i posljednji kriterij koji utječe na donošenje odluke je broj znamenki. Na temelju prikaza važnosti kriterija tj. prioritetnih kriterija došlo se do zaključka da cijena nije uvijek ključan faktor na temelju koje će se donijeti odluka o/u nabavi.

Slika 6.

Slika 6. prikazuje procjene omjera važnosti kriterija kod odabira najprikladnijeg uredskog kalkulatora. Procjene su određene na temelju iskustva autora ovog rada. Pretvarač valute ima najviši kriterij, dok broj znamenki ima najmanji kriterij. Inkonzistentnost je 0,04 te ne prelazi granicu.

Definiranjem modela za odabir najprikladnijeg uredskog kalkulatora i određivanjem težina kriterija i podkriterija stečeni su uvjeti za određivanje prioriteta alternativa uspoređivanjem po pojedinim kriterijima i podkriterijima u cilju odabira najprikladnijeg uredskog kalkulatora.

Slika 7.

Slika 7. prikazuje procjene omjera prioriteta alternativa po točno određenom kriteriju kod odabira najprikladnijeg uredskog kalkulatora. Procjene su određene na temelju iskustva autora rada. Inkonzistentnost niti u jednom slučaju ne prelazi 0,04. U prikazanim slučajevima upotrijebljena je opcija RATINGS. RATINGS je formula za rangiranje s kojom se dodjeljuju diskretne težine alternativama.

Slika 8.

Slika 8. prikazuje prioritete alternativa po kriterijima. Najviši prioritet u ovom slučaju ima uredski kalkulator MP37-MG, što znači da će biti najprikladniji za nabavu za potrebe projekta te će korisnici biti njime zadovoljni. Na taj način je ostvaren cilj nabave „odabir najprikladnijeg uredskog kalkulatora".

Zatvaranje ugovora i važnost realizacije projekta u zadanom roku

Nakon što odluka o odabiru najpovoljnijeg ponuđača počinje vrijediti, slijedi ugovaranje s odabranim ponuditeljem i potpisivanje ugovora o nabavi za potrebe projekta. Nakon potpisivanja ugovora slijedi objava obavijesti o sklapanju ugovora u Narodnim novinama. Ugovorom se obvezuju obije strane da će izvršiti sve obveze koje su definirane u ugovoru o izradi programa za daljinsko očitanje, nadzoru potrošnje, upravljanju potrošnje i podmirenju izvršenih radova te implementaciji novog informacijskog sustava. Između ostalih članaka na temelju ugovora promatrane tvrtke vidi se da je jasno definiran rok do kada projekt informatizacije procesa učitavanje potrošnje mora biti realiziran te do kada mora biti uspostavljen digitalni nadzor potrošnje i upravljanje potrošnjom povlaštenih kupaca kako bi se izbjegli oportunitetni troškovi.[8]

Projekti imaju čvrsti datum završetka – kombinirati sve elemente okoline koji se pojavljuju u projektu i dovesti projekt do sigurnog završetka zahtjeva kombinacije vodstva, umješnosti, ludosti i magije (Šimović, 2011, str. 67). Rok za realizaciju projekta je 5 mjeseci i 27 dana od potpisivanja ugovora s „vanjskim suradnikom 1". Ako se projekt u potpunosti ne realizira do zakazanog roka, promatrana tvrtka ne će moći ostvarivati dobit od ulaganja, tj. neće imati nadzor nad potrošnjom te dalje postoji mogućnost gubitka plina u određenim dijelovima cjelokupne distribucijske mreže.

Interesantan odnos između varijabli vrijeme-troškovi-kvaliteta imaju informatički projekti na kojima se događa da povećanjem obuhvata projekta rastu troškovi na kvadrat. Ti troškovi rastu na softverskim projektima zbog povećane potrebe članova projektnog tima za komunikacijama i koordinacijom rješenja. Također je zanimljiv odnos prema kojem se smanjivanjem vremena trajanja softverskog projekta, povećavaju troškovi na četvrtu, a ako se želi dvostruko smanjiti rok završetka neke aktivnosti ili međuproizvoda, tada će troškovi narasti za 16 puta (Omazić, 2005, str. 218). Kod donošenja odluke o odabiru najpovoljnijeg ponuđača za uvođenje daljinskog očitanja i kontrole potrošnje plina nije bilo potrebno primijeniti AHP metodu iz razloga što je pristigla samo jedna ponuda za razliku od nabave uredskih kalkulatora.

Preporuke za poboljšanje procesa nabave za potrebe projekta

U sustavu nabave za potrebe projekta nerijetko se događaju konfliktne situacije koje remete normalizirano odvijanje procesa nabave. Konfliktne situacije nastaju za vrijeme odlučivanja o najpovoljnijoj ponudi. Pod pojmom "sukob" tj. "konflikt" podrazumijeva se suprotstavljanje razlika u ciljevima, rješenjima, odnosima, očekivanjima, mišljenju, znanju, osobinama, hijerarhiji, načinu rada, ponašanju i donesenim odlukama da

[8] Oportunitetni troškovi nastaju kada cilj projekta nije ostvaren u zadanom roku, tj. kada projektni „proizvod" nije u upotrebi i ne počinje davati koristi koje su bili planirane.

bi se suprotnoj strani nametnule promjene, dokazala ispravnost vlastitih stavova i odluka ili da bi se pružio otpor provedbi jednostrano postavljenih rješenja, ciljeva i očekivanja, odnosno određenog ponašanja (Ferišak, 2000, str. 34). Provođenjem javne nabave za potrebe projekta po Zakonu o javnoj nabavi, jednostavno nestaje mogućnost nastanka sukoba između sudionika u procesu nabave za potrebe projekta. Preporuka je držati se Zakona o javnoj nabavi u slučaju nabavljanja sredstava za potrebe projekta. Postupkom javne nabave se promatraju ponude svih ponuđača i odabire se najpovoljnija. U postupku sudjeluje veći broj članova koji čine povjerenstvo za javnu nabavu te koji promatraju ponudu, zbog čega postoji manja vjerojatnost da dođe do sukoba, tj. konflikta između sudionika povjerenstva u procesu provođenja javne nabave za potrebe projekta. Ukoliko se dogodi drugi slučaj (u postupku nabave za potrebe projekta), u kojem se javlja velik broj konfliktnih kriterija gdje se donose odluke koje se temelje na procjenama, preporuka je primijeniti AHP metodu koja je pogodna za donošenje odluka upravo za taj slučaj. Treća preporuka za poboljšanje procesa u sustavu nabave za potrebe projekta informatizacije je traženje od strane tvrtke koja nabavlja radove, detaljnu razradu ponude ponuđača, pogotovo ako se radi o informatičkim projektima izrade aplikacija za čiju se vrijednost pretpostavlja da će biti veća od 70.000,00 kuna. Razrada ponude bi trebala obuhvatiti (osim brojnih dokaza o nekažnjavanju, poslovnoj, pravnoj, gospodarskoj i financijskoj sposobnosti): (1) definiranje vremena koje je potrebno za izradu određenog programskog modula koji se nastoji implementirati, (2) broj programera koji sudjeluje u izradi aplikacije, tj. određenog programskog modula, (3) dokument o dokazu o stručnoj spremi i formalnoj naobrazbi programera koji sudjeluju u izradi aplikacije tj. na realizaciji projekta te njihovom radnom iskustvu, (4) plan troškova koje izazivaju programeri (ljudski resursi) koji direktno sudjeluju u izradi aplikacije, (5) iznos plaćanja programera po jednom satu rada, (6) potvrdu (referencu) ponuđača da je određeni modul koji nudi ponuđač implementiran u nekoj tvrtki, ako postoji takav slučaj, (7) izjavu ponuđača da je tvrtka (ponuditelj) sposobna sama izraditi određeni programski modul bez suradnje s trećom tvrtkom, (8) izjavu ponuđača u kojem programskom jeziku i/ili alatu će programski modul biti izrađen, (9) plan realizacije po danima, za svaki dan od prvog zakazanog dana do krajnjeg planiranog roka, te očekivani rezultat izrade dijela aplikacija na kraju svakog radnog dana, (9.1) (u planu realizacije, ponuđač bi trebao navesti) koliko zaposlenika bi radilo na točno određeni datum na realizaciji projekta i koliko sati, (9.2) detaljnu razradu cijene svih komponenti računala (hardvera), tj. opreme koja će biti implementirana u sustav, (10) izjavu da ponuditelj ima ustrojenu dežurnu službu programera koji su sposobni u minimalnom vremenu intervenirati.

Zaključak

Postupak javne nabave za potrebe projekta, proveden po Zakonu, omogućuje poštenu tržišnu utakmicu između tržišnih natjecatelja. Cilj javne nabave robe, radova i usluga za potrebe projekta je racionalno trošenje novčanih sredstava namijenjenih

za ostvarenje ciljeva projekta. Nastoji se postići najbolja moguća vrijednost za novac. Stručnom komisijom od više članova koji donose odluke u postupku javne nabave treba spriječiti moguću korupciju. Proučavanjem postupaka javne nabave i sustava nabave može se potvrditi definicija da se u procesu nabave za potrebe projekta stvara dobit.

U sustavu javne nabave prilikom nabave za potrebe projekta možemo se poslužiti AHP metodom jer je pogodna za analizu odluka u kojima se javlja veći broj konfliktnih kriterija te koje se temelje na procjenama. Sljedeći razlog za primjenu AHP metode je taj što za nju postoji program Expert Choice koji omogućuje razumljivu interpretaciju rezultata.

U dokumentu „Select Client List" Expert Choice-a može se naći informacija da su se Expert Choice alatom za odlučivanje koristile banke (bankarski sektor), vladine organizacije, farmaceutske tvrtke, telekomunikacijske tvrtke, informatičke tvrtke (HP, IBM) i komunalne tvrtke. Expert Choice je imao primjenu u proizvodnom odjelu tvrtke Ford, što je još jedan od razloga zašto koristiti AHP metodu koja je upotrebljiva i vrlo korisna u sustavu nabave te služi kao potpora za donošenje odluka prilikom planiranja i realizacije projekata.