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# E-learning Model for Competence Development of Chief Information Officers

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**Abstract:** The objective of this paper is to make an overview and analysis of the role and the challenges that the Chief Information Officers (CIOs) are facing and to present an e-learning model for the continuous development of their competences that will allow regular upgrade of their knowledge and skills according to the needs of the organisations. For this purpose, a comparison is made between the public and the private sector about the fundamental principles, key characteristics and competences of CIOs. An e-learning model for the continuous development of the CIOs is proposed based on the ADDIE model that takes into consideration the required competence areas.

**Keywords:** *Chief Information Officers (CIOs), e-learning, personalised education, learning management platforms, data-driven education, life-long learning.*

## 1. Introduction

In an increasingly technological and data-driven world, the role and the importance of the Chief Information Officer (CIO) is rapidly increasing. Because technology is vital to most companies and organizations, CIOs can no longer simply be technical experts. They have gradually taken on more responsibilities in the strategic decisions of organisations.

The rapid change in the technologies and data management make the role of the CIOs very challenging. Keeping up with the new software and inventions in order to manage the information of the organisations and prevent cyber-crime is a necessity. Life-long learning and constant upgrade of knowledge is a must. Moreover, the need for the CIOs to be actively involved in management decisions require that they develop and learn the necessary management skills.

The following article aims to make an overview and analysis of the role and the challenges the CIOs are facing and to present an e-learning model for the

development of their competencies based on their prior knowledge that will allow regular upgrade of their competence according to the growing needs of the organisations.

## 2. Overview of the CIO role in the public administration and the private sector

Advances in the digital transformation of the administration and emerging technologies pose significant challenges for administrations. Data from the 2018 State of the Administration Report [1] shows that the total number of ICT administration staff is 2,987, which is 120 more than in 2017, but remains very small as a share of the total employees employed (about 2%). According to their functions, they are allocated as follows: ICT support staff – 1 913, planning – 627 and development – 447. This indicates a lack of planning and management capacity for information resources in administrations [2].

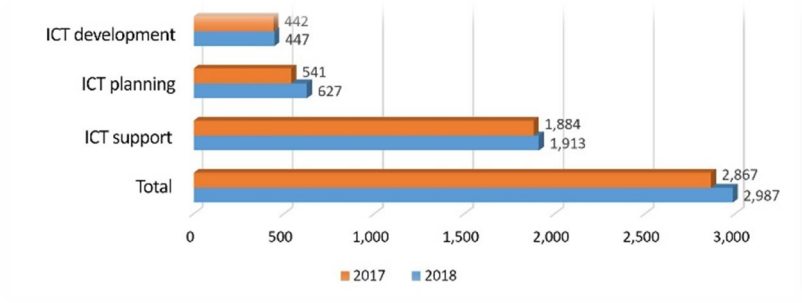



Fig. 1. Number of ICT officials in the public administration

About 30% of the administrations indicate that they do not have the necessary administrative capacity to work in e-government, the main reasons being the lack of qualified or under-trained staff, low pay, insufficient staffing, lack of budget.

Aggregated data received from administrations on the remuneration of ICT employees indicate that the highest average monthly remuneration in administrations is for the position of State Expert – BGN 2 012.

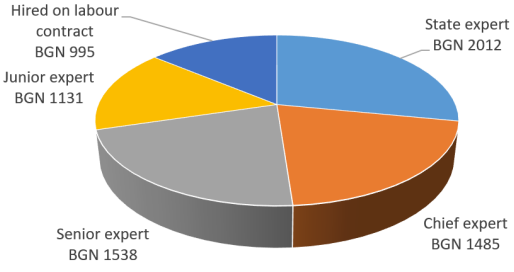



Fig. 2. Average monthly salary of ICT employees

The data on the remuneration of ICT employees in the public sector show that their average monthly remuneration lags far behind those in the private sector. This, combined with intense competitive pressure from the private sector, makes it impossible to attract and retain highly qualified personnel from the public administration.

High staff turnover continues, including due to non-competitive pay to the private sector, lack of career opportunities and incentives and mechanisms to acquire and maintain real hands-on experience and knowledge of the most sought-after and up-to-date technological solutions. The lengthy selection procedures for civil servants, as well as the lack of flexible forms of remote working, also contribute to the low interest of qualified experts in employment in public administration.

The shortage of skilled Chief Information Officers (CIOs) has a major impact on the ability to plan and manage information resources and reengineer processes, the quality of projects being developed and technical specifications, financial planning and the provision of network and information security. The role of the CIOs is crucial for the success of the public administration.

The CIOs of leading organizations describe a consistent set of six key principles of information management that they believe contribute to the successful execution of their responsibilities, according to a research made by the United States General Accounting Office [3]. These six fundamental principles and key characteristics of CIO Management in leading organizations described by the CIOs are:

**Recognize the Role of Information Management in Creating Value**

- Information management organizational functions and processes are incorporated into the overall business process;
- Mechanisms and structures are adopted that facilitate an understanding of information management and its impact on the organizations overall strategic direction.

**B. Position the CIO for Success**

- The CIO model is consistent with organizational and business needs.
- The roles, responsibilities, and accountabilities of the CIO position are clearly defined.
- The CIO has the right technical and management skills to meet business needs.
- The CIO is a full participant of the executive management team.

**C. Ensure the Credibility of the CIO Organization**

- The CIO has a legitimate and influential role in leading top managers to apply information management to meet business objectives;
- The CIO has the commitment of line management and its cooperation and trust in carrying out projects and initiatives;

- The CIO accomplishes quick, high-impact, and visible successes in balance with longer term strategies;
- The CIO learns from and partners with successful leaders in the external information management community.

**D. Measure Success and Demonstrate Results**

- Managers engage both their internal and external partners and customers when defining measures;
- Management at all levels ensures that technical measures are balanced with business measures;
- Managers continually work at establishing active feedback between performance measures and businesses.

**E. Organize Information Resources to Meet Business Needs**

- Managers engage both their internal and external partners and customers when defining measures;
- Management at all levels ensures that technical measures are balanced with business measures;
- Managers continually work at establishing active feedback between performance measures and businesses.

**F. Develop Information Management Human Capital**

- The CIO organization identifies the skills necessary to effectively implement information management in line with business needs;
- The CIO organization develops innovative ways to attract and retain talent;
- The CIO organization provides training, tools, and methods that allow skilled IT professionals to use in performing their duties.

The following table summarizes the practices of the leading organizations in each principle area and compares them with practices in the federal CIO environment.

Table 1. Comparison of leading practices and federal CIO management practices [4]

| Principle | What a Leading Organization Does | What the Public Administration Does |
|---|---|---|
| Recognize the Role of Information Management in Creating Value | • CEOs and governors ensure that the CIO organization is a key business player<br>• CIO is a full participant in the executive decision making process | • Information management generally still viewed as a support function instead of a strategic activity<br>• CIO is not always involved in strategic and policymaking decisions |
| Position the CIO for Success | • Defines clear CIO role and authorities<br>• Matches CIO type and skills set with business needs | • Does not always clearly define CIO role or authority |

| Principle | What a Leading Organization Does | What the Public Administration Does |
|---|---|---|
| | • Forges CIO partnership with CEO and other senior executives | • Does not always match CIO selection with organisation's needs<br>• Does not always provide executive support for the CIO position |
| Ensure the Credibility of the CIO Organization | • CIO builds credibility through effective leadership, good working relationships, track records, and partnering with customers and peers | • Uses practices similar to leading organizations |
| Measure Success and Demonstrate Results | • Strong links exist between business objectives and performance measures<br>• Performance management structure still evolving | • Weak links between organization's goals and information technology and management performance measures<br>• Required annual performance plans still in early stages |
| Organize Information Resources to Meet Business Needs | • Reassigns staff as needed to best serve interests of customers<br>• Structures the organization along business lines as well as information management functional areas | • Tries to meet needs of customers with a fixed organizational structure<br>• Structures the organization primarily along information management functional areas |
| Develop Information Management Human Capital | • Maintains up-to-date professional skills in technology management<br>• Outsources entry-level positions but largely hires at all levels of experience | • Provides limited amount of training in technology management<br>• Assumes entry-level staff will remain in federal service as a career |

Table 1 indicates that a gap exists between the practices and the competency management systems of the CIOs in public administration and CIOs of leading organizations. Areas in which gaps exist should be examined carefully to understand the basis for the differences as well as opportunities for greater implementation of the principles.

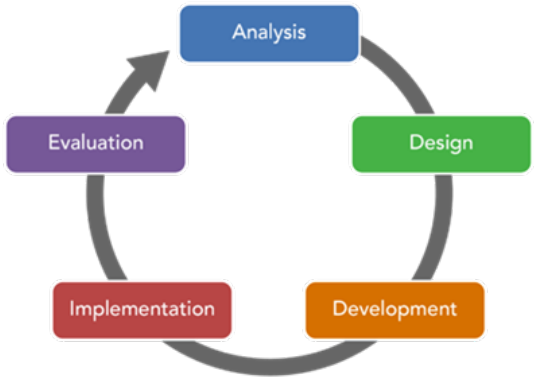
The conclusion is made that an understanding of the information technology and management practices of leading organizations could contribute to the development of improved CIO management practices in the public sector. Increasing the capacity and responsibilities and life-long learning of ICT staff is essential for the success of both public and private sector. The continuous development of Information

Management Human Capital is essential for every organization regardless how big or small.

## 3. E-learning model for development of CIOs based on ADDIE model

The ADDIE model is a step-by-step description of the learning design process [5]. We use the model as a basis for the development of the e-learning content and courses for the CIOs.

The process of creating and implementing e-learning goes through 5 main phases, Fig.3:




- *Analysis;*
- *Design;*
- *Development;*
- *Implementation;*
- *Evaluation*

Fig. 3. ADDIE model

***Analysis***

An analysis is performed at the beginning to determine if:

- Training is needed to fill gaps in professional knowledge and skills;
- E-learning is the best solution for conducting training.

The needs analysis allows to identify the general objectives of the course at a high level. Target audience analysis is another important step. The design and delivery of e-learning is influenced by key characteristics of learners such as their previous knowledge and skills, geographical distribution, learning context and access to technology.

An analysis is also needed to determine the content of the course [6]:

- Task analysis identifies the content that learners need to learn or improve, as well as the knowledge and skills that need to be developed or consolidated. This type of analysis is mainly used in courses designed to build specific work-related skills (also called 'implementation courses');
- The analysis of the topic is performed to identify and classify the content of the course. This is typical of those courses that are designed primarily to provide information (also called "information courses").

### *B. Design*

The design stage includes the following activities:

- Formulation of a set of learning objectives necessary to achieve the overall goal at a high level;
- Determining the order in which the objectives are to be achieved (sequence);
- Selection of training, media, evaluation and delivery strategies.

The result of the design phase is a project that will be used as a starting point for the development of the course.

The plan illustrates the structure of the curriculum (i.e. its organization in courses, units, lessons, activities), the learning objectives related to each unit and the methods and formats of delivery (i.e. interactive stand-alone materials, synchronous and/or asynchronous joint activities) for delivery of each training unit.

### *C. Development*

At this stage, the content of e-learning is actually produced. The content can vary considerably, depending on the resources available. The development of multimedia interactive content consists of three main steps:

- Content development: writing or gathering all the necessary knowledge and information;
- Development of scenarios: integration of teaching methods (all pedagogical elements needed to support the learning process) and media elements. This is done by developing a script, a document that describes all the components of the final interactive products, including images, text, interactions and evaluation tests;
- Development of teaching aids: development of media and interactive components, producing the course in different formats (Local or Web) and integration of content elements in a learning platform to which learners have access.

Essential for building interactive online courses that engage the learners in maximizing online learning is the process of transforming standard learning content into one that is appropriate for conducting online self-paced courses [7].

Personalised learning services are a key point in the field of online learning as there is no fixed learning path which is appropriate for all learners. However, traditional learning systems ignore these services requirements and deliver the same learning content to all learners. In order to design an adaptive learning content, we need to enable the delivery of learning content according to particular learner's needs [8].

The content of the courses for the CIOs will be organized according to the six fundamental principles and key characteristics of CIO Management analyzed in the previous section of the paper:

- Recognize the Role of Information Management in Creating Value

- Position the CIO for Success
- Ensure the Credibility of the CIO Organization
- Measure Success and Demonstrate Results
- Organize Information Resources to Meet Business Needs
- Develop Information Management Human Capital

In order to make the model personalized and take into account the Prior Knowledge of the CIOs, we propose using the following customised e-learning model, shown in Fig. 4.

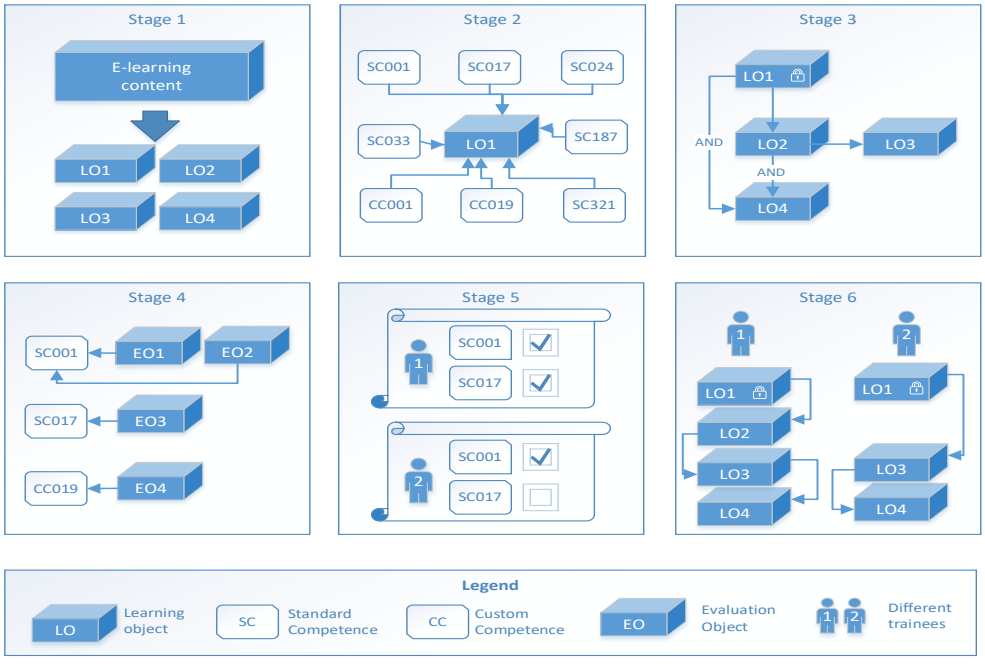



Fig. 4. Stages in developing and delivering personalised e-learning

The model takes into account the accumulated competences of each learner [9] and includes the following stages.

- Stage 1 – Decomposing the learning content into small learning objects;
- Stage 2 – Describing the learning objects with competencies;
- Stage 3 – Linking the learning objects;
- Stage 4 – Creating evaluative/analysing components;
- Stage 5 – Developing a competent profile;
- Stage 6 – Providing access of the individual learners to the learning content based on the competence profile.

There is a broad understanding among the members of the LO (Learning Object) community about the functional requirements a LO should have [9]:

- Accessibility: the LO should be tagged with metadata so that it can be stored and referenced in a data base.
- Reusability: once treated, a LO might be used in different instructional contexts.
- Interoperability: the LO should be independent of both the delivery media and learning management systems.

***D. Implementation***

The implementation phase entails the transformation of the plan into action. It includes the processes of installation and distribution of the created product as well as the management of the provided training. The implementation phase reflects the continuous modification and improvement of the program to ensure the positive results.

The steps of the implementation phase include training the educators, arranging the learners, and organizing the environment for learning suitability. Training the educators before the start of the course will help increase their understanding and awareness of the content and materials. It is imperative that the learners have access to the essential materials, tools, and knowledge, so that they may contribute more effectively to group discussions and activities.

***E. Evaluation***

The evaluation stage covers the process of evaluating the quality of the created e-learning. The results of the assessment are used in the next training cycle to improve its effectiveness and clear up any problems. This is the stage in which the project is being tested vigorously about the what, how, why, when of the things that were accomplished (or not accomplished) of the entire project.

This phase measures the effectiveness and efficiency of the instruction. Evaluation should actually occur throughout the entire instructional design process - within phases, between phases, and after implementation.

Evaluation may be Formative or Summative. Formative Evaluation is ongoing during and between phases. The purpose of this type of evaluation is to improve the instruction before the final version is implemented. Summative Evaluation usually occurs after the final version of instruction is implemented. This type of evaluation assesses the overall effectiveness of the instruction. Data from the Summative Evaluation is often used to make a decision about the instruction (such as whether to purchase an instructional package or continue/discontinue instruction).

## 4. Conclusion

The role and the importance of the Chief Information Officer (CIO) is rapidly increasing and they have gradually taken on more responsibilities in the strategic decisions of organizations. The rapid change in the technologies and data management requires constant e-learning for continuous development of their technical and management skills.

The presented in this paper model aims to propose a personalized e-learning model for continuous development of the CIOs based on ADDIE model and involving the six main areas of improvement as evaluated by leading organisations.

The conclusion is made that the need for life-long learning of the CIOs in every organization will only grow in significance in the future with the rapid change in the technologies and data management. Therefore the e-learning models need to be further personalized in order to ensure their competencies are up-to-date with the requirements.

## References


1. 2018 State of the Administration Report, adopted by Decree No. 273 / 20.5.2019, An official website of the European Union, https://ec.europa.eu/
2. Status report and annual plan for development and updating of information resources in the administration and information resources of the unified electronic communications network of the state administration and for the needs of national security, State e-Government Agency, Republic of Bulgaria, August 2019, https://www2.e-gov.bg/en/1
3. US GAO, Chief Information Officer, Executive Guide, GAO-01-376G, https://www.gao.gov/assets/80/76558.pdf
4. Hannum, W.H.: Instructional Systems Development: A thirty year retrospective. Educational Technology, 45(4), 5-21, (2005).
5. Clark, R.C.: e-Learning and the Science of Instruction: Proven Guidelines for Consumers and Designers of Multimedia Learning, 2nd edn., Pfeiffer, San Francisco (2005).
6. Blagoev, I., Monov, V.: Criteria and Methodology for the Evaluation of e-Learning Management Systems based on the Specific Needs of the Organization. International Journal of Education and Information Technologies, 12, North Atlantic University Union (NAUN), 134-141, (2018).
7. Yarandi, M., Jahankhani, H., Tawil, A-R.H.: A personalized adaptive e-learning approach based on semantic web technology. Webology 10(2), 1–14, (2013).
8. Vassileva, G., Monov, V., Blagoev, I.: E-learning model for personalised online education based on data analysis and competence profile, In: Proc. of the International Conference on Education and New Learning Technologies “EDULEARN19”, Palma de Mallorca Spain, pp. 3726-3732, (2019).
9. Polsani, P.R.: Use and abuse of reusable learning objects. Journal of Digital Information, Texas Digital Library 3(4), 10 pages, (2003).