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INFORMATION AUDIT FOR DECISION PROCESSES

Abstract*. Originating from the Latin auditum – as the endeavor of listening, verifying and recommending – generally the audit translates into a rational and independent contribution to the homeostasis of the audited system. It is a modern buzz word, applied to various systems, from the traditional ones – financial, accounting etc. – to the informational, decisional, communication, bureaucratic ones etc. Under the informational-decisional context, the audit knows specific developments, built on the quality aspect of data or on the stages of the information life cycle. In the following we will present theoretical and practical aspects of information auditing for decision processes, through a case study. The presentation highlights the logical and structural frame of the information audit stages, from planning and definition of the mission to the evaluation and writing the audit report.*

Keywords: *decision process, information audit, decision quality, automated decisions, systemic approach, decision audit.*

JEL Classification: D81, O33, M42

1. Introduction

Decisions are a critical success factor in achieving organization agility. On their efficiency is built the market success of the organization and is performance. Evidence in organisational decision making suggests that: businesses suffer substantial losses due to bad practice in decision making (AlHussayen, 2009), and organizations that show a high level of efficiency in making and implementing decisions generate an average 6% higher result on the stakeholders than others (Blenko et al., 2010).

In the competing economy, business is a very complex decisional act, with high implications and risks for the enterprising business managers (Ratiu-Suciu, 2009). Also, the management passes through the transition from certainty activities to the

management under crisis conditions that requires innovation and ingenuity (Rosca and Moldoveanu, 2009). Presently, organization expansion and increasing complexity of the business environment lead to the decisional process facing at least the following challenges/factors: complexity of decisional environment, the need for dynamic changes in decisions, making decisions based on distributed and heterogeneous decisional resources (Yu and Zheng, 2011), lack of information, top management pressure, lack of time, no consultation, rush the decision (AlHussayen, 2009), uncertainty. Uncertainty is considered a major challenge in making a decision. The major objective of the analyses performed on decisions is to reduce the uncertainty (Harris, 2009). Also, the decision process can be hard to understand and sometimes it is given insufficient attention. Description and explanation of decision making is often difficult due to problems of definition boundary of the process.

Complexity of the decisional process and the frequency of changes in rules and business policies raise the need to automate decisions and decompose strategic human decision into atomic business rules (Mircea et al., 2012). The advantages of information technology may be put to good use only as long as managers and employees are open to change. The change must be understood as a change in human mentality in the context of redefinition of organizational culture. Also, a greater importance must be given to information and organizational culture, which are the first two in the neo production factors sphere. Importance of information and its quality is recognized as being critical at all organizational levels, and especially top management. Lack of adequate substantiation for each activity / phase of decision-making decisions affecting efficacy (Aldeek, 2010; Ganswein, 2011).

The use of decision technologies and decision management techniques (like business rules, data mining, predictive analyses, and optimization) in so many organizations makes decision audit become a necessity. Decision audit is an important process for verification and continuous improvement of decisions made within the organization. Even more, the audit report and recommendations in it provide basic information for structural and functional reorganization of the organization. Also, is helps the organization to identify the place and ways to use information technology (IT) and the right approaches to ensure it is used successfully. This implies the need and an IT audit, which will provide management with assurance that a system or automated process is meeting its objectives. Specifically, the focus may be on managements' control responsibilities over computer-based information assets and processes (Stoel. et al., 2012).

Audit decision is practically the first step in identifying opportunities to redesign the decision-making, the inclusion of decision support systems in business processes and suggests changes in decision technologies that can improve performance and reduce costs (Power, 2009b). Audit decision making involves

both knowing and understanding decision-making. For a particular decision audit task, the decision itself may be a given (Murray et al., 2009).

2. Stages of decision process audit

Decision process audit varies based on the type of decisions within the organization. Thus, the main factors include: level of decision automation (manual decisions, semi-automated, automated), number of decision makers (individual decisions, group decisions), time frame (strategic, tactical and operational decisions), impact on organization (local, global).

Starting from research in the field of decision process audit (Power, 2009), decision audit, decisions management (Park, 2002), informational system audit (Ghilic et al., 2010) and other relevant studies we propose the following general stages (see figure 1): ❶ audit plan, ❷ identification of key decisions, ❸ description of decision processes, ❹ evaluation of decision processes, ❺ drafting the audit report.

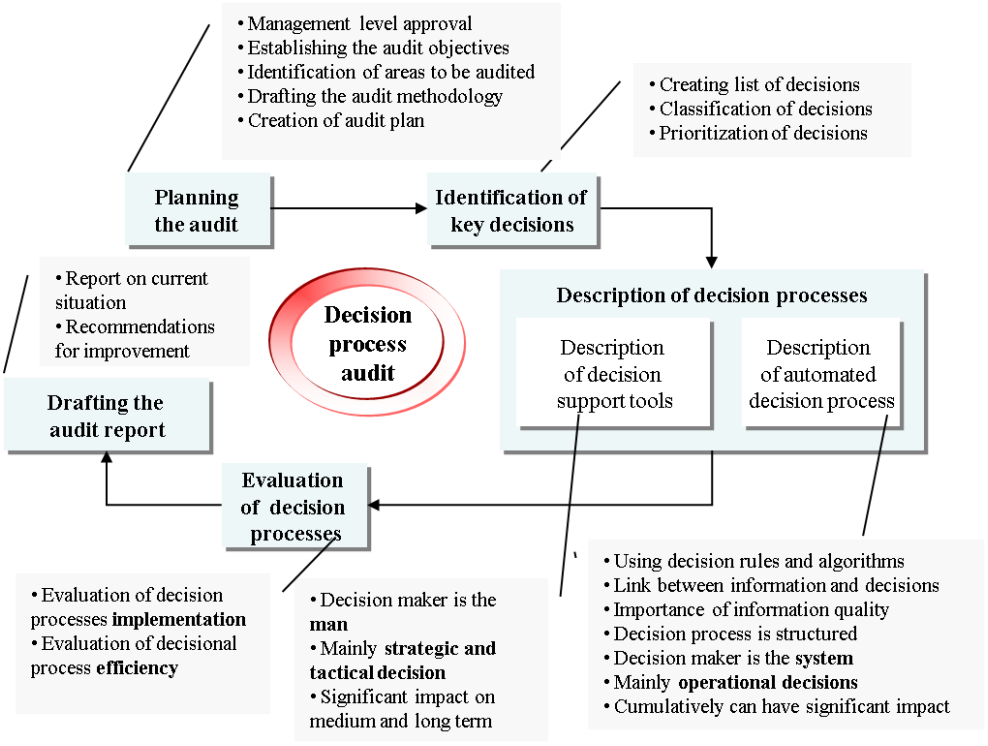

Figure 1. Decision process audit

Stage 1. Planning the audit

a) Management level approval. Approval from the management level is a key factor for audit success. Organization management must be aware of importance of achieving a high level of decision efficiency within the organization and its role in achieving organization success. At the same time, it must understand which are the products, principles, techniques, ways to lower the uncertainty and risks involved in the decision making process and the costs associated with this. Support from management is required because conducting an audit means using financial, time and human resources.

In order to obtain an approximate image of the decision quality level within the organization we can conduct a survey on a sample consisting of decision making personnel. Table 1 presents a few examples of criteria that help doing a preliminary evaluation of the decision quality within the organization. The results of the preliminary evaluation may be influenced by the subjectivity of the surveyed personnel, openness to self-evaluation / evaluation of their own decisions and organizational culture.

Table 1. Preliminary evaluation decision quality

Nr.	Criterion	Explanation	Given score	Importance coefficient
1	Correctness	3 – Yes, most of the cases; 2 – Sometimes; 1 – No, most of the cases	X_1	I_1
2	Speed	3 – High; 2 – Medium; 1 – Low (adapted after Blenko et al., 2010)	X_2	I_2
3	Value	3 – Generally; 2 – Sometimes; 1 – Never	X_3	I_3
4	Acceptance	3 – Yes, most of the cases; 2 – Sometimes; 1 – No, most of the cases	X_4	I_4
5	Effort	3 – Appropriate; 2 – Sometimes too big or too low; 1 – Never appropriate (adapted after Blenko et al., 2010)	X_5	I_5

Total score (TS)	TS> Val_1 efficient decisions $TS \in [Val_2, Val_1]$, good decisions, with room for improvement $TS < Val_2$ most decisions must be redesigned	$TS = \prod_{i=1}^{5} X_i I_i$ with $X_i \in \{1,2,3\}$, $I_5 \in (0,1)$

Decision quality must take into account several perspectives: the degree of goal achievement, the time it takes to make the decision, value of decision (direct benefits – for example money – and indirect – for example satisfaction), the effort required to make the decision (costs, energy, and associated effects), emotional and intellectual acceptance from those that implement the decision. The acceptance is a critical factor for decision success. A low level of acceptance (Harris, 2009) may lead to choosing an alternate decision, with lower quality but higher acceptance.

b) Establishing the audit objectives. During this stage the organization defines aspects related to audit objectives, goals and criteria. In general terms, the audit helps establish the organization's position in relation to its objectives and ways to achieve them. Also, the audit may be used to approach a specific problem that confronts the organization.

c) Identification of areas to be audited. Identification of areas that will be covered by the decision process audit must take into account the importance of decisions within the organization (which create value for stakeholders), the high impact on organization (strategic decisions, that may have significant effects on long term; operational decisions that may cumulate into a powerful impact), the complexity of the decision process (complex decisions made by a group of persons / systems; simple decisions, individual) and the visibility of decisions (visible or hidden within systems or processes).

d) Drafting the audit methodology. This stage involves describing the audit steps or processes, along with audit guide lines and available instruments. Audit methodology includes a well-defined program of using the audit results. This is an action plan oriented towards improving the areas associated with key decisions within the organization. This stage ❶ defines clear policies, procedures and key performance indicators that will be used in the evaluation of the decisional process, ❷ identifies the scale used for measurements and ❸ the questions that will be asked during the evaluation.

e) Creation of audit plan. During this stage the audit team is put together and the audit plan is drafted, based on elements previously identified. The audit plan includes: specification and building of audit requirements; allocation of audit teams based on previously established competences; establishing the start dates and

durations. The action plan and verification lists are introduces to the auditors, those audited and organization management for approval.

Stage 2. Identification of key decisions

In this stage key decisions within the organization are identified (based on decisional areas previously established), classified and prioritized. The decisions may be visible (manual or automated) or hidden inside processes. Taking into account the wealth of decisions in an organization and the major resources required by investments, the selection of key decisions is a very important step in achieving the success of audit process. The audit process must include only important decisions for the successful execution of business strategy, not any other decision.

Stage 3. Description of decision processes

The description of decision processes attached to the identified decisions must consider both the process diagram and the associated decision criteria. For all decision types, the decision process involves five general steps (Armesh, n.d.): identification of the problem or opportunity (managerial situation); development of alternatives; evaluation of alternatives; choosing and implementation of the best alternative; evaluation of decision. Figure 2 presents the decision process within an organization.

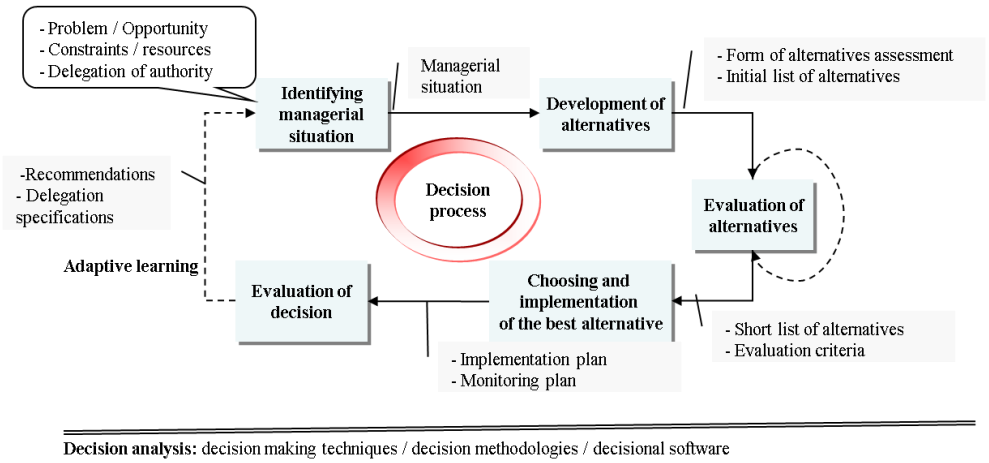

Figure 2. Decision process

The decision process starts by identification of a problem or opportunity by decision makers. Following the level of automation, they can be management personnel or information systems of both. Decision makers rely on information sources (financial reports, performance reports, problem identification indicators) and informal sources (opinions, advices, ideas). At the same time it must ensure a balance between information quantity and time and effort constraints. Lack of

balance may lead to problems related to unfounded decisions (insufficient information), long time to make a decision, inappropriate information management, inappropriate selection of processes, lower decision quality (informational abundance).

There is a tight relation between decision and information, especially for automated decisions. The number of decision makers as well as decision area influences the information quantity and the way to gather information. Thus, for individual decisions, the information is gathered from familiar sources, for group decisions the decision makers (members of the group, leaders) share the information and at organization level, the main involved actors like stakeholders, leaders, and regulators, gather information through rules, routines, procedures and techniques defined by the organization.

Also, the description of the process must include the identification of roles for individuals participating in the decision making, the level of decision structuring, the decision makers' ability to process relevant information and the role of human resources / systems in the decision process (Davenport, 2008).

In the process of evaluating the alternatives, we must take into account both the performance criteria as well as the effects of the decision consequences will have on other decisions (decision interdependence). Also, each alternative will have an associated risk rate. Each alternative transposed into a decision has a short or long term influence on alternatives and future decisions. Generally, alternatives may be evaluated as level of accomplishing the respective criteria.

After evaluation of alternatives, the best one(s) gets selected, based on criteria like importance, cost, time. Thus, the best solution can be chosen as the one with most benefits or less costs/risks, or based on several criteria or the first one that satisfies a minimum level of requirements (see table 2).

Table 2. Example of decision matrix

Criterion	**C1**	**C2**	**....**	**Cn**	**Score**
Importance	**I1**	**I2**	**....**	**In**	
A1	X_{11}	X_{12}	....	X_{1n}	PT_1
A2	X_{21}	X_{22}	....	X_{2n}	PT_2
....	...	...	....	....	....
Am	X_{m1}	X_{m2}	....	X_{mn}	PT_m

where $A = \{A_1, A_2, ..., A_m\}, m \geq 3$ is a set of decision alternatives, $C = \{C_1, C_2, ..., C_n\}$ is a set of evaluation criteria (benefits and costs), $I = \{I_1, I_2, ..., I_n\}$ is the importance of each criterion and complies to the following

relations: $I_i \in [0,1]$ and $\sum_{i=1}^{n} I_i = 1$, $P_j = \{P_{j1}, P_{j2}, ..., P_{jn}\}$ is a set of probabilities associated to the set of values $Val_j = \{Val_{j1}, Val_{j2}, ..., Val_{jn}\}$ calculated for the associated criteria, PT_j – the score for alternative j, $PT_j = \sum_{i=1}^{n} X_{ji}$ where $X_{ji} = P_{ji} \times Val_{ji} \times I_i$.

Evaluation of alternatives based on various criteria constitutes an important activity for the organization. In the example above, for a single decision maker the alternative(s) with highest score will be selected. For group decisions, the model is faced with certain difficulties. A study shows that only 2 of 78 multi-criteria decision methods proposed by researchers are actually used regularly by organizations (Evans in Kwork, et al., 2002).

There are multiple approaches in making a decision, both in United States and Europe, for example CRA (Computer Risk Assessment), MCDA (Multi-Criteria Decision Analyses) and adaptive management methods (Linkov et al., 2006). Thus, after generating the matrix, various MCDA methods (for example MAUT, AHP and outranking) require various kinds of information and optimization algorithms. A careful analyses and comparison of the methods has been conducted by Belton and Stewart (2002). Some techniques evaluate the alternatives, others identify a single optimal alternative, others provide an incomplete evaluation and others classify the alternatives in acceptable and unacceptable (Linkov et.al., 2006).

Also, from the perspective of modeling decision-making process to adopt alternative methods can be addressed optimal exact, approximate or heuristic. Modeling process is summarized in steps as detailed knowledge of the process covered modeling, building proper economic and mathematical model, this model experimentation, evaluation and implementation of model solutions. Can be used for this purpose various models descriptive or normative model type tree, Gantt model, model ADC (critical path analysis), Lagrange model, procedural models, etc.

According to a study conducted by (Davenport, 2008) on 26 decisions, only a few organizations had rigorous founding for them. Generally, they evolve in time, going through several interventions. An explicit design is required, especially for automated decision processes.

Stage 4. Evaluation of decision processes

Evaluation of decision processes must be pursued in all stages of the decision making process (see figure 3). A low level of quality in one or more stages may lead to a reduced quality of the decision and the need to restructure the organization in order to improve the decision process. Decision quality may be

affected in all stages of the decision process (examples (Bickel, 2011): incomplete description of the opportunity, inappropriate allocation of decision makers, faulty implementation of the decision).

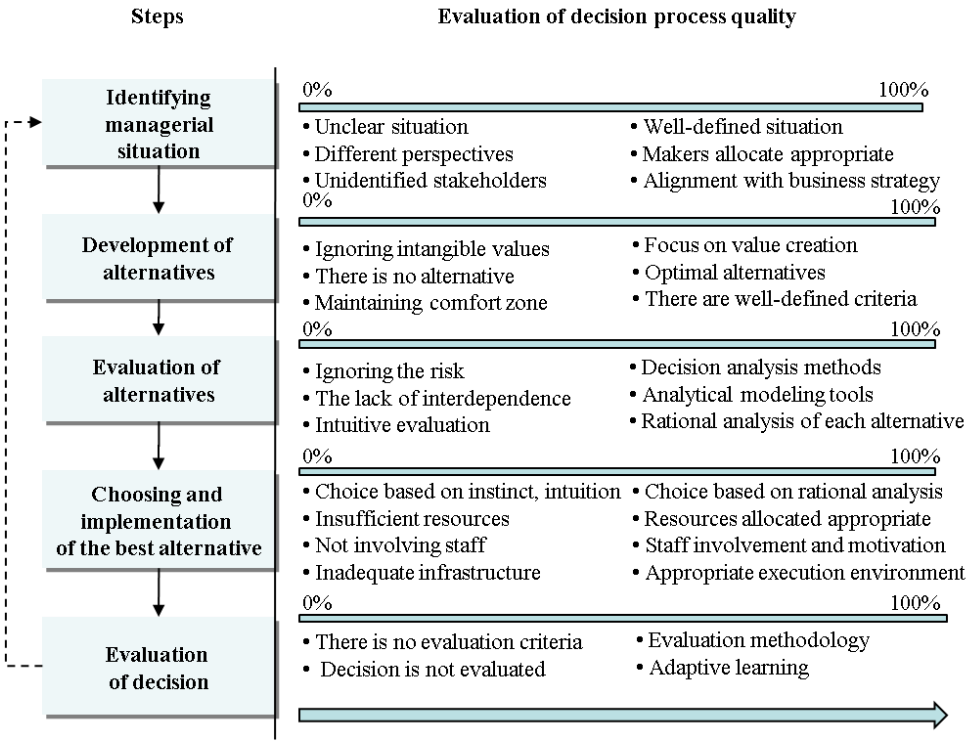

Figure 3. Evaluation of decision process quality

Evaluation of decision processes will be conducted from two points of view: decision implementation (through observation, interviews) and achieved performance (measurements of some performance indicators). Tables 3 and 4 present examples of criteria for evaluating the implementation and performance of decision processes.

Table 3. Evaluation of decision processes implementation

Nr.	Criterion	Score
1.	Availability of required information	20
2.	Appropriate personnel / systems allocation for decision making	10
3.	Decisional process structure efficiency	20
4.	Stakeholders' satisfaction	10
5.	Level of rational usage (vs. intuitive)	30
6.	Transparency in making the decision	10

Evaluation of decisional processes will be carried out taking into account the constraints of time, effort, simultaneous choices, the wealth of information.

Table 4. Evaluation of decisional process efficiency

Nr.	Criterion	Score
1.	Correctness	20
2.	Time saved	5
3.	Goal achieved	20
4.	Economies	5
5.	Cost of making the decision	10
6.	Cost of error	15
7.	Cost of suboptimal decision	10
8.	Effectiveness	5

Stage 5. Drafting the audit report

The audit report will help the organization improve the decision making at least in the following aspects (Davenport, 2009): identification and prioritization of decisions; study of affecting factors; design of roles, processes, systems and behavior in order to improve the decisional process, implementation of a new approach, through training, data analyses and evaluation of results. Additionally, value differences will create the premises for changes in decisional roles, informational flows, performance metrics, process (Blenko et al., 2010).

Among the possible recommendations yielded by the audit we can have automation through business rules; improvement of rules through data mining, reduced uncertainty in making a decision.

3. Audit of a decisional process regarding granting of a public procurement contract – case study

The object of the case study is the audit of the decisional process regarding the granting of a public procurement contract for repair and maintenance services for photocopy equipment in The Bucharest University of Economic Studies (ASE) for four years, starting in 2008.

First stage of the audit – audit planning – requires the approval of institution management, which in turn means a positive situation, after the approval was given at the public procurement department level. In order to establish the audit goals and mission, we defined the information concerning the objectives, according to the specificity of the audited decisional process.

Identification of audit areas, formulation of audit methodology (according to valid legislation for public procurement in 2008, Romania) and definition of audit plan

are performed taking into account the particularities of public procurement as well as the cybernetic external complementarity characteristics (see figure 4) associated to the public procurement in general. The contract targeted by this case study includes three types of services: copy machine repair services, copy machine maintenance services, computer peripherals repair and maintenance services.

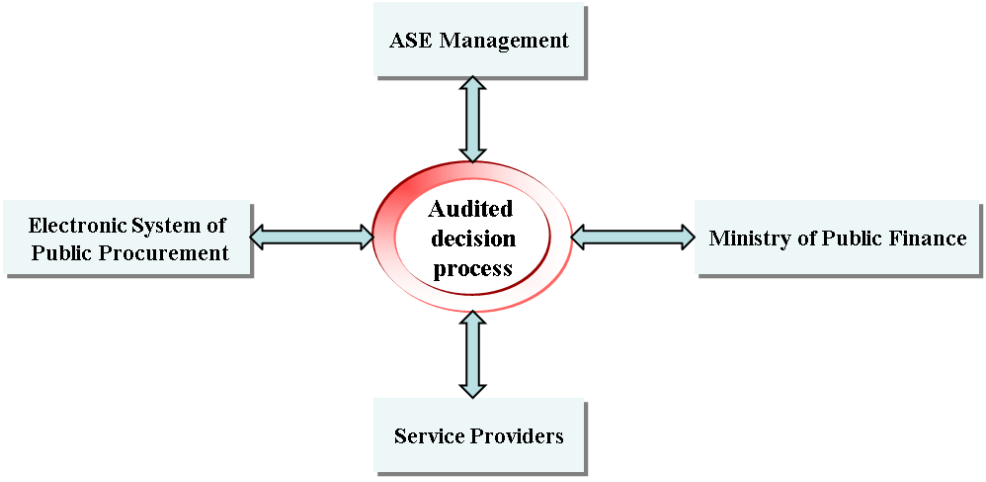

Figure 4. External complementarity of the audited decisional process

During the stage of key decision identification, as mentioned in the preliminary evaluation of decision quality (see table 1), we create the list of decisions, classify and prioritize them. Thus, the following decisions have been identified as main decisions (table 5).

Table 5. Main decisions in the audited process

Nr.	Definition context	Decision	Priority (1-3)
1.	Value threshold without VAT – above 125.000 Euro	Procedure used–open bidding	1
2.	At least 40% of the annual procedures conducted through electronic means	Electronic final phase – YES / No	3
3.	Bidder qualification and selection	Required documentation for bidder personal status – YES	1
		Required documentation for bidder professional capacity – YES	1

Nr.	Definition context	Decision	Priority (1-3)
		Required documentation for bidder economic and financial status – YES	1
		Required documentation for bidder technical capacity – YES	1
		Required certificates, authorizations etc. – YES	2
4.	Participation guarantee	Required – YES	1
5.	Possibility of adding documents to the offer	Allowed – NO	2
6.	Criterion used for granting the contract	The best offer from economic point of view	1

Decisions listed in table 5 were established as main decisions according to the valid legislation governing public procurement activities in Romania. During the decisional process itself, following an exhaustive analysis, more such decisions may be identified.

For the description and evaluation of decisional processes, as exemplification, we will present relevant aspects of the last decision in table 5 –the one made following the decisional process for establishing the criterion for granting the procurement of repair and maintenance services for photocopy equipment.

The criterion used for granting the public procurement contract: *the best offer from the economic point of view*.

A. Computation algorithm for "Copy machine repair service"

Nr.	Evaluation factor	Maximum score
1.	Service price	70
2.	Response time from notification	10
3.	Repair time	20
TOTAL		**100**

A.1. The score for "service price". The offer price (Po) is computed as follows:

$$Po = \frac{\sum_{i=1}^{c} cm_i}{c}, \; where \; cm_i = \frac{\sum_{j=1}^{r} cm_j}{r}$$

where: **c** is the number of classes (brands) of copy machines; $\mathbf{cm_i}$ is the average repair cost for each class / brand, **r** is the number of repair types and $\mathbf{cm_j}$ is average repair cost for each intervention type for each class / brand.

- For the lowest price (Po), the maximum score is granted (70 points);

- For each of the other prices, the score is computed as follows:

$$Pi = \frac{Lowest\ price}{Offer\ i\ price} \times 70$$

A.2. The score for "Response time from notification" is computed as follows:

- For the lowest response time, the maximum score is given (10 points)
- For each of the other offers, the score is computed as follows:

$$P(n) = \frac{lowest\ response\ time}{response\ time\ n} * maximum\ score$$

A.3. The score for "average repair time" is computed as follows:

- For the shortest repair time, the maximum score is given (20 points)
- For each of the other offers, the score is computed as follows:

$$P(n) = \frac{lowest\ repair\ time}{repair\ time\ n} * maximum\ score$$

Numerical example:

Nr.	Evaluation factor	Offer X		Offer Y	
		Effective value	Score obtained	Effective value	Score obtained
1.	Service price (monetary units)	100	56	80	70
2.	Response time from notification (hours)	2	10	4	5
3.	Repair time (hours)	24	20	24	20
		TOTAL	**86**	**TOTAL**	**95**

B. Computation algorithm for "Copy machines maintenance services"

Nr.	Evaluation factor	Maximum score
1.	Service price (subscription)	90
2.	Willingness to provide free services outside the subscription	10
TOTAL		**100**

B.1. The score for "service price" (Po) is computed as follows:

$$Po = \frac{\sum_{i=1}^{n} al_i \times nr_i}{\sum_{i=1}^{n} nr_i}$$

where **n** is the number of copy machine types, $\mathbf{al_i}$ is the monthly subscription value for each copy machine type, $\mathbf{nr_i}$ is the number of devices for each type of copy machine.

- For the lowest price (Po) the maximum score is given (90 points)
- For each of the other offers, the score is computed as follows:

$$Pi = \frac{Lowest\ price}{Offer\ i\ price} \times 90$$

B.2. The score for "willingness to provide free services outside the subscription" is computed as follows:

- For affirmative answer the maximum score is given (10 points)
- For negative answer the score is zero points.

Numerical example:

Nr.	Evaluation factor	Offer X		Offer Y	
		Effective value	**Score obtained**	**Effective value**	**Score obtained**
1.	Service price (monetary units)	100	72	80	90
2.	Willingness to provide free services outside the subscription	Yes	10	Yes	10
		TOTAL	**82**	**TOTAL**	**100**

C. Computation algorithm for "repair and maintenance services for computer peripherals"

Nr.	Evaluation factor	Maximum score
1.	Service price	50
2.	Response time from notification	10
3.	Service warranty	10
4.	Average repair time	30
TOTAL		**100**

C.1. The score for "service price" is computed as follows:

- For the lowest price (Po), the maximum score is given (50 points)

- For each of the other prices, the score is computed as follows:

$$Pi = \frac{Lowest\ price}{Offer\ i\ price} \times 50$$

where Po is $Po = \frac{\sum_{i=1}^{n} p_i \times weight_i}{100}$ with $\mathbf{p_i}$ being the price for service *i*, **n** is the number of services offered and $\mathbf{weight_i}$ is the importance given to the service.

C.2. The score for "response time from notification" is computed as follows:

- For the lowest response time, the maximum score is given (10 points)
- For each of the other offers, the score is computed as follows:

$$P(n) = \frac{lowest\ response\ time}{response\ time\ n} * maximum\ score$$

C.3. The score for "service warranty" is computed as follows:

- For the longest warranty, the maximum score is given (10 points)
- For each of the other offers, the score is computed as follows:

$$P(n) = \frac{warranty\ time\ n}{maximum\ warranty\ time} * maximum\ score$$

C.4. The score for "average repair time from notification" is computed as follows:

- For the lowest repair time, the maximum score is given (30 points)
- For each of the other offers, the score is computed as follows:

$$P(n) = \frac{lowest\ repair\ time}{repair\ time\ n} * maximum\ score$$

Numerical example:

Nr.	Evaluation factor	Offer X		Offer Y	
		Effective value	**Score obtained**	**Effective value**	**Score obtained**
1.	Service price (monetary units)	100	40	80	50
2.	Response time from notification (hours)	2	10	4	5
3.	Service warranty (months)	12	10	12	10
4.	Average repair time (hours)	3	30	4	22.5
		TOTAL	**90**	**TOTAL**	**87.5**

Evaluation of the decision processes that lead to the decisions made in this case study, as well as the performances of these decisions will look at economic and financial aspects. We will approach quality aspects for information used in founding the decision, the cost of gathering that information, as well as informational complexity characteristics. The approach may be developed on the three dimensions of quality (time, shape, content) and on the five stages in the information lifecycle (gathering, transmission, processing, usage, storage).

The results of the evaluation will be used as inputs for the audit report. It may lead to changes in informational / decisional levels of the audited processes, which may consist of redesigning informational flows, documents, algorithms and procedures for founding the decisions etc.

Conclusions

The audit of decisional processes proves to be a hot field as it may yield results that can be used to redesign the organizations. The redesign may target, from audit perspective, economic activities and processes of the organization in order to ensure its adaptation (agility) to dynamic market conditions. Thus, the audit reports become the main generators of instruments (of informational type mainly) that organizations can use in the policies to catch the market opportunities. Also, following the audit of informational-decisional systems, the individuals – as decision makers – may have a more clear and detailed image on the informational dualism in their business. As highlighted in the proposed case study, establishing the key decisions, description and evaluation of decisional processes are the audit stages that imply an analytical endeavor oriented towards the systemic characteristic of the project or business audited. Finally, since any decisional process may be perceived as a systemic manifestation, the audit of such processes will be governed by the laws of cybernetic economic systems.

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