25th Working Meeting
of IFToMM Permanent Commission
for Standardization of Terminology on MMS,
Saint-Petersburg, Russia, June 23 – 29, 2014

IFToMM and MMS: History, Structure, Trends and Challenges

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ABSTRACT

The paper presents a survey of the main aspects of IFToMM in its evolution for, directions of activity, structure, trends and challenges. The IFToMM mission – to promote the mechanism and machine science (MMS) development – is underlined with areas of interests. The role of mechatronic approach is emphasized for mechanism design and machine developments in order to alleviate human operator labor. The current problems addressing great attention are outlined. The achievements and perspective directions in MMS development are indicated.

Key words: theory of mechanisms and machines, mechanism and machine science, mechanics of machines, mechatronics, IFToMM, History of IFToMM, trends for MMS.

INTRODUCTION

The discipline Theory of Mechanisms and Machines (TMM) was identified as a scientific area for the developments of machines and mechanisms, as well as techniques for their theoretical and experimental investigations. The discipline was established with its identity in 19-th century and it has been developed strongly in all countries dealing with structure, kinematics and dynamics of mechanisms and machines of different types as indicated in [1], referring to Russian speaking frames.

The meaning for the word “Theory” helps for better understanding of TMM and today MMS. The Greek word for “Theory” comes from the corresponding verb, whose main semantic meaning is related both with examination and observation of existing phenomena. But, even in the classic Greek language the word theory includes practical aspects of observation as experiencing the reality of the phenomena, so that theory means also practice of analysis results. In fact, this last aspect is what was included in the discipline of modern TMM when Gaspard Monge (1746–1818) established it in the Ecole Polytechnique at the

beginning of the nineteenth century [2] (see for example the book by Lanz and

Betancourt [3], whose text includes early synthesis procedures and hints for practical applications). Later (see for example Masi [4]) and even today (see for example Uicker et al. [5]) many textbooks have been entitled “Theory of Mechanisms” since they describe both the fundamentals and the applications of mechanisms in machinery.

With the progress of technology, the notion TMM and its meaning have been expanded up to MMS (Mechanism and Machine Science). The word-combination the “Theory of mechanisms and mechanics of machines” has also considered as for example in [6, 7]. The textbooks on the mechanics of machines (e.g., [8]) and dictionaries on the mechanics of machines were published in several languages and specific attention was paid within the Russian written literature like in [9]. Several journals have been established for publication in the specific area of TMM and even recently new journal are started for the increasing interest on MMS with more multidisciplinary aspects like for example the journal “Mechanics of machines, mechanisms and materials” that was started in 2008 by the Joint Institute of Mechanical Engineering, Belarus (http://www.oim.by).

1. A Short History

The names of IFToMM, TMM, and MMS are related to the fields of Mechanical Engineering concerned with Mechanisms in a broad sense. TMM is often misunderstood even in the IFToMM Community, although it is recognized as the specific discipline of Mechanical Engineering related with mechanisms and machines, as commented even in [10] announcing the birth of IFToMM. The meaning of TMM, now MMS, can be clarified by looking at IFToMM terminology [11, 12]:

* Machine: Mechanical system that performs a specific task, such as the forming of material, and the transference and transformation of motion and force.

* Mechanism: System of bodies designed to convert motions of, and forces on, one or several bodies into constrained motions of, and forces on, other bodies.

* Mechanism: Kinematic chine with one of its components (links) taken as a frame.

The developments in TMM have stimulated cooperation around the world at various levels. One of the most relevant results has been the foundation of IFToMM in 1969. IFToMM was founded as a Federation of territorial organizations but as based on the activity of individuals within a family frame with the aim to facilitate co-operation and exchange of opinions and research results in all the fields of TMM. Many individuals have contributed and still contribute to the success of IFToMM and related activity, (see IFToMM webpage: www.iftomm.org) under a coordination of IFToMM Presidents over time.

IFToMM was founded as the International Federation for the Theory of Mechanisms and Machines in Zakopane, Poland on September 29, 1969 during the Second World Congress on TMM (Theory of Mechanisms and Machines). The main promoters of the IFToMM World Federation were Academician Ivan I. Artobolevski (USSR) and Prof. Erskine F.R.

Crossley (USA) with the help of Prof. Mikail Konstantinov (Bulgaria) and Prof. Jan Oderfeld (Poland). Their principal aim was to bypass the obstacles of the time of the Cold War in developing international collaboration in TMM science for the benefit of the world society. IFToMM started as a family of TMM scientists among whom we may identify the IFToMM founding fathers, who signed or contributed to the foundation act with the initial 13 Member Organizations. The names of IFToMM founders fathers one can find in various sources in particular on IFToMM site http://iftomm.org, [13].

The foundation of IFToMM was the result of an intense activity for stimulating and promoting international collaboration, more than what had been done previously, and the process started in the late 1950s, as documented by several letters that are stored in the IFToMM Archive at CISM in Udine, Italy. A first World Congress on TMM was held in 1965 in Varna, Bulgaria during which the foundation of IFToMM was planned as later it was agreed during the Second World Congress on TMM in Zakopane, Poland. The Congress series was immediately recognized as the IFToMM World Congresses and in 2011 we have celebrated the 13th event with the participation of delegates from 48 Member Organizations and from more than 55 countries [13, 14].

The term MMS has been adopted within the IFToMM Community since the year 2000 after a long discussion [15], with the aim to give a better identification of the modern enlarged technical content and broader view of knowledge and practice with mechanisms. Indeed, the use of the term MMS has also stimulated an in-depth revision in the IFToMM terminology since the definition of MMS has been given as [13]:

* Mechanism and Machine Science: Branch of science, which deals with the theory and practice of the geometry, motion, dynamics, and control of machines, mechanisms, and elements and systems thereof, together with their application in industry and other contexts, e.g., in Biomechanics and the environment. Related processes, such as the conversion and transfer of energy and information, also pertain to this field.

In 2000 the evolution of the name from TMM to MMS brought also a change in the denomination of the IFToMM Federation from “IFToMM: the International Federation for TMM” to “IFToMM, the International Federation for the Promotion of MMS”, [15]. This can be considered as due to an enlargement of technical fields into an Engineering Science together with a great success in research and practice of TMM with a corresponding increase of the engineering community worldwide.

2. Four IFToMM Generations

IFToMM activity has grown in many aspects, as for example concerning the number of member organizations (from the 13 founder members to the current 46 members), the size and scale of conference events (with many other conferences, even on specific topics, at national and international levels, in addition to the MMS World Congress), and the number and focus of technical committees working on specific discipline areas of MMS (currently 14, with 1 more to be established). IFToMM was founded in 1969 and today a forth

generation of IFToMMists is active, who can be named as those working within the IFToMM community. Knowing the History of IFToMM and how we arrived at today's modus operandi gives a greater awareness of community identity and significance.

The IFToMM community evolved in character from that of a family of a few enthusiastic pioneers/visionaries and founders into a scientific worldwide community through the following generations:

* 1950s-1979 – First generation: founding fathers and their friendly colleagues up to the 4th IFToMM World Congress in New Castle upon Tyne in 1975 with Prof. Leonard Maunder as Congress Chair.

* 1980-1995 – Second Generation: pupils and educated people by founding fathers and their friendly colleagues; up to the 9th World Congress in Milan in 1995 with Prof. Alberto Rovetta (Bianchi's pupil) as Congress Chair.

* 1996-2011 – Third Generation: educated people in the frame of IFToMM and within IFToMM activity with 48 national organizations as IFToMM members, up to the 13th World Congress in 2011 in Guanajuato, Mexico with Prof. Carlos Lopez-Cajan, as Congress Chair.

* 2011 – Today – Forth Generation: educated people in local frame linked to IFToMM and within IFToMM activity with 46 organizations as IFToMM members.

IFToMM officers (who are the Chairs of IFToMM Member Organizations, the Chairs of TCs and PCs, and the members of the Executive Council) have contributed and still contribute as leaders for the mission of IFToMM, which is stated in the first article of the Constitution as: "The mission of IFToMM is the promotion of Mechanism and Machine Science". A complete list of IFToMM officers over time is available in the Proceedings of the second International Symposium on History of Machines and Mechanisms HMM2004 that was published in 2004 by Kluwer/Springer, [16], and is now available also in the IFToMM webpage.

3. Main Areas of Activity

The mission of IFToMM is to promote research, development, and education in the field of Machines and Mechanisms using theoretical and experimental methods, along with their practical application.

Main activities can be outlined in:

* conferences, meetings, publications, knowledge transfer, collaborations.

* 46 IFToMM members of territory and national Associations.

* 14 Technical Committees are functionalize: Biomedical Devices, Computational Kinematics, Multibody Dynamics, Gearing and Transmissions, Human-Machine Systems, Linkages and Mechanical Controls, Micromachines, Reliability, Robotics and Mechatronics, Rotor Dynamics, Sustainable Energy Systems, Transportation Machinery, Tribology, Vibrations.

* 4 Permanent Commissions: Communications, Publications, Archive; Educations; History;

Standardization of Terminology.

* 5 Journals: Mechanism and Machine Theory, Problems of Mechanics, Chinese Journal of Mechanical Engineering, open-access Mechanical Sciences, Advances in Vibration Engineering, Mechanics Based Design of Structures and Machines.

* World Congress every 4 years: Last World Congress – Guanjuato, Mexico, 2011 and next World Congress will be held in 2015 in Taipei, China-Taipei, http://iftomm2015.vohoz.com

4. Structure

The structure of IFToMM is summarized in Fig. 1 where the action of IFToMM bodies is indicated as from IFToMM constitution for a flow of activities. According to IFToMM mission as in the constitution, the IFToMM activity is finalized to provide leadership for cooperation and development of modern results in the Mechanism and Machine Sciences by assisting and enhancing international collaboration.

The bodies of IFToMM can be described synthetically as:

*General Assembly: it is the supreme body of the Federation and determines its policy. It is composed of the Chief Delegates of IFToMM Organization members (in 2013 they are 46) and members of the Executive Council.

*Executive Council: it manages the affairs of the Federation between the sessions of the General Assembly. It is elected every four years, meets annually, and is composed of the President, Vice- President, Secretary-General, Treasurer, and six ordinary members.

In 2013 14 TCs are activate in the fields of: Biomechanical Engineering, Computational Kinematics, Gearing and Transmissions, Linkages and Mechanical Controls, Micromachines, Multibody Dynamics, Reliability, Robotics and Mechatronics, Rotordynamics, Sustainable Energy Systems, Transportation Machinery, Tribology, and Vibrations. Additional TCs are under consideration for hot topics with an IFToMM significant community. The PCs are on: Communications, Publications and Archiving, Education, History of MMS, and Standardization of Terminology.

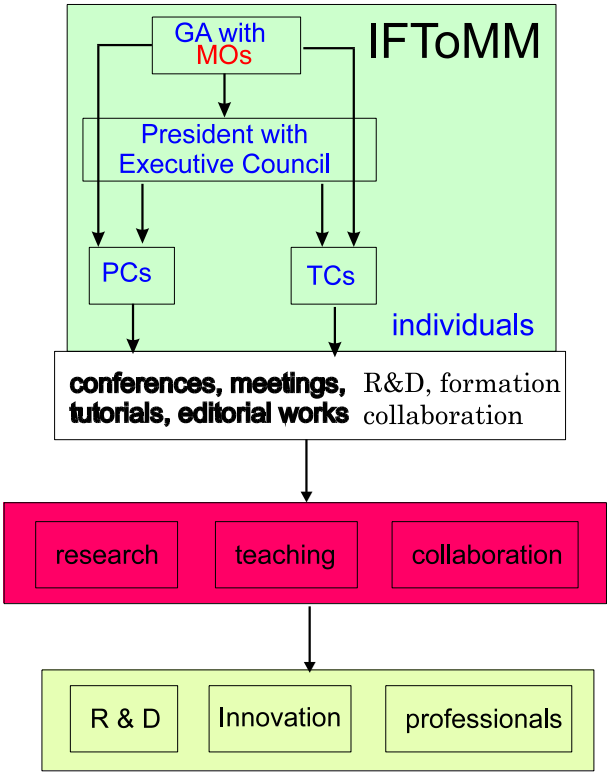

Fig. 1 – IFToMM bodies and activities

5. Mechanisms and Mechatronics: Concept, Basics and Challenges

Today, a modern machine is a combination of systems of different natures and this integration has led to the modern Mechatronics concept, Fig. 2. Thus, most of the recent advances in machinery are considered to be in fields other than MMS. But Mechanism Design can still be recognized as a fundamental aspect for developing successful systems that operate in the mechanical world of human beings. Tasks and systems for human beings must generally have a mechanical nature and a careful Mechanism Design is still fundamental in obtaining systems that assist or substitute for human beings in their operations. Most of those tasks are already performed Activity and Trends in MMS from IFToMM Community with mechanism solutions that can be seen as traditional successful ones that nevertheless could benefit from further update or re-consideration because of new operational strategies and/or new materials and components (scaled designs). Therefore, Mechanism Design can still be considered as an engineering area for current research interests.

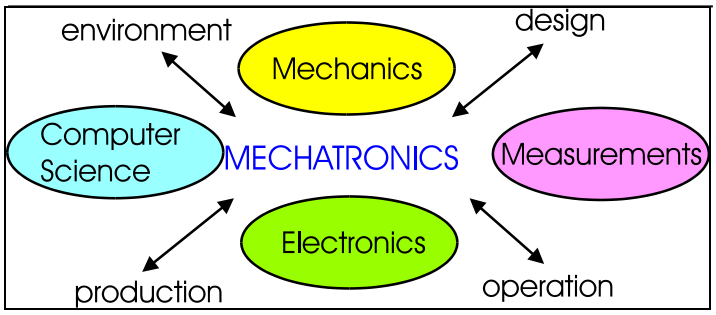

Fig. 2 – A scheme for the concept of mechatronics

Goals for Mechanism role in Mechatronics can be identified in:

* Enhancements in knowledge and Technology needs for human life and industrial production have changed and evolved over time, also because of the evolution of systems, requiring innovation that have brought to Mechatronic design and operation of modern systems,

* Whatever Electronics, Informatics, Telecommunications and so on, will be enhanced and expanded in Mechatronics Technology, Mechanical Design will be always needed since a woman/man will always live and interact with the environment on the basis of mechanical phenomena of the human nature.

Hot topics of Mechanism Design for Mechatronics for great interest can be identified in the following areas:

Kinematics and Dynamics (of load movement):

* to analyse and investigate on the motion of mechatronic systems and load body during the operation performing or not a task;

* to analyse and investigate on actions against the environment and within the mechatronic system yet;

* for safety and security issues both for the system and human operators.

Mechanics of interaction:

* in evaluating situations with mechanical contacts and force transmissions;

* to size the system actions according to the task requirements;

* to achieve desired goals and proper working of the overall system.

Dynamics of Multibody systems:

* to consider complex motions like spatial movement at high acceleration;

* by looking at integrated systems through suitable modelling of components of other nature.

Other mechanical issues for integrated systems like for example:

* locomotion mobility, object grasping and manipulation, human-machine interaction, and so on.

Main challenges and topics for formation, research, and professional activity in Mechanism Design for Mechatronics can be outlined in:

* new mechanisms even with proper multi-functionality;
* scaled mechanisms (from nano to giga mechanisms);
* simplified mechanisms;
* further mathematization for mechanism properties and design procedures;
* new design procedures with integration within mechatronic concept;
* new synthesis algorithms;
* rethinking and re-application of past mechanisms and developments;
* new technology for mechanisms;
* development of intelligent mechanisms [17];
* application and transfer of mechanism design approach to other aspects of mechatronic designs.

6. Trends and Challenges

MMS activity can be directed in further developments for:

* information and understanding of the functionality and impact of systems;
* algorithms for design, operation, and evaluation of systems with user/task –oriented performance;
* operation and application for full tasks, as constrained by environmental limits;
* performance evaluation and economic merit of systems;
* transfer of innovation;
* human-machine interfaces and interactions.

Main current interests for research in MMS can be summarized as the following trends and challenges:

* 3D Kinematics;
* Modeling and mathematization for MS;
* Multi-d. of multibody systems;
* Spatial mechanisms and manipulators;
* Unconventional mechanisms (with compliant, under- or over-constrained ones and other types);
* Scaled mechanisms;
* Tribology issues including the scale level of the object being created [18], and geometry-energetic theory of friction, allowing to design the junction mechanical elements with an optimal form of the mating parts [19];
* Creative design;

* Mechatronic designs;

* Human-machine interactions for user-oriented systems;

* Reconsideration and reformulation of theories and mechanism solutions.

TMM has experienced a considerable growth to MMS with a modern view with the development of robotics in the 20th century as also indicated in [20].

Another surge of interests to mechanics was observed in the 80s in connection with miniaturization of electronic devices. This has given a possibility to build-in electronic components into the mechanical (electromechanical) base for PC-aided control of motion. A renewed interest for integrating TMM in other disciplines to give it the MMS character has been experienced with the rise of mechatronics that has formulated its theoretical foundations, including its basic terminology, in design procedures, subject area, technologies, and the relationship with the bordering scientific and engineering domains. The works dealing with terminology as per Russian written literature can refer to [21, 22] Mechatronics, microsystems and nanoengineering are viewed today as differently scaled mechatronic systems so that the mechatronic approach is expanded and treated as a systematic procedure for designing and operating all kind of systems, as also stressed in [23].

It is important to underline that mechatronics does not substitute the traditional mechanics but supplements and impact its further development.

CONCLUSIONS

IFToMM is a federation of worldwide community working in MMS (Mechanism and Machine Science) with a modern vision that is evolved from TMM. In this paper mission and characters of IFToMM are outlined also using historical perspective to emphasize on the role, trends and future interests of today

MMS whose TMM foundation is still the core for technological developments also for mechatronic systems.

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While in Saint-Petersburg seeing tour.

25th Working Meeting
of IFToMM Permanent Commission
for Standardization of Terminology on MMS,
Saint-Petersburg, Russia, June 23 – 29, 2014

PARTICIPATION OF SCIENTISTS FROM FORMER SOVIET REPUBLICS AND CIS COUNTRIES IN IFToMM ACTIVITIES

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ABSTRACT

The data on participation of scientists from ex-USSR and CIS countries in the IFToMM foundation, development and current activities as well as in scientific and technical conferences and workshops promoted by the Federation are presented. Their contribution in the IFToMM structure and activities is described. The questions concerning terminological problems are discussed too.

Key words: IFToMM, Theory of Mechanisms and Machines (TMM), Mechanism and Machine Science (MMS), terminology, Russian version.

INTRODUCTION

Information on scientists who took active part in the IFToMM can be consistently and credibly traced almost from its very onset. Four years after the IFToMM had been founded a Permanent Commission on TMM History (HMMS PC) was established through the efforts of the first President of the Federation, Academician I.I. Artobolevsky (USSR) and enthusiasm of the first Commission Chairman, J. Fillips (Australia). This occurred in 1973 [1].

The achieved results have shown that the work of the Commission was activated when Prof.

M. Ceccarelli (Italy) headed the Commission in 1998 and proposed to organize symposia on the MMS history every four years in the time between the IFToMM Congresses. In the period from 2000, the Symposia were held in Cassino (Italy) in 2000 and 2004, in Taiwan in 2008, Amsterdam (Holland) in 2012, while the next one is planned to be held in 2016 in Queretaro (Mexico). Besides, Prof. M. Ceccarelli has proposed to conduct scientific workshops as a preparatory stage on the history of MMS which are convened in different countries, e.g., in Moscow in 2005 on the base of N.E. Bauman Moscow State University (Prof. A.A. Golovin). Similar Workshop on History of Mechanism and Machine Science was held in St. Petersburg in 2015 on the base of St. Petersburg State Polytechnical University (Prof. A.N. Evgrafov)* (http://hmms2015).

To summarize the results of the above-named events it was decided to publish collections of the Symposia and workshops papers [1-3] with contribution by scientists from the CIS countries and Baltic States on the following topics: history of creation of the first steam vehicle [4, 5] and the prototypes of manipulators [6], examples from the HMMS studies [7, 8] and modern investigations in the MMS field [9, 10]. The HMMS presentations included: the description of the collection of models of different mechanisms in the Bauman Moscow State University [11, 12]; a report on the contribution by such eminent Russian scientists as N.I. Mertsalov, L.P. Smirnov, A.G. Ufimtsev and other [13, 14] in the development of MMS; the results of work of the IFToMM Technical Committees on Gearing [15] and Reliability [16]; reports of the Chairmen of the National IFToMM Committees on their contribution in the development of MMS [17-21].

Analysis of the aforementioned reports and the experience gained by the authors in the IFToMM structures, as well as the information available on the IFToMM web-site http://www.iftomm.net provide a clear vision of participation of the scientists from Russia, Belarus, Ukraine, Armenia, Baltic countries, etc. in the IFToMM activities.

Their significant contribution both to the work of the Federation and to the science as a whole was marked by Prof. A. Fuentes (Spain) in his speech at the International Symposium "The Theory and Practice of Gearing" in Izhevsk (Russia) in January, 2014**. He said: "It is very important that the Symposium has gathered a reputable international community of scientists in gears. Unfortunately, in my viewpoint, till now the Russian science in all its diversity is undeservedly insufficiently known abroad. In this respect, Prof. Goldfarb has made every effort to change this situation, e.g. by publishing the Proceedings of this Symposium in English to make them available to the world public."

* Several papers of Russian authors have been published in Special Issue (see Appendix4).

** Proceedings of the International Symposium "Theory and Practice of Gearing" (January 21-23, 2014, Izhevsk, Russia), Izhevsk: Publisher IzhSTU, 2013. – 580 p.

1. In the beginning of IFToMM

The activities of Russian scientists in the field of machines science have been closely interrelated with IFToMM from the very beginning. For instance, Academician Artobolevsky I.I. was one of initiators and founders of the organization in 1969. He was its first President and was at the head of the organization for the next 8 years. At the same time, he was the first Chairman of the USSR Committee of IFToMM.

Artobolevsky's successor as a representative of the USSR and Russia was Prof. A.P. Bessonov. He was also elected the Chairman of the National Russian Committee. The XI-th World Congress (2004) acknowledged his fruitful work in the Federation and awarded him the honorary medal.

It is worth mentioning an interesting fact that the President of IFToMM, Prof. K.J. Waldron and the General Secretary of the Federation, Prof. M. Ceccarelli took part in the Conference dedicated to a Centenary Jubilee of Prof. I.I. Artobolevsky in 2005 at the Institute of Machines Science in Moscow.

In 1969 when IFToMM was founded, they have organized a Permanent Commission on Standardization of Terminology (IFToMM PC A). Prof. D. Muster was elected as the Chairman and Prof. N.I. Levitsky (USSR) as the Vice-Chairman.

2. Participation in executive boards and technical structures

Based on the available information let us dwell upon the personal participation of the scientists from the former USSR in the activities of IFToMM organization departments.

Professor Yury L. Sarkissyan worked at the Yerevan Polytechnic Institute (from 1971 – the Armenian State Technical University (SEUA). The development of TMM in Armenia started from the moment when a Seminar on TMM was organized at the Yerevan Polytechnic Institute in 1971 which was a part of All-Union Seminars on TMM conducted in the USSR [22]. The first works on the four-link mechanisms were published by Yu.L. Sarkissyan as a co-author with Prof. N.I. Levitsky [23, 24]. Armenia became a member of IFToMM in 1998.

The Armenian IFToMM National Committee published a terminological dictionary [25] in 2009 and its electronic version in English is available on the University web-site (www.seua.am). Prof. Yu.L. Sarkissyan has published his works in the Journal of Machines Science (Russian Journal "Mashinovedenie") [26-28], participated in the work of a number of IFToMM Congresses, Symposia [29-34] and Conferences [35-39]. He has published a monograph on the approximating synthesis of mechanisms [40]. Prof. Yu.L. Sarkissyan was elected as the IFToMM Executive Counsel (1991-1995), was a member of the USSR IFToMM National Committee and a Chairman of the Armenian IFToMM National Committee. As a member of the IFToMM on Terminology (PC A) (1963) he worked on compiling the Russian version of sections 0-6 IFToMM Terminology (1991) [41].

Professor Veniamin I. Goldfarb (Kalashnikov Izhevsk State Technical University, Institute of Mechanics) – author of publications on spiroid gears, simulation and computer-aided design of gears, in particular, monographs [42, 43], public speeches at IFToMM World Congresses [44-47], conferences on gears [48-52] and the scientific seminar on terminology [53].

He is the organizer of international scientific technical conferences and conferences with international participation "Theory and Practice of Gearing" (1996, 1998, 2001, 2004, 2008), as well as the International Symposium of the same name (2014).

In 1994 Prof. V.I. Goldfarb was elected as the member from Russia to the IFToMM Technical Committee for Gearing and Transmissions. Immediately he proposed to edit and publish regularly the International Journal "Gearing and Transmissions". Since 1991 it has been published in Russia as the official press edition of Association of Mechanical Transmission Engineers (AMT) and has become one of IFToMM official journals. Since 1994 Prof. Goldfarb had been the chief editor of "Gearing and Transmissions" Journal till 2005 when it ceased to be published in Russia.

In 1997 Prof. V.I. Goldfarb was elected as the Chair of IFToMM Technical Committee for Gearing and Transmissions (IFToMM TC G&T). After a 4-year period of his Chairmanship he was re-elected for the second term 2001 - 2005. He contributed a lot to revitalizing IFToMM TC G&T: a new concept of its activity was proposed in 7 directions including the development of joint programs and projects, publishing activity, educational and other activities; a new international program on gears was organized with the participation of Slovakia, Czech Republic, Hungary, Poland, Bulgaria, USA, Belarus. One or two meetings were held annually, usually within the framework of international conferences all over the World. Being the Chair of IFToMM TC G&T, Prof. Goldfarb participated actively in the Executive Councel meetings by taking part in discussions of key directions of the Federation's activity.

In 2008 Prof. V.I. Goldfarb was elected as a constant member of IFToMM Executive Council as the expert who contributed immensely to IFToMM activity. He was the member and Chair of a number of Working Groups on development of the procedure for the new members election, on interaction with other international organizations, etc. He participated in all meetings with the full voting status.

In 2011 Prof. V.I. Goldfarb was elected as the Vice-President and member of the Executive Council of IFToMM (till 2015). At the same time he was elected as the Chair of IFToMM Permanent Commission for Communications, Publications and Archiving. At present he is in charge of extensive and critical activities on restructuring, reprogramming and continuous updating of IFToMM official website http://www.iftomm.net, on collaboration with national committees and other ongoing obligations.

In January, 2012 he participated in the meeting of Belarus IFToMM National Committee which brought a very productive exchange of ideas on the directions of activities of IFToMM, Joint Institute of Mechanical Engineering of the National Academy of Sciences of Belarus, Belarus IFToMM National Committee and IFToMM PCA. Several proposals were

made on participation of Russian and Belarus experts in IFToMM Technical Committees and IFToMM Permanent Commissions and many of which were implemented later.

At the annual meeting of IFToMM Executive Council in 2010 Prof. V.I. Goldfarb, for the first time ever, proposed the idea to organize and hold regularly International Student Olympiads on Theory of Machines and Mechanisms supported by IFToMM. In 2011 Prof. V.I. Goldfarb became the organizer of the First International Student Olympiad on TMM which was successfully held in Kalashnikov Izhevsk State Technical University and gave rise to a number of international student initiatives in the field of TMM.

Professor Mark M. Kane (Belarus State Technical University) is a member of the PC A since 2005. He is the author of monographs and textbooks for students and participated in elaboration of standards on the technology of mechanical engineering and quality of techware [54-56]. He has compiled a terminological section on "Quality Parameters of Machines and Their Components". Restructuring and contents of this section were a subject of discussion at the 23rd (Minsk–Gomel, Belarus, 2010) and 24th (Ilmenau, Germany, 2012) PC A Working Meetings.

Classification of terms included in the original version of the Chapter "Quality" is presented below

Chapter, group	Name of group, subgroup (number of terms)	Chapter, group	Name of group, subgroup (number of terms)
1.	General notions of quality (61 terms)	3.1.	General notions (8 terms)
1.1.	Quality as such (10 terms)	3.2.	Machine behavior (6 terms)
1.2.	Machine quality characteristics (16 terms)	3.3	Defects, failures, damages, and faults (36 terms)
1.3.	Correspondence between product quality and requirements (13 terms)	3.4.	Redundancy (19 terms)
1.4	Quality estimation (7 terms)	3.5.	Notions concerning machine structure (design) (7 terms)
1.5.	Audit of correspondence between quality and requirements (15 terms)	4.	Structure-technological indices of quality (46 terms)
2.	Anthropological parameters of machine quality (30 terms)	4.1	Machine structure characteristics (5 terms)
2.1.	Labor safety indices (19 terms)	4.2	Technical efficiency Indices (6 terms)
2.2.	Machine safety (11 terms)	4.3.	Technical compatibility of Machines and their components (23 terms)
3.	Machine dependability parameters (76 terms)	4.4.	Process ability of machines and their component structure (12 terms)

Professor Vladimir D. Plakhtin (Moscow State Open University) – was a member of the PC A since 1995 till 2008. He translated and edited the Russian version of sections 7-13 of the IFToMM Terminology published in 2003 [57].

Professor Eduard E. Peisach (Saint - Petersburg University of Technology and Design) took part in the 19th (Kaunas, Lithuania, June 25-30, 2000) and 21st (Bardejov Spa, Slovakia, June 27 – July 2, 2005) meetings of the PC A as an expert. He has analyzed the both issues: [41] (paper in English) and [57] (paper in Russian). The analysis has been carried out through the "classical" TMM sections: 0 – Generalities; 1 – Structure of Machines and Mechanisms; 2 – Kinematics; 3 – Dynamics; 6 – General terms used in MMS and briefly remarks stated as follows:

1. Presence of notions (28) taken from other disciplines – mathematics, physics, theoretical mechanics, which disturbs the general principles of architecture of scientific notions (e.g., 2.2.1 MOTION).

2. There are the notions, related to the general principles and laws of physics and theoretical mechanics (14), establishing the relation between mechanical values, that can not be related to the category of terms (e.g., 3.4.11 HAMILTON'S PRINCIPLE).

3. In the Russian part of Terminology there are some inadequate word-combinations (6), such as 3.4.3 ПРИНЦИП КОЛИЧЕСТВА ДВИЖЕНИЯ – PRINCIPLE OF MOMENTUM, which are irrelevant with the established traditional conventional verbal expression in this discipline in Russian ("theorem about change in momentum of a system").

4. Unacceptable notions from a scientific slang (7) are included such as 1.1.49 ХРАПОВАЯ СОБАЧКА – PAWL [CLICK, DETENT] and other.

5. There are the forms of terms not reflecting, the essence of the phenomena due to their incompleteness (10) such as 3.7.40 ВОЗБУЖДЕНИЕ – EXCITATION [STIMULUS], which become concrete only in word-combination, such as "ВОЗБУЖДЕНИЕ – EXCITATION OF VIBRATION" (power, kinematic, parametric, harmonic) or it is included.

6. There are the notions that are not terms (6) e.g., 2.3.14 POLE, 2.3.16 POLE VELOCITY and other.

7. There is disagreement between some notion and its definition (5), e.g., notion 1.3.2 ISOMORPHISM. If we change its definition for "STRUCTURAL ISOMORPHIC MECHANISM", it would recover agreement between the notion and its definition.

8. Polysemy of notions encountered in different sections of Terminology (8), such as 3.2.31, IMPULSE – ИМПУЛЬС, 3.5.53. MECHANICAL SHOCK – ИМПУЛЬС. To remove it, we should either (1) leave one term with a compromise definition (if terms are close in sense) or (2) include two terms of different forms (if terms differ much in sense). In [58] proposals for terms 1.3.13, 3.2.30, 3.2.31, 3.5.53, 3.5.55, 4.1.14, 4.2.5 have been formulated.

9. Inaccuracies in definitions to the terms (especially in Russian-language version) as well

as in sense of the concept content itself, and in relation to the norms of Russian language (18). This occurred because of insufficient of participation of Russian-language editors in the Terminology development.

10. Absence of the range of important generally accepted notions related to the theory of mechanisms (47), contained in sources [143] (47) and [144] (22), as well section "Synthesis of mechanisms" and important group of notions "Assembly of Linkages" (10 notions have been mentioned in the source [145]).

Our comments concerning above remarks and proposals can be summarized as follows:

Concrete proposals in relation to the principles of selecting the terms and formulation of definitions long with their translation into other languages can be in different extent considered during further work with the terminology. The proposals in what concerns returning to a traditional abbreviation of TMM and definition of the sphere it occupies, questioning of the leading specialists in this field as well as preparation of corresponding books in certain TMM directions can not be realized within the frames of the IFToMM concept consisting in a wide understanding of TMM as a science on the mechanisms and machines (MMS) that was adopted in 2000, and is continuously expanding. Besides, it is necessary to take into account the adopted system of work with terminology in the Commission and the results of a many-year titanic work of more than one generation of professionals and its major result in the form of the functioning today electronic terminological multilingual dictionary. In this connection, it will be better to consider these proposals as a self-reliant project that requires mobilizing of corresponding organization, intellectual and material resources.

Dr. Yury L. Soliterman (Joint Institute of Mechanical Engineering of National Academy of Science of Belarus) (JIME of NASB) was a member of the IFToMM Technical Committee "Gearing and Transmissions" from 1995 till 2008 and a member of the IFToMM Permanent Commission on History of TMM.

He is a specialist in the dynamics and vibroactivity, prediction of reliability, standardization of gearing and problems of terminology [62-64]; he has numerous publications on these topics, he participated in international conferences and symposia. Yury Soliterman took part in the 4th World Congress on Gearing (Paris, France, 1999) [65], in the 10th World Congress on TMM (Oulu, Finland, 1999) [66, 67], International Symposium on HTMM (Cassino, Italy, 2000) [68], 10th ASME conference on gearing (Las Vegas, Nevad, USA, 2007) [69]. His latest publications are articles in the journal "Reducers and Drives" [70] and in the proceedings of the Association on Design, Elements and Construction (ADECO, Serbia) [71, 72]. He was among the initiators and developers of the standard on the gear failure modes [73].

Professor Victor E. Starzhinsky (V.A. Belyi Metal-Polymer Research Institute of NASB). Prof. V.E. Starzhinsky has been a member of the IFToMM Technical Committee "Gearing and Transmissions" since 1995 and a member of the IFToMM PC A since 2000. He took part in all IFToMM PC A Working Meetings from 2000 till 2014. He has been engaged in

the problems of gearing terminology in cooperation with Dr. Yu.L. Soliterman and Dr. A.M. Goman since 1990-ies. [62].

As the result of analysis of publications and standards on terminology performed in 2000-2003 [63, 64, 74, 75], the Reference Dictionary Book on Gearing [76] was finalized. Prof. Starzhinsky is the author of Chapter 12 "Gearing" (226 terms) of the IFToMM Terminology [57]. He also participated in preparation of the electronic version of the dictionary (www.iftomm.3me.tudelft.nl) and worked on the problem of the so-called "missing links" in Chapters 7-13 of the Russian part of the IFToMM Terminology, as well as on translation of Chapter 14 "Transportation Machinery and Logistics" into Russian. As a member of the IFToMM PC A and the member of Belarus IFToMM National Committee he was the organizer (jointly with Prof. V.B. Algin) of the 23rd Working Meeting in Minsk and Gomel in 2010. In cooperation with Prof. E.V. Shalobaev, Prof. V.E. Starzhinsky was a chief organizer of the 25th Working Meeting of the IFToMM (St. Petersburg, Russia, 2014). Prof. V.E. Starzhinsky was the editor of the 5th edition of the Reference Dictionary Book on Gearing published in 2011 [77].

Professor Vladimir B. Algin (The Joint Institute of Mechanical Engineering NASB) is the Chairman of Belarus IFToMM National Committee, and a Member of IFToMM Technical Committee on Multibody Dynamics. He is the organizer (together with Prof. V.E. Starzhinsky) of the 23rd Working Meeting of IFToMM PC A in Minsk and Gomel. He took part in the work of the 12th (Besancon, France, June 2007) and the 13th (Guanajuato, Mexico, June 2011) World Congresses [79, 80], as well as of the 23rd Working Meeting of IFToMM PC A (Minsk-Gomel, Belarus, 2010) [81]. He participated in the organization, carrying out and publication of proceedings of the Belarus Congresses on Theoretical and Applied Mechanics and [82-84, 146] and "Innovation in Mechanical Engineering" [147-151.

The research directions in the field of mechanism and machine theory in Belarus are considered by V. Algin in the chapter "Role of MMS and IFToMM in Belarus" of the monograph "MMS and IFToMM" [85]. They are as follows:

- theory of superlong highway multilink trucks;
- investigations in modelling and simulation of mobile machines and their units as multibody systems (MBS) for driving and braking modes;
- investigations in advanced vehicle control using multibody dynamics methods and software;
- investigations on automobiles with hybrid power units;
- theory and calculations of mobile machines: load modes, life-and-functional computation, reliability calculation, life expectancy of machines and their units.

Some important results obtained in the aforementioned directions are presented in works [86, 87].

Professor Eugeni V. Shalobaev (St. Petersburg National Research University of Information Technologies, Mechanics and Optics).

The first contacts with IFToMM were initiated by Prof. E.V. Shalobaev in 1975 when Prof. F.R.E. Crossly (USA), the then IFToMM Vice-President, visited departments "Theoretical Mechanics" and "Parts of Instruments" in the Leningrad Institute of Precise Mechanics and Optics. At that time Prof. V.E. Shalobaev was a post-graduate student and acted as a German translator for the guests; later he was invited to Germany for practical training during the IFToMM probation period.

Prof. E.V. Shalobaev has published (with co-authors) a number of articles in the journal "Gearing and Transmissions" (Editor-in-Chief, Prof. V.I. Goldfarb) [88, 89]. The journal has grown from an industry journal of the Association of Engineers of Mechanical Transmissions (AMT) to the IFToMM body which Editorial Board was expanded by the scientists from Bulgaria - Profs. K. Arnaudov and V. Parushev (recommended by Prof. V.I. Goldfarb). Prof. E.V. Shalobaev was invited by the Vice-President of IFToMM Prof. V.I. Goldfarb to take part in the International Conferences and Symposia on the Theory and Practice of Gearing organized by the IFToMM Technical Committee "Gearing and Transmissions" jointly with Russian IFToMM National Committee in 1996 [90], 1998 [91], 2004 [92-95], 2014 [96].

He also participated in the International Conferences organized jointly with IFToMM in Great Britain [97], Serbia [98, 99], Bulgaria [100].

In 2000 Prof. E.V. Shalobaev was invited by Prof. V.E. Starzhinsky to take part in the work within the frame of IFToMM [63]. He joined the team of the authors of the 2nd edition of the Reference Dictionary on Gearing (Russian-English-German-French) which was published in 2002 [76] and afterwards re-edited several times [77, 101-104].

In 2002 Prof. E.V. Shalobaev began his work in the IFToMM PC A as an expert in the field of mechatronics [105]. He has published several works in this field of knowledge [106-113] and put forward valuable proposals, in particular, with respect to the electronic version of the Dictionary IFToMM Terminology 2003 [114] which is being constantly revised. This includes, e.g., the notions like "sensor-controller-actuator" triads, mechatronic levels (macro-, micro-, nano-), etc.

Prof. E.V. Shalobaev participated in the 19th (2000, Kaunas, Lithuania as a contributor) and 23rd (2010, Minsk-Gomel, Belarus, as a participant) IFToMM PC A Working Meetings. Prof. E.V. Shalobaev has presented two papers that were published in the Proceedings [115, 116] and was introduced to the PC A as an observer.

In the decade 2004-2014 Prof. E.V. Shalobaev individually and with Prof. R.T. Tolocka as a co-author published a series of articles devoted to the problem of terminology in the field of mechatronics [117-124]. At the 24th Meeting (2012, Ilmenau, Germany) Prof. E.V. Shalobaev was elected a member of the Commission.

At the Plenary Session of the International Symposium on the Theory and Practice of Gearing [125] in January 2014, Prof. E.V. Shalobaev proposed to significantly increase the coverage of the activities of scientists from the former USSR in IFToMM publications. On behalf of the IFToMM authoritie, Prof. M. Ceccarelli (President of IFToMM 2007-2011)

asked a group of scientists from CIS countries (Profs. V.E. Starzhinsky, E.V. Shalobaev and A.E. Volkov) to give their opinion on the progress of TMM in CIS states to get an objective picture on TMM evolution in the world. Prof. M. Ceccarelli proposed to organize closer collaboration with the IFToMM's Permanent Commission on the HTMM and to take part in the Seminar on HMMS to be held in 2015 in Russia, St. Petersburg.

Prof. E.V. Shalobaev together with Prof. Starzhinsky are the main coordinators and organizers of the 25th Working Meeting of the IFToMM PC A in 2014.

Professor R. Tadas Tolocka (Kaunas Technological University) has been a member of the IFToMM PC A since 1998. He took part in the PC A Working Meetings in 1998, 2000, 2002, 2005, 2008, 2010. He is a developer of Chapter 13 "Mechatronics" published in a special issue "Standardization of Terminology" in 2003 [57]. He has a number of publications in the field of mechatronics [118-123] jointly with his co-author Prof. Shalobaev, articles in the proceedings of scientific seminars on Terminology of TMM, as well as on modern history and terminology of smart adaptive mechanisms [126, 127]. He also takes part in the work of Permanent Commissions on communications, publications and archiving, education and history.

3. Terminology: contribution of scientists from the ex-USSR and CIS countries

The work on compilation of the TMM dictionary has begun from the first days of the IFToMM PC A establishment. At the first working meeting in 1971 the participants adopted the main list of terms, the draft program, responsibility zones and a set of rules. In 1973 the provisional program of work was discussed with respect to the subject matter, structure and volume of information; contacts with ISO were established (TC 10/SC4 and ES 45). Subsequent meetings were devoted to the discussion of specific sections of terminology which were being gradually filled with the terms [128].

In 1987 the completed versions of terminology were presented at a Special Meeting of the VII World Congress of IFToMM: the German version by Prof. G. Boeglsack, Russian version by Prof. Yu.L. Sarkissyan and the French one by Prof. J.P. Lallemand. In 1990, at the 12th Working Meeting, responsible persons presented the final version of the terminology; the editors and persons in charge of the terminological sections were elected. In 1991, the 26th volume of the Journal "Mechanism and Machine Theory" was issued which official version of terminology contained 773 terms with definitions in four languages [41].

The IFToMM Terminology 1991 [41] included the terms grouped into 7 sections, namely: 1. The main terms (4); 2. Design of machines and mechanisms (124); 3. Kinematics (97); 4. Dynamics (352); 5. Control of machines and measurements (73); 6. Robotics (91); 7. General terms used in TMM (32).

The transition to a new concept proposed by IFToMM which envisaged both the expansion of "The theory of mechanisms and machines" (TMM) subject matter and the change of its

name to the “Mechanism and machine science” (MMS) was officially adopted in 2000. To this effect, the IFToMM PC A has prepared the basis. At the Working Meeting in 1994 the IFToMM PC A discussed new additional terms which had appeared in dynamics and robotics. In 1998 the functioning IFToMM PC A were reorganized and new sub-commissions were established to develop terminology in “Dynamics” and new “Rotor dynamics” and “Nonlinear oscillations” sections. At the 19th (2000) and subsequent Meetings the IFToMM PC A discussed the above-mentioned sections, as well as newly proposed ones, such as “Stability”, “Systems and models”, “Biomechanics”, “Gearing”, “Mechatronics”. This work has spurred preparation and publication of the IFToMM Terminology 2003 [57]. It included the sections developed earlier (0-6) and the following new chapters: 1. Dynamics. New terms (42); 2. Rotor dynamics and measurements (110); 3. Vibration and oscillations (125); 4. Stability (22); 5. Biomechanics (51); 7. Gearing (223); 8. Mechatronics (63).

In line with the work on new terminological sections, the Commission was preparing a new variant of representing and relative position of the texts in four languages. At the 18th Meeting in 1998 it was decided to organize a new sub-commission “A new order of organization and interaction of the system”. At this and subsequent Meetings, the Commission undertook the discussion on the digital Internet version of the electronic terminological Dictionary.

The final stage of the work on the Dictionary was to place its version 3.0 on the website www.ocp.tudelft.nl/tt/cadom/IFToMM/web/index.html.

At the 23rd (Minsk-Gomel, Belarus) and 24th (Ilmenau, Germany) Meetings the Commission addressed the following issues:

- definitions of a number of the main terms in “Kinematics” and “Dynamics” sections;
- structure of “Gearing” section, division of the terms according to their subject matter attribution for subsequent use in the electronic Dictionary;
- finalization of “Transportation Machinery and Logistics” section for subsequent use in the electronic Dictionary;
- review of terminology in the new “Quality factors of machines and their components”, “Compliant mechanisms”, and “Micromechanisms” sections;
- enhancing the volume, refinement of terminology quality, format and monitoring of electronic Dictionary in the Internet in view of the latest updated version 3.0;
- creation of the database within the frame of DMG-lib/think MOTION project.

As it was previously mentioned, the Russian versions of sections 0-6 (translations into Russian) were prepared by Prof. Yu.L. Sarkissyan (member of the PCA since 1983) and were later included into the terminological book 1998 [41]. Finally, this version was reviewed by Dr. I. Ionescu (Concern “Romanian State Passenger Railroads”, Romania). New sections (2003) of the terminology were prepared by Prof. V.D. Plakhtin (Moscow State Open University, Russia) jointly with Prof. V.E. Starzhinsky (MPRI NASB, Belarus).

Prof. V.E. Starzhinsky has also prepared the first draft variant of Section 12 “Gearing” in four languages that was later updated and restructured by Prof. A.J. Klein-Breteler (Technical University, Delft, the Netherlands).

The so-called missing links were fixed in sections 0-6 of the Russian version of the electronic Dictionary by Dr. S. Segla (Slovakia); for sections 7-13 this work was done by Prof. V.E. Starzhinsky (Belarus).

It should be reiterated that Prof. E.E. Peisach has made significant and creative contribution into the elaboration of the classical TMM terminology, which includes the basic notions of kinematics and dynamics. He has thoroughly analyzed the terms and definitions for sections 0-6 and pointed out a number of essential drawbacks in formulations and translations in the Russian version [58, 59].

The issues related to translation of MMS terminology into Chinese, Dutch, Romanian and Czech languages was repeatedly discussed at the Meetings. Nevertheless, only Romanian version of the terminology has been published [129]. We know that the terminology translations into Armenian [25] and Georgian [130] languages are also available.

In the closing part of the article, it is worthwhile to underline the importance to adhere to traditional approaches which have been formed in a tedious and long-lasting process of terminology elaboration and legacy of the developers participating in it. Based on the analysis of the issue we should emphasize a systematic work in this direction by the national Committees of Germany, France, Hungary and Romania. For instance, Prof. G. Boegelsack (Ilmenau) was succeeded by Prof. B.Corves (Ilmenau) in 2005, and two young specialists Dr. T. Brix and Dr. U. Doering from the same University started their work in the PC A in 2008. A broad-minded expert, Prof. J.P. Lallemand (France) who was the member of the Commission from 1988 till 2000 handed over his position to Prof. D. Remond (France) in 2002. Prof. I. Salyi (Hungary) was working in the Commission from 1980 till 2000 and was substituted in 2000 by Dr. I. Biro. The Romanian specialists introduced changes in 1992 when Prof. N.I. Manolesku retired and Dr. T. Ionescu was accepted as a member, then Prof. O. Antonescu came in 1996, and since 2008 Dr. O. Antonescu is working in the PC A as an expert.

The bulk of work on the Russian translation of Chapters 0-6 terminology which was incorporated in the issue of 1991 [41] had been done by Prof. Yu.L. Sarkissyan. Russian translation of new Chapters 7-13 has been prepared by Prof. V.D. Plakhtin.

It should be noted that, unfortunately, the Russian IFToMM National Committee has not managed to preserve stable continuity of the Russian specialists. We have to admit that Prof. Yu.L. Sarkissyan rarely attended the Meetings, especially in recent years (his last presence at a meeting dates back to 1991). Professor V.D. Plakhtin has retired because of a disease; Prof. D.N. Levitski did not take part in the work of the Commission in the recent decade. The above facts have strained the situation with the Russian part of work on terminology. The work of the delegates from Belarus (Prof. V.E. Starzhinsky since 2000, and Prof. M.M. Kane since 2005) and invitation of Prof. E.V. Shalobaev as an observer to the Commission (2010) and then as its member (2012) have alleviated the situation with deficiency of the

Russian-speaking specialists. Nevertheless, the issue of filling the second vacancy in the restricted quota of the IFToMM representatives from the Russian members remains outstanding.

Let us cite a generalized statistics for objectiveness [128]. In total, about 60 scientists from 25 countries of the world participated in the work of the IFToMM PC A from 1969 till 2012, among them seven members from Germany; four scientists per Great Britain, Poland, Romania, USA; three representatives per Hungary, China, Russia, France; two representatives per Belarus, The Netherlands, Serbia, Taiwan, Czechoslovakia, Yugoslavia, Japan; one member per Austria, Armenia, Bulgaria, Spain, Italy, Lithuania, Slovakia, USSR, Finland.

Taking into account the importance of systematic work on terminology and coordination of the efforts of scientists from different countries in achieving high-quality results, it is highly important for the Russian IFToMM National Committee to analyze the situation and make everything possible to organize participation of Russian specialists in the Meetings for preparation and coordination of terminological texts, development of new sections. It is of no less importance to attract competent young scientists with a fluent knowledge of English.

Unfortunately, the long-lasting reorganization in the Russian IFToMM National Committee due to the departure of its Chairman Prof. N.V. Umnov in 2010 and election of a new Chairman, Academician of RAS, V.M. Fomin, transfer of the Committee coordination center to Novosibirsk are the factors impeding stabilization of the work.

In this connection, the Belorussian IFToMM National Committee has asked the Chairman of the IFToMM PC A to approve election of Dr. S.V. Shil'ko (V.A. Belyi Metal-Polymer Research Institute of NASB, Gomel, Belarus) as an expert. Dr. S.V. Shil'ko has a profound experience in the field of terminology [76, 77, 101-104, 131], book publications in English [132, 152], as well as participation in the International Conferences on mechanics [133-139].

CONCLUSIONS

In conclusion, the available data on participation of scientists from the USSR, CIS and Baltic countries in the leading and technical structures of IFToMM are presented in a summarized form [140].

The members of the Executive Council of IFToMM in different periods were:

- Academician of RAS N.I. Artobolevsky as a President (1969-1974), and an Honorary President (1975-1979);
- Prof. A.P. Bessonov as a member of the Council (1975-1979, 1979-1999), Vice-President (1980-1983); was a Chair of the Permanent Commission for publications (1971-1981) periodically exchanging the position with Prof. Erskine F.R. Crossley;
- Prof. V.I. Goldfarb as a member of the Executive Council (2008-2011), Vice-President (2012-2015), Chairman of the Technical Committee on Gearing (1998-

2005), Chairman of the Permanent Commission on communication, publications and archiving (2012-2015);

- Academician of RAS K.V. Frolov as a member of the Executive Council (1984-1991), Chairman of the Technical Committee on the systems man-machine (1986-1989);
- Prof. Yu.L. Sarkissyan as a member of the Executive Council (1992-1995), member of the Permanent Commission on terminology (1983-till now);
- The Corresponding Member of the Ukrainian Academy of Sciences Prof. S.M. Kozhevnikov was a member of the Executive Council of IFToMM (1971-1983), and then (till 1986) an Honorary member of the EC, a member of the Permanent Commission on science connections with industry;
- Academician of Kazakhstan AS Prof. Gakhal Umaliev was a member of the Executive Council since 1983 (Kazakhstan).

In the first years of IFToMM organization, a well-known Soviet scientist Prof. N.I. Levitskii was the Vice-Chair of the PC on standardization and terminology

Along with the above-mentioned specialists, the scientists from the former USSR, which currently represent CIS and Baltic states, are working in the Technical Commissions and Permanent Commissions of IFToMM [140]:

Technical Committees:

- TC on Gearing: Prof. B. Shchokin (Ukraine), Prof. S.A. Lagutin (Russia), Prof. I. Belokonev (Ukraine);
- TC on Linkages and Mechanical Controls: Prof. R.I. Alizade (Azerbaijan);
- TC on Micromachines: Prof. B. Bansevicius (Lithuania);
- TC on Multibody Dynamics: Prof. V.B. Algin (Belarus), Prof. Oleg Gasparyan (Armenia);
- TC on Reliability: Prof. I.V. Demiyanushko (Russia), Prof. O.V. Berestnev (Belarus), Prof. Pereverzev (Ukraine), Prof. V.P. Roizman (Ukraine), Prof. G. Panovko (Russia), Prof. K.N. Voinov (Russia), Prof. B. Bansevicius (Lithuania); Dr. V. Barzdaitis (Lithuania), Prof. G. Kulvietis (Lithuania), Prof. V.A. Glazunov (Russia);
- TC on Rotor Dynamics: Prof. Yu. Vorobiyov (Ukraine);
- TC on Sustainable Energy Systems: Dr. G. Stauskis (Lithuania);
- TC on Tribology: N.K. Myshkin (Belarus), Prof. V. Dulgeru (Moldova), Prof. R. Barauskas (Lithuania);
- TC on Systems Man-Machine: Prof. V.P. Tregubov (Russia, is a chairman since 2002);
- TC on the Personnel of Higher Qualification: Academician U.A. Zheldosbekov (Kazakhstan).

Permanent Commissions

- PC on Communication, Publications and Archiving: Dr. N.A. Barmina (Russia);

- PC on Education: Prof. V.A. Gavrilenko (USSR, till 1977), Prof. V. Barzdaitis (Lithuania), Prof. D.N. Levitskiy (Rusia);
- PC on History: Prof. A. Golovin (Russia), Prof. V. Tarabarin (Russia), Prof. Ya. Kinitskii (Ukraine), Prof. B. Kopey (Ukraine), Prof. O.V. Egorova (Russia).

Let us once again track the major stages of progress in the MMS with regard to the terminological aspect due to its paramount importance:

1. Terminological Dictionary issued in 1991 [41] that included seven subject sections edited by the Chairman of the PC A, Prof. G.M. Prentis (1988-1990).
2. Publication of "Terminology of MMS – 2003" [57] that included seven new sections taking into account new interpretation of TMM as a Science on mechanisms and machines presuming changes in the format of representing blocks of terminology to simplify preparation of the electronic version of the dictionary. The book was prepared and published under the guidance of the Chairman of the PC A, Dr. T. Ionesku (1997-2005).
3. Preparatory and organizational works on launching the electronic version of the dictionary through Internet were initiated and monitored by the Chairman of the PC A, Prof. A.J. Klein-Breteler (2006-2013) [141, 142].

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25th Working Meeting
of IFToMM Permanent Commission
for Standardization of Terminology on MMS,
Saint-Petersburg, Russia, June 23 – 29, 2014

STATE OF THE ART AND PERSPECTIVES OF DEVELOPING TERMINOLOGY ON CHAPTER 15 "QUALITY FACTORS OF MACHINES AND THEIR COMPONENTS"

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ABSTRACT

The principles of formation, state and perspectives of further development of Chapter 15 "Quality Factors of Machines and Their Components" of the Terminology IFToMM are discussed.

Key words: quality parameters, general notions of quality, dependability, reliability, anthropological factors, constructive and technological factors, service factors.

Effectiveness of economics is in a great degree dependent on quality of machines used in all branches of economy and defining its technical level. At the present time much attention is paid to the problems of quality of production and services, since it is generally recognized that this objective is closely related to the quality of life. A series of new standards in the field of quality have been created and are functioning.

By case study is a series of ISO 9000 standards on quality management developed in 1987. As of the date of their creation, there were 5 such standards, while now this series includes more than 50 normative documents which are used practically in all industrially advanced countries.

Terminology in the field of quality has been standardized in a large number of international (ISO, FEC, EN et al.) and national standards. They embrace a lot of quality factors and use many terms, although some variations of them are not employed. In connection with this situation the designers, producers and customers encounter difficulties in development of constructions, their production and maintenance in respect to the requirements to the

machine quality which are actual in different countries. In conditions of globalization of world economics the importance of the problem is intensified.

On these grounds, in 2006 Prof. M. Kane proposed to include the section "Quality factors of machines, their components and materials" in the "Terminology IFToMM on MMS". A subcommission consisting of Prof. M.M. Kane (Chair) and Victor Starzhinsky has proposed the following basic principles of its structure:

1. The section should include the main factors of machine quality and their components, necessary for development, production and operation of machines.
2. The contents of the terms should be in line with the basic international and national standards in the given field.
3. It is necessary to include into the section most widely used terms in a most simple and accessible for specialist's formulation.

Quality parameters of machines can be divided into operating and technical factors. The operating factors characterize commercial properties of machines that are evident in operation, for example: ergonomics, dependability, effectiveness, ecological compatibility, etc. Technical factors characterize the properties of machines that are formed in manufacture and ensure the operating factors. For example, accuracy of manufacture and assemblage of machine parts, sub-assembling and machine as a whole, strength and wear resistance of its components, etc. may be related to the technical factors. In the 1st edition, we attempted to take into account the mentioned groups of factors. Hence, initial 712 factors have been included into the section.

Then, the list has gradually decreased. Description of the 2nd edition, in which the number of terms was reduced to 213, was given in the report "Principles of Creation and Contents of the New Chapter IFToMM Terminology "Quality Indices of Machines and Their Components", at the 24th Working Meeting of the IFToMM PC A (Ilmenay, Germany, June 24-30, 2012). After discussion, Prof. A.J. Klein Breteler proposed the following changes for the 3rd edition:

1. The terms, unrelated directly to machines and the ones rarely used have been excluded. As a result, 23 terms were excluded from part 1, 13 terms from part 2, 36 terms from part 3, and 23 terms from part 4. In all 95 terms were excluded. The volume of section 15 reduced two times.
2. Formulation of many factors was made more precise in order to harmonize them with the main international and national standards, simplify formulation of definitions, and achieve more precise and complete correspondence of the factor description to its contents.

The operating factors were basically included in the 3rd edition of Chapter 15. They are divided into four groups:

1) general notion of quality (33 factors);

2) quality factors concerning human safety and health (16);

3) factors on dependability and reliability (37);

4) constructive and technological factors (23).

In total Chapter 15 contains 109 notions of machine quality.

On our opinion, in future it is necessary to expand and perfect this section by way of making more precise and extension volume of the current parts and introduction of new ones. For example, “Selection of requirements to the quality of machines and their components”, “Technique of checking and diagnostics of quality of machines and their components”, “Testing of machines and their components”.

In conclusion, it should be noted that the concept presented in the given section of terminology is based not only of a large quantity of normative documents, but also on experience of the authors. The main publications are listed below.

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