

Applying Expert Systems for the Evaluation of the Career Development of Information System Auditors

Igor Karnet

Deržaničeva pot 14, SI-2341 Limbuš, Slovenia
Igor.Karnet@gmail.com

Eva Jereb and Vladislav Rajkovič

Faculty of Organizational Sciences, Kidričeva cesta 55a,
SI-4000 Kranj, Slovenia

Abstract. *This paper presents the reasons, benefits, and weaknesses of applying expert systems to evaluating the career development of information system auditors. A computer-based multi-attribute hierarchical model was developed to enable assessment and self-assessment of auditors' career development. This paper presents the needs that led to the decision to develop this type of computer-based model, which was designed on the basis of information system auditors' characteristics and the characteristics of their work environment. The model was developed using the DEXi computer program for multi-attribute decision making.*

The paper continues by presenting how expert modeling, as a method and technique for resolving multi-attribute decision problems, can be used to support and improve the process of evaluating the career path of information system auditors. The systematic process and the use of a computer-supported model enable information system auditors to reduce their dissatisfaction with the course of their career development.

The reasons for such dissatisfaction and the areas influencing their career development are explained; in addition, further light is shed on how expert systems can be used in human resource management or, more specifically, in evaluating the career development of information system auditors to improve the existing state of affairs.

Keywords. IS auditors, career, assessment, model, Dexi

1 Introduction

Employees are a key success factor of any company [9, 23]. However, this is true only if employees are sufficiently qualified and motivated to work in the company – that is, only if the company succeeds in getting them to do their best. Maximum employee satisfaction must be ensured

by simultaneously taking into account the employer's needs. An important step in this regard is made by managing employee career development based on an individual developmental plan, which entails a definition of an individual's wants and needs while simultaneously taking into account the company's needs.

This paper focuses on IS auditors and their career development. It presents a multi-attribute model for evaluating the career development of information system auditors. It begins by presenting IS auditors, their roles, and reasons for the importance of their career development.

2 IS auditors

IS auditors are a fairly specific group of employees [5, 2-3]. As a rule, they include highly educated and qualified professionals [10, 30], [14, 79].

IS auditors check the operation of IT internal control systems and IT operational risk-management systems [6, 17-18], [23, 113]. Due to their extensive expertise and experience, they often provide advice on how to improve the system of internal controls in order to increase effectiveness, performance, and economy in risk management and control. IS auditing is an integral part of IT Governance [17, 22], [22, 23], [24, 89].

The goals of IS auditors are thus directed to encouraging the audited company's management to establish a prudent and well-organized method of assessing, handling, managing, and controlling risks [15, 152], [19, 76], [21, 14]; on the basis of improved management quality, this leads to achieving better operating results and increasing

the company's profile and added value [1, 3], [14, 70], [24, 114].

As part of performing their auditing activities, IS auditors become familiar with the details of the processes carried out in the company, acquire a great deal of new knowledge and important experience, work together with the managerial staff on a daily basis, and thus become extremely well acquainted with the audited company and its organizational culture [10, 30], [20, 879-881]. This means they have the best preconditions for successfully assuming new managerial or leading positions in the company [18, 61]. It is precisely because of the fact that IS auditors have such great potential that their career development is extremely important.

Career development of individual IS auditors is largely influenced by their personal characteristics (i.e., ethics, flexibility, professionalism, communicative skills, way of thinking, effectiveness, work quality, etc.) and their work environment (i.e., working conditions, opportunities for further professional development, incentives for work performed, and a number of other motivators).

3 Career-development evaluation model

In monitoring their career development effectively, the computer-based hierarchical model presented below can be of great help to IS auditors. They can use this model for self-assessment, but it can also be used by auditing firms to monitor the career development of the IS auditors they employ more systematically, more objectively, and in a more organized manner [11, 2].

The purpose of using the multi-attribute method is certainly not to replace the human decision-maker, who remains fully responsible for the final decision; its purpose is to encourage decision-makers to think more thoroughly about and gather more detailed information on the problem at hand and reduce the possibility of overlooking factors that significantly influence their decision. The supporting computer tools assist them in developing a decision-making model, evaluate the career development of IS auditors, and provide a series of various analyses that can be used to verify, justify, explain, and document the evaluation made in greater detail [2, 9-10], [4, 438].

The model is designed in the form of a tree structure of criteria, which are combined into two branches: the auditor's personal characteristics and the auditor's working environment (Fig. 1). Each branch contains several levels of subsegments until reaching the leaves of the decision-making tree.

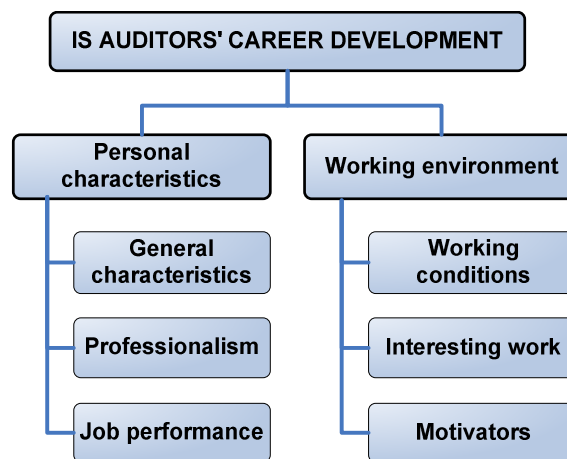


Figure 1: Upper part of the model's tree structure

The model was implemented using the DEXi computer program, which was developed on the basis of the expert system shell for multi-attribute decision making, also known as DEX. DEX contains a user interface and deduction mechanism, but an empty knowledge base. DEX (Decision EXpert), which is primarily intended for resolving complex decision-making systems, was developed at the Jožef Stefan Institute in Ljubljana. It is based on the DECMAC (DECision MAKing) methodology developed by Janet Efstathiou and Vladislav Rajkovič. Within the DEXi program, the desirability of an individual variant (in this case, the career development of an IS auditor) is calculated using the decision-making rules or the utility function. The decision-making rules are defined in an "if-then" form, according to which the lower-level attributes (criteria) merge into higher-level combined attributes or criteria [7, 27-28], [13, 482].

The goal of expert system developers is to record the knowledge about the problem domain studied in a formal form that will enable automatic deduction. In doing so, they use a multitude of formalisms and deduction techniques applied to these [2, 9], [8, 370].

With the help of the professional community (i.e., a number of IS auditors and heads of auditing firms), the degrees of criteria desirability were embedded in the model. The result is transparent solutions in the form of a knowledge base (i.e.,

deduction data and mechanisms) that can be reused [16, 170].

4 Advantages and potential weaknesses of the computer-based model

The model developed is simple to use. It stimulates evaluators to collect a multitude of data on individual IS auditors, which is positively reflected in the quality and accuracy of the result.

Because we are dealing with complex systems with many factors that are connected with one another in a complex manner, the expert modeling method was selected; this method presents knowledge in a more user-friendly and understandable way than traditional decision-making methods. Transparency is ensured through the use of artificial intelligence methods. Results are shown primarily in the explanation of evaluations and the transparency of procedures as a whole [3, 283-284], [12, 109-110].

The model's application provides positive psychological motivation for using an expert system because IS auditors believe more in the method, model, and computer support than in people that claim they can evaluate their career development well enough without using one type of model or another because they have everything they need in their heads and trust their own intuition.

Due to the systematic nature of the procedure, there is small possibility of overlooking something important that could significantly influence the IS auditor's career development.

This model enables more successful detection of individual IS auditors' characteristics and areas in which they do not meet expectations.

The application of DEXi enables an extremely good overview of work results because it provides a number of insights into and presentations of data supported by evidence in a simple and understandable way. Based on well-documented work performed, DEXi is capable of explaining how it arrived at individual evaluations.

A very useful functionality of DEXi is also its ability to perform simulations – that is, the possibility of using a “what if” analysis, which can be used to evaluate hypothetical scenarios in a simple manner.

The data collected can be integrated with other segments in the company and the auditing profession, and can also be used for research and development.

Through appropriate approach and systematic work, it is possible to provide a high-quality evaluation of IS auditors' career development. An important benefit of objective evaluation is also increased satisfaction of IS auditors and the resulting greater effectiveness and added value of the auditing firm because the multi-attribute hierarchical model for evaluating the career development of IS auditors presented promotes comprehensive analysis of their career development.

Auditing firms must provide high-quality services and work in line with standards, which, among other things, also envisage internal self-assessment. This official certification requirement, which is vital for the validity of the auditing work performed or the documents issued by the auditing firm, can be easily adjusted and the model presented can serve as an aid in meeting this requirement. From the methodological point of view, the model definitely represents a broad and gratifying starting point. In addition to the assessment and self-assessment of the IS auditors' career development, this computer-based multi-attribute hierarchical model also has wider social and professional implications.

Among the potential weaknesses, one should mention the risk of paying too much attention to the computer-based model instead of the importance of evaluation. The computer and DEXi cannot substitute for the evaluator's creative work and thinking, but only serve as aids because the model is only an approximation of reality. It must be used as an aid in making decisions. The final decision remains with the individual.

The computer model was tested on a group of IS auditors and so, as in any other complex and extensive system, there is a risk of error. It is therefore prudent and necessary to test the model as widely as possible in various environments in order to apply it in practice with greater reliability.

We believe that, despite the possible deficiencies described, expert modeling as a method and technique of solving multi-attribute decision-making problems can be used to support and improve the process of evaluating the career path of IS auditors and measure the impact of individual factors on their career development. The model presented can also be used for self-assessment. In this way, IS auditors can take advantage of existing career opportunities to a greater extent and develop their careers more successfully.

5 Conclusion

In order for human resources to become the greatest capital of a company, a planned, prudent, and systematic approach must be applied. To this end, a computer-based multi-attribute hierarchic model for evaluating career development has been developed and implemented using the DEXi computer program.

With the use of appropriate IT-support, the model developed enables transparency and explanations of the evaluation process and indicates what measures should be taken to optimize IS auditors' career development and consequently improve their quality and effectiveness. Concrete examples were used to establish that expert modeling as a method and technique of solving multi-attribute decision-making problems can be used to support and improve the process of evaluating the career path of IS auditors and achieve new and better quality in human-resource management.

6 References

- [1] Benzien I.: Human Issues in Information Systems Audit, ISACA Denmark Chapter, *The Fourth Conference in Information Systems Audit and Control*, Portorož, Slovenia, 12–13 September 1996.
- [2] Bohanec M.: DEX: Program for Multi-Attribute Decision Making, User's Manual, v.3.00, IJS Report DP-9989, Jožef Stefan Institute, July 2008, available at <http://www-ai.ijs.si/MarkoBohanec/pub/DEXiManual30r.pdf>, Accessed: 24th April 2010.
- [3] Bohanec M.: Odločanje in modeli [Decisions and Models], Zbirka Učbeniki in priročniki, DMFA, Ljubljana, 2006.
- [4] Bohanec M., Rajkovič V.: Večparametrski odločitveni modeli [A Multi-Attribute Decision-Making Model], *Organizacija, Revija za management, informatiko in kadre*, 28(7), Kranj, Slovenia, 1995, pp. 427–438.
- [5] Chau C.: Career Plateaus – Career Stagnation, *Internal Auditor*, Oct., The Institute of Internal Auditors, USA, 1998, available at http://findarticles.com/p/articles/mi_m4153/is_5_55/a_i_54250895, Accessed: 5th March 2010.
- [6] Čotar N.: Revizija informacijskega sistema kot sestavni del revizije upravljanja z operativnim tveganjem [Information System Auditing as a Component of Auditing Operative Risk Management], *Varnostni forum*, 5(9), Palsit d.o.o., Slovenia, 2009, pp. 17–18.
- [7] Črnivec Ž., Rajkovič V., Skuber B., Bohanec M.: Načrtovanje razvoja kadrov z ekspertnim računalniškim sistemom [Planning Personnel Development Using an Expert Software System], *IB – revija za planiranje*, 33(1–2), Ljubljana, Slovenia, 1989, pp. 23–36.
- [8] Furlan Š., Rupnik R., Krisper M.: Vega, lupina ekspertnega sistema [Vega: An Expert System Shell], *Zbornik 8. mednarodne multikonference Informacijska družba 2005*, Ljubljana, Slovenia, October 2005, pp. 370–373.
- [9] Jazbec B.: Kakšno vedenje zaposlenih nagrajevati in kako ga nagrajevati [What Kind of Employee Behavior to Reward and How], *Revizor, revija o reviziji*, 95(2–3), Slovenski inštitut za revizijo, Ljubljana, Slovenia, 1995, pp. 23–39.
- [10] Karnet I., Rajkovič V.: *Računalniško podprt večparametrski hierarhični model evalvacije delovanja revizorjev* [A Computer-Supported Multi-Attribute Hierarchical Model for Evaluating Auditors' Work], master's thesis, Univerza v Mariboru, Fakulteta za organizacijske vede, Kranj, Slovenia, 2007.
- [11] Karnet I., Jereb E., Rajkovič V.: *Model ocenjevanja kariernega razvoja revizorjev informacijskih sistemov* [A Model for Assessing the Career Development of Information System Auditors], *Zbornik referatov 17. Dnevi slovenske informatike 2010*, Portorož, Slovenija, Slovensko društvo Informatika, Portorož, Slovenia, 14–16 April 2010, pp. 1–9.
- [12] Kljajić M.: *Teorija sistemov* [Systems theory], Moderna organizacija, Kranj, Slovenia, 1994.
- [13] Kljajić M., Rajkovič V., Kljajić M.: Primerjava klasičnega in mehko systemskega večkriterijskega odločanja na modelih systemske dinamike [A Comparison of a Traditional and Soft Multi-Attribute Decision-Making System on System Dynamics Models], *Management in razvoj organizacije, zbornik 22. mednarodne znanstvene konference o razvoju organizacijskih ved*, Moderna organizacija, Portorož, Slovenia, 26–28 March 2003, pp. 480–486.
- [14] Koletnik F.: Novi okvirji strokovnega ravnanja v notranji reviziji [New Frameworks of Professional Conduct in Internal Auditing], *Zbornik referatov 5. letne konference notranjih revizorjev*, Slovenski inštitut za revizijo, Otočec, Slovenia, 2002, pp. 69–85.

- [15] Korbar L. B.: Kako notranjerevizijski predstojnik zagotovi v načrtu revizije "prave revizijske cilje"? [How Can Internal Auditing Directors Ensure the "Right Auditing Goals" in an Auditing Plan?], *Zbornik referatov 12. letne konference notranjih revizorjev*, Slovenski inštitut za revizijo, 12–13 November 2009, Ljubljana, Slovenia, 2009, pp. 151–165.
- [16] Kovač T., Resman M., Rajkovič V.: *Vpliv participacije učencev na kakovost vzgojno-izobraževalnega dela šole* [The Influence of Student Participation on the Quality of Schools' Educational Work], doctoral dissertation, Univerza v Ljubljani, Filozofska fakulteta, Ljubljana, 2008.
- [17] Krisper A., Klakočar S.: Izvajanje vodstvenih notranjih kontrol v plačilnih agencijah Evropskih kmetijskih skladov in vloga notranje revizije [Carrying Out Internal Control Management in Paying Agencies of the European Agricultural Fund and the Role of Internal Auditing], *Revizor, revija o reviziji*, 19(5), Slovenski inštitut za revizijo, Ljubljana, Slovenia, 2008, pp. 7–25.
- [18] Lajara B. M., Lilli F. C., Sempere V. S.: Human Resource Management: A Success and Failure Factor in Strategic Alliances, *Employee Relations*, 25(1), 2003, pp. 61–80.
- [19] Prevodnik G.: Razkrivanje in merjenje dodane vrednosti aktivnosti notranjega revidiranja uprave banke [Disclosure and Measurement of the Added Value of the Internal Auditing Activities of Bank Management], *Zbornik referatov 9. letne konference notranjih revizorjev*, Slovenski inštitut za revizijo, Portorož, Slovenia, October 2006, pp. 75–95.
- [20] Sawyer L. B., Dittenhofer M. A., Scheiner J. H.: *Sawyer's Internal Auditing, 5th Edition, The Practice of Modern Internal Auditing*, The Institute of Internal Auditors, USA, 2003.
- [21] Vitasović M.: Organiziranost notranjega revidiranja v Hrvaškem javnem sektorju [The Organization of Internal Auditing in the Croatian Public Sector], *Revizor, revija o reviziji*, 19(3), Slovenski inštitut za revizijo, Slovenia, June 2008, pp. 7–23.
- [22] Vuga R.: Revizija – poklic sprememb [Auditing: A Career of Changes], *Varnostni forum*, 5(9), Palsit d.o.o., Slovenia, 2009, pp. 22–24.
- [23] Vuk M.: Vloga notranjega revidiranja pri upravljanju poslovnih procesov [The Role of Internal Auditing in Managing Business Processes], *Zbornik referatov 11. letne konference notranjih revizorjev*, Slovenski inštitut za revizijo, Portorož, Slovenia, 13–14 November 2008, pp. 113–127.
- [24] Wostner Ž.: Internal Auditing Department or Outsourcing, *Zbornik referatov 5. letne konference notranjih revizorjev*, Slovenski inštitut za revizijo, Slovenia, 2002, pp. 87–98.