

The AHP Method Implementation for ERP Software Selection with Regard to the Data Protection Criteria

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Abstract – The area of planning, management and process level assessment in enterprises, whether in small firms or multinationals companies, requires flexible and quality information systems. Within any company the management of the information system plays an important role. Throughout the organization, rapid and accurate transmission of information through information channels is needed, where there is a possibility for the application of basic logistics principles (system approach, coordination, planning, algorithmic thinking, global optimization). The need for information transfer, management as well as information systems is to identify and review criteria to ensure the flexibility and quality of the process level. The aim of this paper is to analyse the criteria for selecting the information system into a production company using the AHP method. In addition to the criteria for choosing an information system, the need to protect proprietary information assets is also required. The protection of information assets involves identifying and analysing risk criteria with a link to security risks for selected processes.

Keywords – Data protection, Information strategy, Security of IS, Risk criteria.

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1. Introduction

The starting point for the creation of information systems projects is the company's information strategy. The strategy includes the development of information systems to improve the status and value of the business, increased value added to the customer, streamlining business processes, and communicating both within and outside the enterprise. For new situations and system development, new tendencies can be identified, the benefits and deficiencies of the relevant system, whether logistic, formalized or expert. Specific problem solving can be done through system analysis. The purpose of the system analysis is to create an adequate subject of research based on a general methodological understanding of the beginning of the research phase, using the means and methods appropriate to this analysis. The baseline for monitoring and reviewing criteria is the processing of an information strategy. The priorities of the strategy include the directions of IS development in relation to:

- improving the position and values of the business,
- increased added value to the customer,
- streamlining business processes,
- communication within the company, but also in synergy with the business environment.

Enterprise Resource Planning (ERP) is software that enables the enterprise to automate and integrate the core business processes (from warehousing and material delivery, order management from pick up to shipping, including production planning, and related financial and cost accounting as well as human resource management) enables shared enterprise data to be shared and made available in real time.

2. Application of management methods in business IS

The basic of this method is to determine the material requirements in terms of actual needs arising from a specific product that the customer requires or

possibly was predicted as the expected market need in the future. These material requirements are determined through bills of materials, inventory status and production schedule (Figure 1.). Also, using this method, it is possible to define proposals for the purchase of materials and production orders of produced groups and parts. MRP requires:

- the existence of purchased and produced items with the identification of basic data,
- the existence of a bills of materials for each item produced,
- the existence of information on stock status, planned and open orders,
- the existence of the values of the continuous durations of the purchase, or the production of the related batch-setting methods for the given items [1, 2].

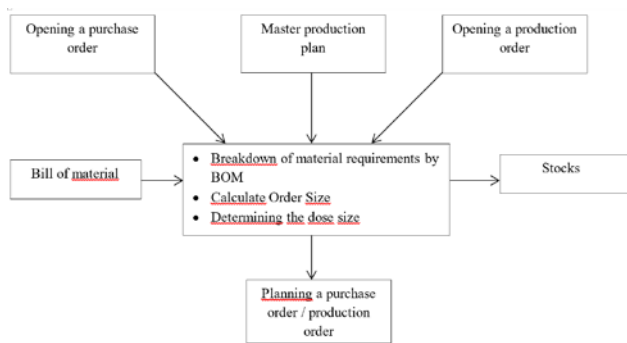


Figure 1. Specification of data files for MRP [1]

Capacity Requirements Planning – CRP

The principle of the method is based on tracking the actual spending. In the process, it is necessary to determine the amount of work and machine time required to meet the production orders. The CRP method is based on detailed capacity planning and prevents the so-called "gross planning. This analysis serves to monitor the actual capacity utilization and leads to better planning and decision making for detailed work scheduling in relation to deviations from the original plan [1, 2].

Manufacturing Resources Planning – MRP II

The subject of the method is planning of material and capacity resources. Part of the method is the business plan, production, and purchase plan. In addition to the specified schedules, the method provides information on the financial statement on orders, production and stored material. It represents a classic approach to business management. It is based on the "push" principle, which is based on product structure terms for ordering materials and commencing individual operations so as to ensure the final delivery date of the goods [1, 2].

Enterprise Resource Planning – ERP

It is a financially-oriented information system for identifying and planning corporate resources that are needed to accept, construct, deliver and account the customer business case. The distinction between ERP and MRP II is based on technical requirements such as graphical user interface, relational databases, computer support for product design, client / server architecture, and the portability of the system [1, 2].

Theory of Constrains within Business Innovation Systems

Dr. Application Eliyahu Moshe Goldratt, one of the leaders in modern management, is the creator of the Theory of Constrains. This theory has greatly contributed to improvements and innovations in areas of human activity, such as management of manufacturing and service enterprises, as well as health, state administration and projects [3].

3. Multi-criteria AHP method

This method is designed to address complex decisions. It is based on mathematical practice as well as on human psychology. It is used in decision-making in various departments to evaluate several alternative solutions. The method uses a pairing of the degree of significance of individual criteria and the extent to which these individual solutions meet the criteria selected. The benchmarking of criteria and variants is based on expert judgment, with experts comparing the mutual influences of the two factors.

Table 1. A rating scale for assessing two factors [4]

Factor A					Factor B				
9	7	5	3	1	3	5	7	9	
Very strong	Strong	Medium	Weak	The same	Weak	Medium	Strong	Very strong	

Consequently, it is necessary to determine the normalized own vector for each matrix. Its components determine the weights of the individual criteria and the evaluation of the solution variants according to the above-mentioned criteria. The resulting evaluation of each variant should be calculated by weighing the sum of determined ratings multiplied by the weightings of the criteria [4].

$$w_i = \sum v_j \cdot w_i \tag{1}$$

The optimal variant is the highest aggregate weighing option. Consistency needs to be calculated by [4]:

$$\frac{CI}{RI} \tag{2}$$

If the consistency ratio is up to 10%, the subjective assessment is consistent [4].

$$CI = \left(\frac{\lambda - n}{n - 1} \right) \tag{3}$$

where:

CI - Consistency index.

RI - Random index.

λ - Own array number.

Matrix size (1x1, ...)	1	2	3	4	5	6	7	8	9	10
RI	0.00	0.00	0.58	0.90	1.12	1.24	1.32	1.41	1.45	1.49

4. Determination of criteria and sub-criteria for implementation of the AHP method

In order to select an adequate information system, the requirements of the company and the adaptation of the IS to the needs of the enterprise are essential. Using the AHP method, it is possible to select an appropriate supplier based on criteria and sub-criteria [5, 6].

Step 1: Description of the criteria for the implementation of the AHP method.

The identified criteria include:

1. Price - is an essential factor in the choice of IS whether it is a small or medium-sized enterprise. It is necessary to set a trade-off between price and business requirements. Currently, there are information systems on the market for a variety of different purposes / industries that compete with each other, with competition between suppliers causing price reductions for this kind of products. Besides the basic purchase price of the products, it is also necessary to take into account the prices for the services and upgrades.

2. Availability of the trial version - the priority of selecting the appropriate information system lies in the availability of the software. The customer can get a better idea about the offer of a full version, and whether the pre-defined requirements are met. Module availability variation is reflected in the length of the available versions available for the software as well as the duration of the software and the cost of the software.

3. Service - the importance of the additional services offered is as important as the information system itself. Suppliers offer services to help ease the transition to a new system to provide services for smooth running of the system. The role of the

providers is to implement changes in the system and to inform the customer about ongoing changes. Another obligation of the provider is to provide training and retraining.

4. Support - the objective of the evaluated systems is to provide approximately the same modules, where the base for a quality information system is the possible extension with other functions, in order to adapt to current requirements and market development with an advantage over competition. A priority for backup and reliable operation of any system is to ensure regular backup of the most important data in order to avoid loss of sensitive information.

5. Security of the IS - the obligation of any given organization is to take sufficient care of its information assets, which includes a range of organizational, personnel and technical activities. One of the first steps is to secure access to the information system. In most cases, each organization processes personal data during its administrative activities, whether from external entities such as customers or suppliers. Likewise, most organizations have personal information stored in their information systems stored by their employees in connection with the creation of a labor-law relationship and wage obligations. Despite the IS security, there are still a number of cyber-attacks occurring.

Step 2: Implementation of the AHP method to evaluate selected suppliers within the selected criteria (Table 2.).

Table 2. Evaluation of suppliers through identified criteria

Criterion	Sub-criterion	ERP vendor rating		
		A	B	C
The price	Price offer	5	7	9
	Upgrade price	5	7	9
	Service cost	3	5	7
Software availability	Duration	9	7	3
	Meeting customer requirements	7	3	9
Service	Employee training	3	5	9
	Guidance	5	7	9
	Retraining	9	5	7
	Connection with departments	7	9	5
PC support	Operation System Compatibility	5	7	9
	Package contents	5	3	9
	Modules	5	3	9
	Data collection	5	9	7
	Processing	5	7	9
	Retention	7	5	9
Security IS	Responsibility	7	5	9
	Cyber attacks	9	7	5
	Data protection	9	5	7

Step 3: Perform a consistency test.

$$\lambda_{\max} = 5.0072$$

$$n = 5$$

$$CI = 0.0018 \quad RI = 1.12$$

$$CR = 0.1628 \%$$

Conclusion: $CR < 10 \%$ - subjective assessment is consistent.

Step 4: The results of the AHP method show that Supplier C meets the identified criteria (Table 3.).

Table 3. Final Scoreboard

	Price	Standard price	Ratio Criteria / Price	Order
Supplier A	21000	0.5634	0.4902	3.
Supplier B	7000	0.1878	1.4491	2.
Supplier C	9275	0.2488	1.8160	1.

The need to protect the personal information assets is now very important. In relation to asset protection, it is necessary to identify and analyze risk criteria with a link to security risks for selected processes. When performing evaluation, it is possible to apply a matrix for risk assessment. Consequently, it is necessary to propose measures to increase safety.

For this particular case, the team of experts consisted of a project manager, an information technology consultant, and an officer for an information security of the management system (Table 4.). To determine the values of sub-process risk criteria, a level 1 to 5 evaluation was used. The subprocess is rated as:

- 5 - very important,
- 3 - important,
- 1 - insignificant or little important.

The risk coefficient can be expressed based on the formula:

$$RC = \frac{E \cdot S}{100} \quad (4)$$

where:

E – Evaluation

S – The severity of the risk criterion.

RC – Risk coefficient.

Proposal of measures to improve the IS security [7, 8]:

1. Software failure in calculations - regular inventory tracking due to negative values in some documents (inventory status cards, orders, ...) must be ensured. In the case of zooming to zero, create an automatic notification of the information system.

2. Upgrading the Year-End Software - plan ahead to schedule all the updates needed to prevent the update from being pre-booked.

3. User's error - a major measure is to ensure that staff qualifications are continuously enhanced by training. Despite the increase in employee qualifications, it is not possible to rule out a human error factor that cannot be completely eliminated.

4. Interruption of electricity supplies - database servers must be secured by UPS - Uninterruptible Power Supply / Source / System. All sensitive workplaces where data loss may occur need to be secured by backup resources in the event of unexpected power outages.

5. Natural disasters - the design measure may consist of installing flood sensors. In addition to conventional fire detectors, it is possible to use thermal or an optical smoke fire detector as well as the installation of a sprinkler fire extinguisher. It is a self-contained fire extinguisher that belongs to water fire extinguishers category. The aforementioned fire detectors and fire extinguishers can be installed in all areas of the company.

6. PC closure - you need to ensure constant updating by purchasing contracts for the necessary time periods. Appropriate selection and subsequent installation of available versions of antivirus programs (NOD, Eset, Avast, ...).

7. Loss of Sensitive data - to prevent sensitive data leak, it is necessary to train all the employees within the organization on data protection and safety in order to avoid potential safety risks due to lack of employees knowledge. The data itself should be secured with limited user access, by passwords, cards, chips, etc.

Table 4. Defining the risks and determining the severity

O.n.	Risk criteria	Assessment level of by evaluation			E (%)	S	RC
		5	3	1			
1	Software failure in calculations	Very important	Important	Not important or not very important	30	5	1.5
2	Upgrading the Year-End Software	Very important	Important	Not important or not very important	25	3	0.75
3	User's error	Very important	Important	Unimportant	20	3	0.6
4	Interruption of electricity supplies	Often	Occasional	Any	10	1	0.1
5	Natural disasters	Very important	Important	Unimportant	5	1	0.05
6	PC closure	Very important	Important	Unimportant	5	1	0.05
7	Loss of Sensitive Data	Very important	Important	Unimportant	5	1	0.05

5. Conclusion

Currently, ERP (Enterprise Resource Planning) systems are important for successful business operation. These systems offer solutions for more efficient enterprise data management, production planning, material ordering, inventory tracking and human resource management. However, there are a number of types of ERP systems on the market that differ in the services provided [9, 10]. It is important for an enterprise to define goals and parameters related to the benefits of the implemented software. Particular attention should be paid to the implementation of objective ERP solution comparisons available on the market in relation to the needs and financial capabilities of given company. An overview of the main activities during the selection of a suitable ERP solution can be done in three ways [11, 12]:

1. technology aspects - ERP testing by applying test data using the company's own technique, evaluating the results according to the selected criteria of the company,

2. personnel perspective - visits of individual ERP vendors, test trials of ERP reference installs, process evaluation of assessed ERPs by involved employees, recommendations for purchase of selected ERP system,

3. management - creation of ERP selection and evaluation group, implementation of ERP system selection, preparation of contract with supplier of selected ERP system.

Choosing the right system helps increase the efficiency and quality of each activity while saving considerable funds. On the other hand, choosing an inappropriate information system, with disregard to data protection can cause significant losses for the company and even incur penalties.

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