NATIONAL UNIVERSITY OF PUBLIC SERVICE
DOCTORAL SCHOOL OF MILITARY ENGINEERING

THESIS BOOKLET OF DOCTORAL DISSERTATION

Major Sándor Hennel

CONCEPT ON A STATE AND CIVILIAN MULTIPURPOSE LIGHT AIRCRAFT

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NOMINATION OF SCIENTIFIC PROBLEM

The changed societal and security policy environments, the technical progress parallel thereto and the evolving technical backgrounds thereof entail new problems, and generate new solutions in warfare. Among the observations of the Cold War arms race the foremost one belongs to the viewpoint of traditional warfare. This is none other than – in the famous words of Montecuccoli – „three things are necessary for war: money, money and money. For a successful campaign, proper preparations are needed. Through decades, and via immense expenses, superpowers have built forces, which, by their numbers and their state of advancement, have managed to act both as deterrent and to secure victory in live applications. Simultaneously however, there have been local acts of aggression, in which opposing forces wielding outdated – sometimes outright medieval – technology have managed to attain significant victories.

As it stands, there isn't any aircraft in service neither in Hungary nor in the NATO, which:

- would be able to fulfil an operational support role in asymmetrical warfare (combating guerrilla forces) with low maintenance costs, in a cost-effective manner;
- may be used in peacetime as training aircraft;
- can serve to fulfil border observational law enforcement purposes by military standards;
- can be used profitably within a market economy environment;
- aims to satisfy both civilian and military purposes in its planning and conception.

These are the conditions by which technical solutions must be pursued that enable the creation of military instruments able to be used optimally in the given field.

The purpose of my research is to find a common ground in military and civilian aviation tasks, which – by mutual cooperation – serves to improve the situation of both cooperating parties regarding the carrying out of their tasks, achieving the titular multipurpose nature, which is the ability to fulfil various tasks via a single vehicle.

In the examination the various state and civilian use multipurpose aircraft, I restrict the scope of research to the category of light aircraft. The definition of categories in academic literature varies significantly: by turbulence categories, aircrafts under 7000 kg are grouped here.

NOMINATION OF RESEARCH HYPOTHESES

I presume that following the logic of the American LAAR program aimed at the sourcing and acquisition of light, armed aircraft, a concept may be established, which would serve to **provide answers to various elements of newly emerged risks, challenges and dangers, both on a national and an international level**.

I presume that for the purposes of cost-effectiveness and for the optimal utilisation of human resources, it would be reasonable to integrate light aircraft in a mixed role into our national voluntary reserve system.

I hypothesise that today's domestic aircraft manufacturing industry is clearly capable of designing, developing and producing multipurpose light aircraft.

I hypothesise that based on international experience both in civilian and in military applications, an outstanding light multipurpose aircraft can be developed.

I presume that in order to combat and destroy guerrilla forces within the framework of asymmetrical warfare, both NATO and the Hungarian military could

effectively utilise multipurpose light aircraft as per the LAAR program, or a similarly outlined concept.

I believe that technical advances have significantly reshaped propulsion systems in the category of light aircraft: diesel engines able to be run on kerosene have, in certain fields, displaced lower efficiency petrol-based Otto engines; moreover, hybrid drive (internal combustion – electrical) propulsion systems may warrant usage in light aircraft.

RESEARCH AIMS

I have processed the topic to such an extent that it may serve as general guidance in domestic applications for the election, the development and the fielding of aircraft under the category in question, and for the ensuring of operational conditions. My goal in the elaboration of this concept is for it to serve also as possible guidance for future doctrines, government and ministry development programmes and plans.

Regarding civilian applications, I've only examined profit-oriented enterprises, as is dictated by the aircraft category sizes in question.

In order to provide a solution to the emerged scientific problem, and in order to provide proposals on solutions, I have set out the following as goals:

1. The researching of academia pertaining to my field of inquiry, with emphasis on relevant facts, cases and knowledge, with both a domestic and a foreign outlook.
2. The examination of multipurpose light aircraft by international examples, in which I seek conceptual correlations by comparing technical data and by electing appropriate, multi-parameter means of comparison.
3. Regarding domestically designed aircraft, the establishment, the examination and the evaluation of both ability and necessity.
4. The examination of military and tactical processes, the investigation of application needs, and the evaluation of economic efficiency.

5. The examination of the possible establishment of a **technical** environment able to satisfy the emerging requirements.
6. The examination of the possible establishment of an **organisational** environment able to satisfy the emerging requirements.
7. Deduction of summary conclusions, either strengthening my hypothesis, or discarding it.

RESEARCH METHODS

In my dissertation, by the method of ***academic research*** – in proportion to the requirements of my research – I have examined and evaluated domestic and international regulations, guidelines, combat procedures, prognoses, books and research findings. By way of this research method, I have identified the application needs which may serve as basis for the structural design of an aircraft.

By utilising the ***analysis-synthesis method*** I have examined the structural designs of certain aircraft pertaining to the category at hand, as well as the design necessities and results thereof. The types and their major parameters I have assembled into tables, and based on the findings, I have made a proposition on a new concept and on the environment of its creation.

I have used ***mathematical proportionality methods*** regarding the prognosis of the changes in aviation propulsion systems, with which I have laid out explanatory and forward pointing trends.

By using the KESSELRING method of the ***comparative methods***, I have examined and ranked the relevantly identifiable aircraft attributable the category, as well as the concept of a hypothetical aircraft designed by myself.

By conducting ***questionnaire interviews*** I have refined my concept per the expert opinions of military and civilian aviation professionals.

Using the ***"snowball method"*** I have researched and identified the distinguished experts who have in turn been interviewed in the questionnaires. With this method, I have been able to improve on both quantitative and qualitative elements.

THE STRUCTURE OF THE THESIS

This thesis is comprised of an introduction, six chapters of research work, and the exhibit of new scientific findings. In the introduction, by nominating the scientific problem, I have outlined the group of questions and the goals which I continue to examine, and to which I provide a possible solution in the research chapters. Summaries are provided per chapter, and partial conclusions are made.

In Chapter I, I examine the role of **multipurpose light military aircraft** – hereafter as MLMA – in modern warfare. I provide an overview and a syllabus of the **already existing aircraft** within the category, and their unique qualities. **What already exists**.

In Chapter II, the national and international efforts, theories and experiences, military industry programs and – via an outlook – possible concepts similar to my own are examined. **What is needed – what is required**.

In Chapter III, I examine the manufacturing capacity and the feasibility thereof based on the national requirement structure. **What may be realised**.

Chapter IV deals with the system analysis of the environment of **airframe design** from a technical feasibility standpoint, and the comparison of military and civilian design attributes.

In Chapter V, I provide **propulsion and power analysis** with special regard to diesel and hybrid propulsion

Chapter VI introduces a new concept of my own design on the creation of an MLMA, and compares it to other, various concepts and programs within the category.

Formulation of concept.

Under Summary of research efforts, in accordance with my above-set goals, by the simultaneous listing the final conclusions and expected scientific findings, I comprise my new scientific findings into theses; after which I pose recommendations on the possible uses of the present thesis.

SUMMARY CONCLUSIONS

Military and civilian aircraft are significantly different from one another, both in their respective requirements and in their roles. Optimising them to serve special tasks entails certain unique design elements, the identification of which both aids the design and proves the feasibility of a multipurpose light military aircraft. Based on my research, the designs of military and civilian aircraft are based on the same principles, but are optimised pursuant to different considerations, and in turn, realise different structural designs. Thus, these considerations would be wise to be integrated into the early steps of the planning phase.

In my thesis I have examined the light aircraft that have been utilised in the past. I have taken note of both civilian and armed, military-designed models, their appearances, their technical parameters, their design concepts. I have elaborated on the LAAR light aircraft sourcing and acquisition program initiated in the United States, as well as the LIMA program, along with their respective systems of requirements. The LAAR and LIMA programs – in my opinion – may serve as an example to the development and the fielding of a Hungarian military-civilian multipurpose light aircraft.

As it was revealed in the research of application requirements, the role groups of military and civilian aircraft are different on multiple points, thus, I have identified the various areas application per the national circumstances that apply thereto. The technical requirements of the two role groups vary fundamentally, with the provision of

solutions thereto being either impossible or only possible by significant losses. Thus, these unique considerations must be taken into account in the early stages of multipurpose aircraft concept and design.

The applicable military requirements are dictated by national military necessities and by tasks set out by our NATO membership. Although the number of military purpose aircraft may not be diminished due to standing-by obligation, the low flight hours of the aeroplanes significantly hinder effective usage.

The foundation for satisfying civilian requirements is the maximising of profits. Cost effectiveness may be attained by low flight hour costs, meaning high annual flight hours. Application needs and requirements are also generally parallel to this principle. This means that a favourable means of improving cost-effectiveness may be the introduction of civilian-military multipurpose aviation, since the annual flight hours may thus be raised, while the flight hour costs may be concordantly reduced.

The national aircraft manufacturing companies and the automotive manufacturing supply industry may both serve as viable foundations to the kick-starting of domestic aircraft manufacturing. The level of quality in the automotive manufacturing supply companies have elevated to such a level, that their products are by now in complete compliance with the quality control system AS/EN 9100, which is widely accepted in aviation. Although the developments and products used in the automotive industry has previously been drawn from aircraft manufacturing industry; by today, this has reversed. Thus, we have the domestic means to utilise in aircraft manufacturing the automotive engines that are being produced domestically– naturally, with the required upgrades being carried out.

Hungary possesses the necessary experience in the fields of aircraft operation, development and production, and trains aviation professionals on various academic levels and in various professional fields to this day. The Hungarian engineers' and researchers' background is of a satisfactory level in order to design a multipurpose

military aircraft. Regarding resource provision, metal mining, foundry works and alloying however, there is a need for foreign import.

Based on the concept outlined in my present thesis, the civilian-military multipurpose application of light aircraft may be carried out in a most cost-efficient manner if done primarily in the Voluntary Reserve System. Pursuant to a cooperation agreement with the government, civil pilots and engineers could take part in military trainings and in the carrying out of military tasks with self-owned aircraft. Thus, in their private occupations they would carry out the tasks of their private enterprises, while pursuant to their government contract, they would regularly take part in military exercises and in the carrying out of military- or various other state tasks.

For the provision of military and civilian tasks, I have created the concept of an aircraft which has a take-off mass of no more than 2500 kg, while having a working load of 8-1000 kg, and a maximum velocity of 420 km/h, with the hull able to provide seating for six passengers. As its power source, I have primarily proposed diesel engines running on kerosene, seeing as these meet the applicable tactical, logistical and NATO requirements best. Noting moreover fuel consumption as an economical and tactical consideration, these two technical elements may be considered as the most suitable ones.

Regarding engines, diesel engines continue to serve the more prominent role in aviation. Prior to the Second World War, where operational range was of distinguished importance, considerable improvements had been realised with these engines being installed into bombers, as well as into supply- and naval aircraft. Hybrid propulsion systems continue to entail some mechanical shortcomings regarding their power storage and low energy density that remain to be solved; however, because of their numerous favourable qualities, considerable expansion is a valid prognosis regarding hybrid drive aircraft within the category of light military purpose aircraft in the decades to come.

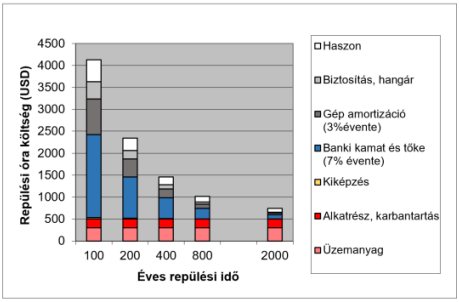
In my present thesis I have examined moreover what effect the fielding of a multipurpose light aircraft might have on other fields. This concept – in my opinion – would enact positive results in numerous fields; foremost in the industrial and the educational sectors, moreover in the creation of employment opportunities, in addition to the military and strategic benefits to be had. Moreover, the cost-effectiveness of miscellaneous state uses (law enforcement, border protection, disaster relief, aerial radiation reconnaissance, aerial photography, VIP transportation) may be simultaneously achieved.

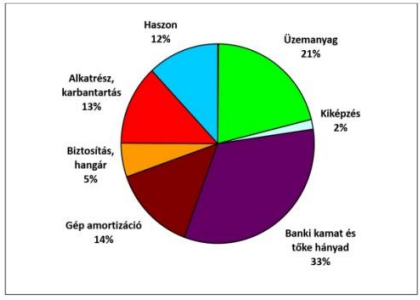
When creating a concept on aircraft design improvement, it is undoubtedly necessary to examine the possible outcomes of long-term changes, such as global warming, climate changes, societal-political-sociological tendencies, overpopulation, etc. Examining these factors falls out of the scope of my means regarding this dissertation however, but these may serve to point out future research directions.

NEW SCIENTIFIC FINDINGS

Thesis no. 1:

By utilising available academia and international experiences on light aircraft manufacturing, I have proven the **existence of a global requirement on, and the economy** of the category of multipurpose light military aircraft. With the Kesselring method, I have identified the **major technical data** of such a multipurpose light military aircraft.





Variance of flight hour costs by differing annual flight times regarding the TBM-850 aircraft

High annual flight hours entail low flight hour costs, and as such, good economy in civilian aviation.

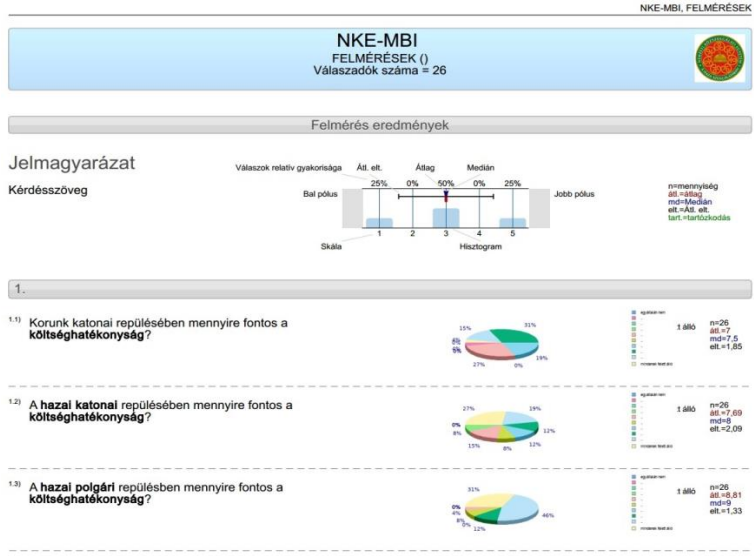
	Hawker Beechcraft AT-6B	Ahrlac	Super Tucano EMB-314	Bronco OV-10D	Air Tractor AT-802U	IDA			
							ideális	Súlyszám	ideális
Maximális	9,9	8,5	10,0	7,8	6,7	7,1	$P_{imax}\omega_i$	ω_i	P_{imax}
Sebesség (km/h)	585	504	590	463	394	420	80	8	590
	2,3	6,7	6,2	9,6	10,0	2,8			
Hasznos terhelés	2950-2135=815	4400-2000=2400	5400-3200=2200	6552-3127=3425	7257-3700=3557	2250-1250=1000			3557
(kg)	815	2400	2200	3425	3557	1000	60	6	
	5,8	7,1	10,0	7,8	8,5	9,1			
Hatótáv (km)	1667	2030	2855	2224	2414	2600	60	6	2855
	3,1	5,3	3,1	2,4	3,1	10,0			
Teljesítmény (LE)	1600	950	1600	2080	1600	500	80	8	500
							280		
Súlyozatlan Σ	**21,2**	**27,7**	**29,3**	**27,7**	**28,3**	**29,0**			
$\Sigma P_i \omega_i$	153,10	193,59	202,11	186,52	189,16	208,46			
P_i	**0,55**	**0,69**	**0,72**	**0,67**	**0,68**	**0,74**	**1**		

Comparative table of multipurpose light aircraft using the Kesselring method

With the Kesselring method, the technical data of various aircraft may be objectively compared and evaluated.

Thesis no. 2:

Using the method of questionnaire interviewing of experts and the analysis of the national background industries, I've proven that it is possible for nations of similar industrial capacities to our own to develop and produce multipurpose light military aircraft. I have examined and proven the present synergy potential of the automotive industry and of the light aircraft manufacturing industry, and have pointed out the conceptive effects thereof. I have also identified the relevant technical and constructional design possibilities, proving their feasibility.



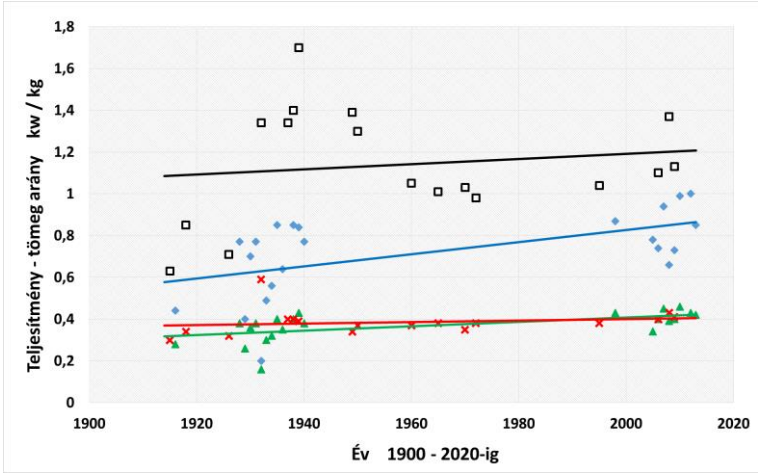
Visual representation of evaluation regarding inquiries in the Evasys system

Using the method of questionnaire interviews, I have supported the fundamentals of the MLMA concept. Concordant to the national government strategy, the automotive industry possesses considerable industrial potential. The domestic supply background

serving the automotive industry is on a level that is satisfactory to the quality control levels acceptable in aviation.

Thesis no. 3:

With the analyses of technical parameters of aircraft power systems via tables and diagrams, I have pointed out a development trend, by which kerosene-run diesel engines continue to supersede Otto engines in the light aircraft category and in extended service.



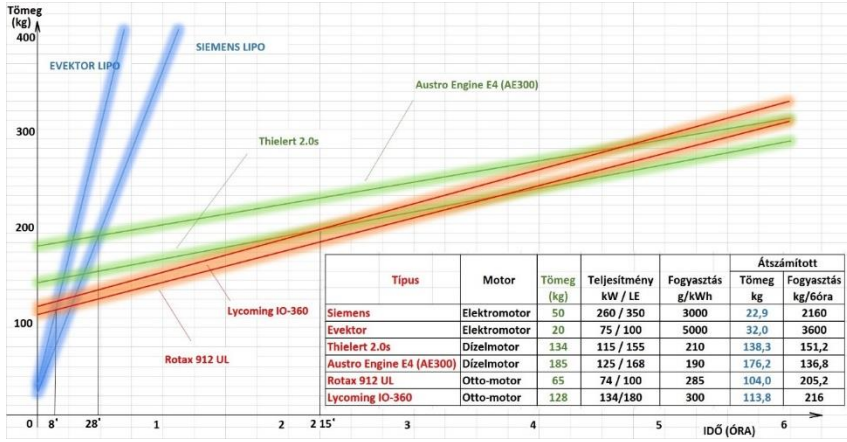
The performance-mass ration of piston aircraft engines

Today, there are numerous diesel engine aircraft available for purchase, which have certificates of qualification acceptable by the authorities, making the aircraft able to be used for commercial aviation.

Diesel engines counteract their handicaps that are attributable to their constructional weight by their consumption on longer flight distances. The trendlines drawn to the dot line intersects each other, which means that the performance-to-weight ratio is more favourable in case of a diesel engine on a 5,5 hour flight, as is shown on the image. Regarding the military usage of diesel engines, many more tactical and application advantages may be identified.

Thesis no. 4:

I have examined, and by mathematical table- and diagram analysis, I have proven the advantages of a hybrid drive train in the multipurpose light military aircraft category, which may be observed in periodical performance increases, reduced consumption, improvements in reconnaissance, protection and survivability, and in autonomous operation.



Típus	Motor	Tömeg (kg)	Teljesítmény kW / LE	Fogyasztás g/kWh	Átszámított Tömeg kg	Átszámított Fogyasztás kg/6óra
Siemens	Elektromotor	50	260 / 350	3000	22,9	2160
Evektor	Elektromotor	20	75 / 100	5000	32,0	3600
Thielert 2.0s	Dízelmotor	134	115 / 155	210	138,3	151,2
Austro Engine E4 (AE300)	Dízelmotor	185	125 / 168	190	176,2	136,8
Rotax 912 UL	Otto-motor	65	74 / 100	285	104,0	205,2
Lycoming IO-360	Otto-motor	128	134/180	300	113,8	216

Diagram of weight necessary for a given flight time in cases of petrol, diesel and electric engines

Electrical engines becoming more widespread in aviation is primarily hindered by the significantly lower energy density of their energy storage systems and their considerable weight. In the past decade, due to the spread of mobile phones, GPS systems and music players, batteries have undergone significant technological advances, which in turn have brought the hybrid drives of motor vehicles within reach.

Regarding military usage, contrary to the above mentioned drawbacks, by the increase of survivability and by autonomous operation, such advantages may be had, that result in the use of hybrid drive becoming feasible.

Thesis no. 5:

I have been the first in creating a multipurpose light military aircraft concept which is in line with the concept considerations of the LAAR and the LIMA programs, and which harmonises the military and civilian application requirements at the same time. I have supported the feasibility of the concept using the method of questionnaire interviews.

New challenges	Possible solutions	Location in thesis
Low operational costs	- economy, cost-effectiveness - light aircraft - military-civilian multipurpose usability - integration into the reserve system - domestic development - domestic production - diesel drive, high efficiency - hybrid drive - multipurpose nature	Point II.1 Point II.2, II.3 Point I.2, VI.1 Point VI.1 Point III.1, III.2 Point III.1, III.2 Point V.2 Point V.3 Point IV.3
Low purchase costs	- light aircraft - domestic production	Point II.2, II.3 Point III.1, III.2
Domestic industrialisation	- domestic development - domestic production - domestic training of pilots and engineers	Point III.1 Point III.1 Point III.1
NATO requirements	- asymmetrical warfare roles - Single Fuel Conception (SFC) – diesel drive	Point II.3 Point V.1
Military requirements	- national military requirements - network-based, multipurpose nature	Point II.3 Point IV.2, IV.3

Summary of concept challenges and possible solutions

In the concept of Multipurpose Light Military Aircraft, civilian pilots and engineers take part in training exercises and in the provision of military tasks with their own aircraft. In their everyday private occupations, they carry out the tasks required by their own, profit-oriented enterprises. The development and the production of an aircraft optimised to this task would result in favourable costs. In order to serve both military and civilian tasks, an aircraft would have to be produced, which has a take-off mass of no more than 2500 kg, while having a working load of 8-1000 kg, and a maximum velocity of 420 km/h, with the hull able to provide seating for six passengers.

RECOMMENDATIONS ON THE PRACTICAL APPLICATIONS OF THE THESIS

As one of the relevant goals of my thesis, I recommend for it to be used to broaden the academic background on the subject matter, to those involved in strategy, military planning, technical development, to students in higher education and post-graduate students.

I recommend my research to be used in the creation of initial concepts on the matters of aircraft design, planning principles and for deliberations of particular structural elements and solutions.

The MLMA concept is valid, as is supported by proven theses, and may serve as a gap filling solution both in national and international markets. I recommend its design, development, manufacturing and fielding in applications relating to the war on terror, in border protection, and in the efforts against naval piracy.

MY PUBLICATIONS ON THE SUBJECT MATTER

HENNEL Sándor: **Helikopterekkel végrehajtott köteles kirakási harceljárások alkalmazása** in Turcsányi Károly – Hegedűs Ernő A légideszant II. Ejtőernyős-, helikopteres- és repülőgépes deszantok a modernkori hadviselésben (1945-2010) Puedlo Kiadó Nagykovácsi 2010 ISBN: 978 963 249 124 0.

HENNEL Sándor: **THE SCOPE OF APPLICATION FOR PASSENGER AND CREW RESCUE EQUIPMENT IN MILITARY-CIVILIAN LIGHT MULTIPURPOSE AIRCRAFTS** – Repüléstudományi Közlemények ISSN 1417-0604 XXV. évfolyam 2013.2. szám.

HENNEL Sándor: **Légi járművek repülőtéren kívüli szükségleszállóhelyeinek harcászati korlátai, alkalmazhatósága, kialakulásának körülményei** – Repüléstudományi Közlemények ISSN 1417-0604, 2010.04.16.

HENNEL Sándor: **Helikopterekkel végrehajtott harceljárások a speciális erők érdekében** – Honvédségi szemle ISSN 2060-1506 64. évfolyam 6. sz. - 2010. november.

HENNEL Sándor: **Dízelmotorok felhasználhatóságának lehetőségei a katonai repülésben -** – Honvédségi Szemle ISSN 2060-1506 65. évfolyam 5.szám 2011. szeptember.

HENNEL Sándor**: A Magyar Honvédség önkéntes tartalékos rendszerébe illeszthető többcélú, könnyű repülőgép koncepciója** – Repüléstudományi közlemények ISSN 1417-0604, 2011. 2. szám.

MÉHES Lénárd – HEGEDŰS Ernő – HENNEL Sándor: **Pilóta nélküli légijárművekhez kötődő szaktevékenységek a HM Logisztikai Ellátó Központnál** - Sereg Szemle ISSN 2060-3924, 2011. április.

HENNEL Sándor: **Többfeladatú könnyű repülőgép vegyes katonai-polgári alkalmazásának gazdaságossági vizsgálata** – Katonai Logisztika ISSN 1588-4228, 2012.1. szám.

HENNEL Sándor: **Repülőgép dízelmotorok hazai használatának és fejlesztésének lehetőségei -** Katonai Logisztika ISSN 1588-4228 2012./3.

HENNEL Sándor – OZSVÁTH Sándor: **Légijárművek mentőberendezései és azok jövőbeni fejlesztési irányai** - Katonai logisztika ISSN 1588-4228, 2013.1. szám.

HENNEL Sándor: **Katonai és polgári repülőgépek tervezési sajátosságai, eltérései -** Repüléstudományi Közlemények ISSN 1417-0604 XXV. 2012./2.

HENNEL Sándor: **A GANZAVIA GAK-22 DINO könnyűrepülőgép, mint a polgári-katonai többfeladatúságra való törekvés egyik példája a 90-es években** - Katonai Logisztika ISSN 1588-4228 2015/2. szám.

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HENNEL Sándor: **ANALYSIS OF THE CAPACITY OF THE HUNGARIAN AVIATION INDUSTRY** - biztonsagpolitika.hu ISSN 2062-4379 2013.

HENNEL Sándor: **A légi szállítás technikai igénye a Saskarom hadművelet tükrében** - www.biztonsagpolitika.hu ISSN 2062-4379 2010.

HENNEL Sándor: **Katonai és polgári légijárművek vegyes felhasználása -** MRT Évkönyv 2011 (Magyar Repüléstörténeti Társaság) ISSN 1416-5287.

HENNEL Sándor: **A dízelmotorok reneszánsza a repülésben és a katonai felhasználásának lehetőségei -** MRT Évkönyv 2011 (Magyar Repüléstörténeti Társaság) ISSN 1416-5287.

FAZAKAS László, HEGEDŰS Ernő, HENNEL Sándor: A Szent Korona Őrzése Koronaőrség, koronaőrök Heraldika Kiadó, 2002. ISBN 963 9204021, 201-211. oldal.

PROFESSIONAL CV

The aviation interests and the relationship towards aviation of the candidate, Sándor Hennel was influenced by formative family experiences: both his father and sister have attained doctorate degrees on the subject of aircraft propulsion, and have worked in aviation and its technical lecturing for decades.

The candidate has attained his GED and apprenticeship certificate as an aircraft mechanic in Kossuth Lajos Mechanical Secondary School. He has attained his college degree in 1997, as a helicopter pilot at the Flight Engineer faculty of the Szolnok Aviation Mechanical College. His mechanical engineer degree was awarded in 2001, by the alma mater of Budapest University of Technology and Economics, Department of Aircraft and Ships. He has flown over 1000 hours on four different helicopter types and four types of fixed-wing aircraft, and has a pilot licence since 1995. He has served in the military since 1993, and has served in various positions. He has attained the highest available status of "Combat Ready", and is currently serving in a position of Pilot.

His studies in the civilian sector have also aided his research, he possesses multi engine (ME), instrument rating (IR) and commercial pilot licences (CPL), and has attained a frozen ATPL in 2007.

He was admitted to the National University of Public Service, Doctoral School of Military Engineering in 2010. His main field of research is the military-civilian multipurpose application opportunities of light aircraft.

He is a member of the Military Sciences Society, Air Force Section, being an active participant in the events and conferences of the Society.

He is a member of the Szemere Bertalan Scientific Society on the History of Hungarian Law Enforcement since 2013.

As an officer of the Crown Guard – and as a board member of the Crown Guard Fund – he organises a series of symposiums as the "Crown Guard Salon", which is held as a popular event series on the topic of the Holy Crown, by scientific standards.
Many of his works have been published in Repüléstudományi Közlemények, Sereg Szemle, Katonai Logisztika, Haditechnika and in Honvédségi Szemle.
More than 19 published works have awarded him 35 publication points, substantially over-achieving the minimum requirements posed by the Doctoral School.
He has language exams on various levels in English and German.

The Minister for Defence has awarded him with the distinction of "Service Medal for Flood Relief" in 2006 and in 2010.
For the relief efforts regarding the red sludge disaster, he received the "Disaster Relief Service Medal" in 2010.
In 2003 and in 2013 he received the 3rd and 2nd class of the "Officer's Service Medal".
In 2016 he was awarded the Commemoratory Silver Medal of the Order of St John of Capistrano and the Bronze Level of the Service Merit.
The Szemere Bertalan Scientific Society on the History of Hungarian Law Enforcement has awarded him with the "Commemoratory Cross for the Distinguished Scholars of Law Enforcement History" in 2002.