

AUTHOR'S PRESENTATION FOR DOCTORAL (PHD) DISSERTATION

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*Consideration on the competency based education and training of aircraft
maintenance engineers*

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1. DEFINITION OF THE SCIENTIFIC PROBLEM

The changes that have taken place in tertiary education over the past few decades have had a profound effect on the higher education institutes of the defence sector, including the training of aviation engineering officers. Competencies appeared as requirements in the training output, and they made it necessary to modify the subject structure, internal time (credit) proportions, as well as other content and methodology components of training. In parallel to this, the Hungarian Air Force (as an arm of service) has seen changes that can be viewed as significant in relation to aviation assets. Aircraft already in service were complemented with a new tactical aeroplane, while other assets were withdrawn from the system of operation. The new operating technology demands a kind of knowledge and approach of the system different to previous ones, which stems partly from the fact that the operating classification of the systems of the aircraft differs from that of other types. As a consequence, it became central to research of scholarly character to examine the balance and harmony that appeared in the shape of expectations related to the expertise of specialists and the competencies embodying it in the output of aviation engineering officer training and the input to organisations who became employers and users thereof.

The research problem is formulated as follows: the changes in aviation engineering officer training and those in the number and composition of air assets, as well as in the technical operating system, make it necessary to analyse and evaluate the basic (BSc) level system of aviation engineering officer training along professional lines. A category central to the investigation is the competencies of aviation engineering officers related to professional tasks, the identification of which is in the focus of the scientific research.

2. RESEARCH OBJECTIVES

1. To define the professional competencies of aviation engineering officers on a scientific basis.
2. To identify the professional competencies that deserve special attention in the course of changing technologies and must inevitably appear in the training programs.
3. To indicate which of these competencies may emerge as new ones, and which ones need to be retained or improved when a new type of aircraft enters service.

4. To reveal the competencies which present (officer) personnel involved in ground operating with different requirements in the course of operating processes related to various operating strategies.
5. To develop a process model which can serve as a basis for producing programs and documentation of basic training, retraining and further training taking output-based regulation and the demand for changing requirements into consideration.

3. RESEARCH HYPOTHESIS

1. The competencies can be viewed as characteristics which can be associated with professional tasks and which contain, order and enable the use of knowledge necessary for completing aviation engineering officers' tasks to expected standards.
2. The qualitative methodology widely applied in sociological research lends itself to identifying both explicit and implicit knowledge components of aviation engineering officers.
3. Identifying the knowledge components of the necessary competencies makes it possible to plan, check and improve the educational processes of various levels (BSc, MSc) and parts of aviation engineering training.
4. Quantitative research and its application in combination with qualitative research enables the checking, correction and further refinement of qualitative research findings. In our context, it means the precise and adequate definition of required competencies related to types of aircraft operated and various operating process systems.
5. Based on the above, it is possible to set up, through linking the knowledge content necessary for the work of aviation engineering officers to the professional competencies revealed, a process model that enables the professionally based construction, development and implementation in the planned process of education and training of an effective and modern input and output requirement system forming the foundation of basic training.

4. RESEARCH METHODOLOGY

In my dissertation, I employed the following research methods:

- Research and analysis of the specialised literature in order to draw adequate conclusions related to competencies, the theory of operating aircraft, as well as the principles and practice of education and training.
- Primarily inductive research methodology in order to identify competencies of aviation engineering officers. Accordingly, in line of the research hypotheses, collecting data through qualitative and quantitative primary data collection procedures.
- Correcting and expanding on partial research findings in the primary research period through combining qualitative and quantitative methods, which constituted a unified integrated research method.
- Semi-structured interviews in the qualitative part of primary research, and questionnaire-based inquiries in the quantitative period.

5. SHORT SUMMARY OF THE COMPLETED EXAMINATION BY CHAPTERS

In **Chapter 1**, the operating systems of aircraft in service with the Hungarian Air Force and their various co-existing operating strategies are introduced and analysed. Their comparison is based on the activities that make up the operating process of the aircraft.

It begins with operating strategies that can be employed with air assets, then proceeds to analysing strategies related to fixed operating periods and to conditions in the second half of the chapter. The comparison of the two operating systems is based on the technological processes involved in the interest of contrasting the expected knowledge of specialists taking part in these processes.

In **Chapter 2**, theoretical knowledge pertaining to competencies is detailed and systematised. As a result, a definition that can be used in further research is constructed and issues of approach determining the investigation are addressed. That served as the reason for systematising the profession-related characteristics of aviation engineering officers in the focus of the research according to a unified model recommended by the Society of Institute Developers in Hungary (Szervezetfejlesztők Magyarországi Társasága - SZMT).

In **Chapter 3**, the method of primary research is chosen through the evaluative analysis of qualitative and quantitative procedures often followed in sociological research. It emerges that, in the quantitative part of collecting data, the most effective method of identifying the competencies of aviation engineering officers is conducting semi-structured interviews. The interview technique chosen on the recommendations in the specialist literature ensures that processing yields characteristics and knowledge components describing competencies of aviation engineering officers that would be difficult to obtain through other methods.

In the quantitative part, a questionnaire-based inquiry was found to serve the purpose of collecting data best, using the findings of qualitative research. It was confirmed that the representative nature of the data was ensured by the ‘snowball’ method.

As for the objective of the questionnaire, predominantly closed questions were used as per the recommendations, while as regards the form of the questions, the Likert-scale type was found most suited to the purpose. The ‘EvaSys’ system was used during the entire process from designing the questionnaire to online inquiry, as it guarantees a high level of effectiveness both in terms of the time and cost requirements of the research.

Chapter 4 contains the description of the process of empirical research and the results thereof. Qualitative data were collected through semi-structured interviews, which resulted in traits and groups of characteristics representing the knowledge of aviation engineering specialists. Quantitative data collection, conducted through questionnaire-based inquiry, corrected and supplemented the results of qualitative research. The chapter features a comparison between competencies of commanders and subordinates, as well as those associated with various operating systems.

Chapter 5 contains the description of the process model of designing training programs that take the above mentioned research findings into consideration and are based on the competencies. The model was designed with the basic principle of output-based control in mind. Training and Output Requirements need to be defined with the competencies as their starting point, while for subject and module requirements, the formulation of learning end-products is necessary. The chapter also features an analysis of the Training and Output Requirements of current aviation engineering officer training.

6. SUMMARY OF CONCLUSIONS

1. As regards the technical operation of aircraft in service with the Hungarian Air Force, basically there are two significantly different operating strategies employed in parallel. The technical operation of second-generation aircraft is dictated by the fixed operating time strategy. The systems of these aircraft are operated in groups formed on the basis of their branch of specialisation; accordingly, engineering specialists with knowledge of airframe and engine (mechanics), electrical instrument and oxygen, radio, locator and weapons systems are required. As a fourth-generation aircraft, the JAS-39 is operated according to the on condition strategy, stemming from the principles of its construction and thanks to its predominantly electronic systems. Consequently, its systems are grouped in a manner that differs greatly from the former. Therefore, engineering officers involved in operating them must also have expert knowledge of mechanical engineering, electronics and electrotechnics.
2. In the course of research, a working definition published by Spencer was used. Utilising a slightly refined version of the definition, the concept was interpreted as the sum total of all knowledge, attitudes, capabilities and skills necessary for completing a given task associated with a job or profession.

The competencies yielded by the empirical research are classified and systematised using a model recommended by the Society of Institute Developers in Hungary, because this model is closest to the processes in the system of education and training and its essential content components.
3. In collecting qualitative data, conducting semi-structured interviews was most effectively suitable for the purpose of identifying the competencies of aviation engineering officers.

During the quantitative phase, data were collected through questionnaire-based inquiry using qualitative research findings. The questionnaire was designed taking recommendations in the specialised literature into consideration; inquiry and the statistical evaluation of responses were carried out exploiting the capabilities offered by the 'EvaSys' system, which supports questionnaire-based research.
4. The competencies emerging from empirical research conducted earlier were classified and systematised in terms of the unified concept of 'Knowledge, Capabilities and Attitudes'. Important aspects of the approach to designing training programs and content components of training were output-based control and controllability, as well as the formulation of

requirements in terms of learning end-products. All this is reflected in the process model of designing competency-based training programs proposed in this work.

The components of the process model, which build on and succeed each other, combined with operating a suitable controlling system can ensure that the output of training will be specialists meeting the expectations of employers, available to aviation units of the Hungarian Defence Forces.

7. NEW SCIENTIFIC RESULTS

Thesis 1.

I presented that the competencies can be considered, as related attributes for professional tasks too, which contain, arrange and make useable the necessary knowledge for the aviation technical officers to perform and maintain their professional tasks on the expected level. All this was geared to the operational systems of all types of aircraft, introduced in Hungarian Defence Forces.

Analyzing the related scientific literature I consider the competency as the collection of necessary knowledge, attitudes and capabilities to perform and maintain the tasks of a particular profession on the expected level.

The knowledge is the heterogenic and continuously changing mixture of experiences, values and contextual information manifested in actions, which create the base to accept new information and to integrate into the personal knowledge. A certain part of the knowledge is explicit knowledge, which codifiable, with formalised existence and availability for everyone. The education system basically and primarily provides and transfer that kind of knowledge element.

The other part of the knowledge is tacit knowledge which one is difficult to transfer to another person by means of writing it down or verbalizing it, but through the actions and extensive personal contact it can be integrated into the inclusive personality. It prefers such kind of learning and cooperation forms like community projects, or team works which were common even earlier in higher educational establishments of natural sciences. Using the frequently mentioned “ice berg” model, this knowledge element is hidden under the water line and provides the necessary conditions for the application of explicit knowledge.

Abilities and skills as parts of the personality provide the action field in which the knowledge (and both of its contributors) leaves scope to perform the duties of professions and reach the related performance levels.

Attitude – which means beliefs and the reflection of humans and surrounding – is the affective scope of competencies.

Considering the plenty of literature and analysis related to the definition of competency, as well as the diversity of definition I use the version, as my basic (work) definition, in which the competency is prior and defining feature of the person, and which are in direct causal link with

appropriate effectivity and/or excellent performance in accordance with the related criterion level.

That kind of view as a certain working, task performing professional interprets the work duties that is what organises the knowledge and skills into distinctive competencies. Despite that this kind of definition is relatively newly emerged, in its approach it is quite close to the “income” views. Considering the competencies of aviation technical officers, I accept and use this kind of approach.

Thesis 2

I confirmed that the qualitative research methods, which are frequently used in social scientific researches is suitable to determine both the explicit and implicit knowledge elements of aviation technical officers.

During the qualitative part of data collection to determine the competencies of aviation technical officers most efficiently the half-structured interviews were appropriate. It gave the possibility that the interviewees about an area of particular interest, fixed in advance could express his (her) opinion freely with the minimal intervention of moderator. By the recommendation of the literature the chosen interview technics provided, that after the processing I obtained the properties and knowledge elements, directly related to the competencies of aviation technical officers, which hard or impossible to obtain in other way.

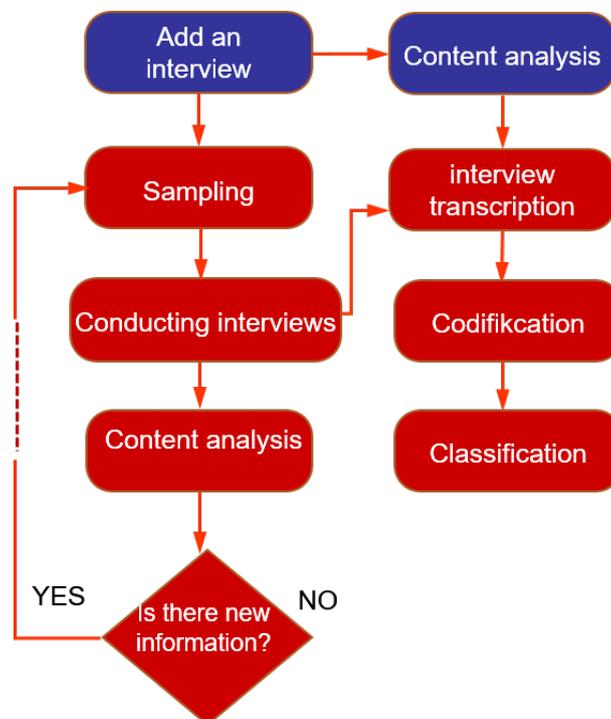


Figure 1. The procedure of the qualitative research

I grouped the properties and features, obtained by the procedure presented in Figure 1, by the two component of knowledge (“To know what” and “To know how”) the abilities and skills as well as the categories of desired behaviours.

As a final result, I got a total of 13 properties and competency elements related to the explicit knowledge, and the same number of 13 properties for the implicit knowledge element. There were 19 properties for the category of skills, abilities and 18 properties for the attitudes.

Thesis 3.

I proved that with the identification of the knowledge elements of necessary competencies the different levels (BSc, MSc) and parts of aviation technical officers training process can come plannable, controllable and improvable.

I determined as the purpose of the research, most of them, to separate the competences related to the various levels of aviation technical training. The data collection through the interviews contained only implicit information about this. The integrated research method, combined with questionnaire research, provided the opportunity to acquire the relevant information. Since the training levels (BSc, MSc) in aviation engineering organizations are predominantly linked to senior (commander) and subordinate positions and organizational levels, one of the blocks in the questionnaire included questions about this.

Considering the high posts of hierarchy, beside the expectation of high level of professional knowledge, there has been an increased focus on the management, human management and logistic knowledge.

Regarding the ability of the leaders, the essential necessity of organizational skills has emerged by the answers of interviewees. Besides that, the expectations of decision-making and leadership skills were also very high, compared to the expectations of the subordinate positions.

In the context of leadership attitudes, I have experienced the appreciation of the importance of proper military contact as well as the highly preferred necessity of professional discipline and credibility.

Thesis 4.

I presented that how the quantitative research and its combined use with the qualitative research gives the possibility of verification and correction as well as further refinement of the results of qualitative research, namely, in this case the exact and adequate determination of the necessary competencies in accordance with the operated aircraft types and different operational process systems.

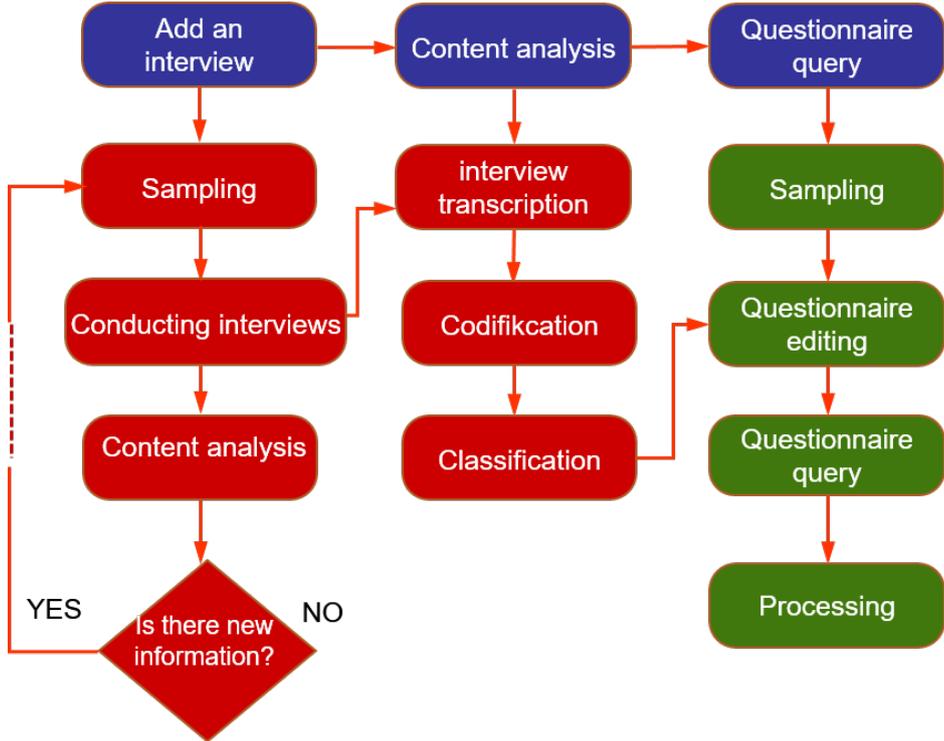


Figure 2. The graph of empirical research

The empirical research was conducted using the qualitative research methodology including the interview technique, which resulted in a well-grouped competency list as a result of content analysis.

In a quantitative part of the research, a group of questions aimed to separate the competences which are related to the different operational strategies. As a result of processing of the questionnaires, I could significantly distinguish the competencies, that are equally important to both technology systems and the important (less important) competences related to the given operational strategy.

Thesis 5.

I proved that such a process model can be produced, which through the adaption of the knowledge elements, necessary for the profession of aviation technical officers, to the revealed professional competencies makes possible the completion of a professionally created, developed and accomplished, effective and up to date, focused on basic training fundamentals, training and output requirement system and its installation in the planned education-training process.

Establishing the particular courses and developing a state-of-the-art training program based on competences, the initial step is to fix the competences designated as output objectives of the training.

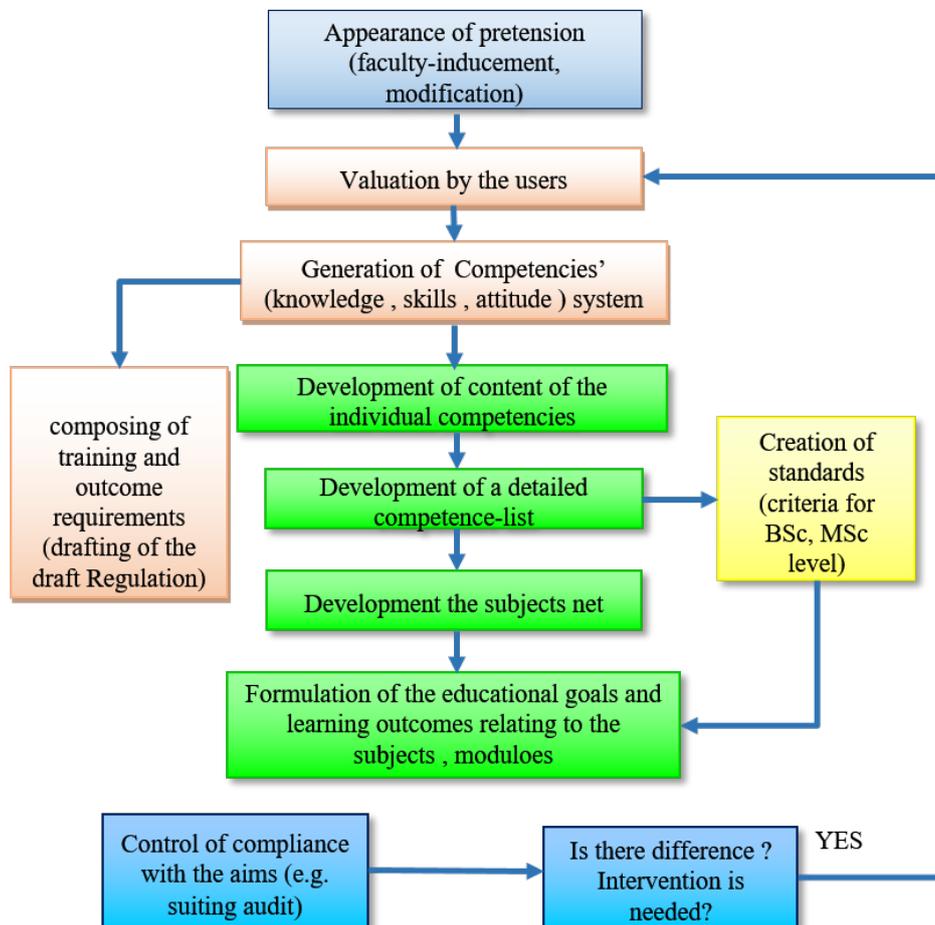


Figure 3. A process model for developing training programs based on competences

The process model, on the one hand, takes into account the output principle that ensures the regulation of the programs, the formulation and the possibility of measurement of the training outputs that provide the opportunity for the development of the competences.

One of the forms of regulatory feedback can be the continuous personal contact with the staff of the Air Force units, which can be done through the active participation in the annual aviation engineering conference. Another way to get information about the emerged problems is the feedback of the results of regularly measured aptitude test.

It has prior importance that the elements of the process should follow a strict hierarchy. Monitoring as well as the controlling system element ensures the control of process and ability to quickly integrate the necessary changes.

8. PRACTICAL APPLICABILITY OF SCIENTIFIC RESULTS

1. From this point of view, my scientific results can be used in the field of human resource management, actual information can be obtained, which can be applied as human management function in the areas of selection, performance evaluation, career planning and training.
2. In my opinion, my research results can be used effectively to modernize the basic training programs of aviation engineering officers and/or to develop training programs for new sub-courses or specializations
3. The results can also be used to investigate the competencies of other specialist groups in aviation. Accordingly, I see the possibility of using the method for the compilation and use of the competency list and competence map of the aircraft pilot, air traffic controller and air defence controller.

9. RECOMMENDATIONS

1. The empirical research and information gathering process I used allows to create a proper monitoring and controlling system. This way, it is possible to explore and follow the new emerging needs that may arise in connection with the introduction of a new type of aircraft.
2. Besides the basic training, I see the possible use to create other training programs for aviation technician officers, which can be required when there are any variations in the operation system or in some of its processes.
3. By my opinion it is important to build a competency dictionary and a competency map based on the revealed features, whose usefulness is evident in relation to the efficient operation of organizations.
4. Further scientific research work can be induced by the needs of effective basic training, the structure of knowledge of professionals and the exploration of the interdependencies of aviation security.

10. LIST OF PUBLICATOINS OF THE CANDIDATE

Book details:

1. Szegedi Péter, Tóth József: Repülőgép üzemeltető szervezetek humán erőforrásának kompetencia vizsgálata kvalitatív módszerrel In: Békési Bertold, Szegedi Péter (szerk.) Repülőműszaki üzemeltető szervezetek működésével, fejlesztésével kapcsolatban Tanulmánykötet a BSc, MSc hallgatók számára. 82 p. Szeged: Magánkiadás, 2016. pp. 64-82. (ISBN:978-963-12-5621-5)
2. Tóth József: A repülő műszaki tiszti kompetenciák kvalitatív vizsgálata In: Békési Bertold, Szilvássy László (szerk.) Repüléstudományi Szemelvények. Szolnok: Nemzeti Közzolgálati Egyetem Katonai Repülő Intézet, 2016. pp. 177-189. (ISBN:978-615-5057-70-0)

Articles published in periodicals in foreign language:

3. Tóth József: Компетентностный подход модернизации образования инженеров по эксплуатации современных летательных аппаратов Repüléstudományi Közlemények (1997-től) (XXVIII.évfolyam 2016. 1. szám) pp. 49-54. (2016)
4. Tóth József: Considerations On Modernization And The Competencies And Education Of Aircraft Maintenance Engineers HADMÉRNÖK XI:(1) pp. 294-299. (2016)
5. Turcsányi Károly, Szegedi Péter, Tóth József: Определение компетенций офицеров авиационных инженеров Repüléstudományi Közlemények (1997-től) (3) pp. 7-14. (2016)

Articles published in periodicals in Hungarian language:

6. Tóth József, Turcsányi Károly, Szegedi Péter: A katonai repülőműszaki tiszti kompetenciák felmérése integrált kutatási módszerrel Repüléstudományi Közlemények (1997-TŐL) (XXVIII. évf. 2.szám) pp. 153-164. (2016)
7. Békési László, Tóth József: Neobook platform alkalmazás a Katonai Repülő Tanszék pályára irányító tevékenységében II. rész, Repüléstudományi Közlemények (1997-TŐL) XXVII. évfolyam 2015. szám:(I) pp. 41-60. (2015)
8. Koronváry Péter, Szegedi Péter, Tóth József: Kutatás és képzés – módszertani felvetések az elvárások és a képzési portfólió összehangolására a repülőműszaki képzésben HADMÉRNÖK X.:(4) pp. 237-246. (2015)
9. Tóth József: A légi járművek üzemeltetési stratégiáinak változásmenedzsment szempontú összehasonlítása ECONOMICA (SZOLNOK) (4/2) pp. 228-234. (2015) IX. Alföldi

Tudományos Tájégzdálkodási Naphoz kapcsolódó konferencia. Szolnok, Magyarország:
2015.11.1

10. Tóth József: A Magyar Honvédség humánstratégiájának hatásai a repülő műszaki szakember képzés rendszerére Repüléstudományi Közlemények (1997-TŐL) pp. 922-929. (2012)
11. Békési László, Tóth József: A humán tényezők vizsgálata a korszerű repülőeszközök üzemeltetési rendszereiben Repüléstudományi Közlemények (1997-től) XXI:(2) pp. 1-6. (2009) Repüléstudományi Konferencia 2009: 50 év hangsebesség felett a magyar légtérben. 2009.04.24 (Zrínyi Miklós Nemzetvédelmi Egyetem)

Foreign Language Articles published in a conference publication:

12. Békési Bertold, Szegedi Péter, Szabó Vivien, Tóth József: How Terrorism Can Affect Technological Aspects of the Airport Security In: Rolandas Makaras, Robertas Keršys, Povilas Gražulis, Rasa Džiaugienė (szerk.) Proceedings of 19th International Scientific Conference Transport Means 2015. 781 p. Konferencia helye, ideje: Kaunas, Litvánia, 2015.10.22-2015.10.23. Kaunas: Technologija, 2015. pp. 112-115

Hungarian Language Articles published in a conference publication:

13. Tóth József: A tanulási eredmények meghatározása a mérnökképzés folyamatában In: Bodzás Sándor (szerk.) Műszaki tudomány az észak-kelet magyarországi régióban 2015. 591 p. Konferencia helye, ideje: Debrecen, Magyarország, 2015.06.11 Debrecen: Debreceni Akadémiai Bizottság Műszaki Szakbizottsága, 2015. pp. 188-193. (ISBN:978-963-7064-32-6)
14. Tóth József: Kompetenciák alakításának teljesülése a repülő mérnöki alapképzésben In: Rohács József, Gáti Balázs (szerk.) XVII. Magyar Repüléstudományi Napok. Konferencia helye, ideje: Budapest, Magyarország, 2010.11.11-2010.11.12. Budapest: BME Repülőgépek és Hajók Tanszék, 2011. pp. 1-6. (ISBN:9789633130322)

11. PROFESSIONAL – SCIENTIFIC CURRICULUM VITAE OF THE CANDIDATE

Education:

- Zhukovsky Military Academy of Aerospace Engineering
- Technical University of Budapest (BME) MBA Program 2000 (PTB 004249)
- National University of Public Service (NKE), Military Science Doctoral School, Date obtaining Absolutorium: November 2012.

Language knowledge:

- Russian high level „C” 1992. (DVO 055033)
- English basic level „C” 2001. (046653)

Positions:

- György Kilián Aircraft Technical College, Department of Airframe and Engines, Instructor, 1985 – 1988.
- Szolnok Aircraft Officer College, Department of Airframe and Engines, Instructor 1992 – 1997.
- Miklós Zrínyi National Defense University, and Applied Organizational Science, Assistant Professor, Associate Professor, 1997 – 2000
- Miklós Zrínyi National Defense University, Department of Economics and Defense Economics, College Associate professor 2000 – 2004
- Miklós Zrínyi National Defense University, Air Defence Institute, Department of Aircraft and Engine, College Associate professor, 2004 – 2015
- National University of Public Service, Department of Aircraft and Engine, practical instructor, 2015 –

Scientific and publication activities:

- Research areas: Problems of competence-based education of aircraft technical personnel; and environmental and economic issues of alternative aircraft use of fuels.
- 26 publications (3 in English, 2 in Russian)

Public activities:

- Member of the Hungarian Military-science Association (Magyar Hadtudományi Társaság)

Future research plans:

- Researching the competency based education of pilots
- Economic assessment of investments in alternative fuels.