

IPMA Standard Competence Scope in Project Management Education

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Abstract

The authors of the paper endeavoured to find out key competences in IPMA standard for educational approaches in project management. These key competences may be used as a basis for project management university courses. An incidence matrix was set up, containing relations between IPMA competences described in IPMA competence baseline. Further, discrete-time Markov chain was used to calculate the weights from the incidence matrix. The authors later considered the most important competences whose weight sum equalled 50% importance. The article defines IPMA standard competence minimum. Since the minimum comprises the standard from more than its half, it can be regarded as minimum for the creation and development of project management teaching and learning. The structure corresponds to IPMA certified B level (excluding such requirements as experience etc.). In the discussion of this article the defined minimum of the standard competences was compared with recommended preparation for individual certification levels. The findings show that real distribution of competences in the IPMA standard based on importance and real IPMA standard requirements for non-purpose and complex project management education differ from the structure of basic certification degrees of the standard. The authors further say that the education as such should exceed requirements for professional certification. The students should benefit from a complex training with emphasis on such topics and competences that would help them make a successful foray into project management practice.

Keywords: project management, teaching, IPMA standard, competence, Markov chain, weights

1. Introduction

1.1 International IPMA Standard in Project Management Area

A call for more intense education in the area of project management and its standards is constantly rising. Indisputably, the answer can be found in the growth of university bachelor's, master's and doctoral courses dealing with the issue. The following text of the article enhances previous work of the authors' team (Bartoška et al., 2011) and brings forth an original way of the International project management association (IPMA herein) standard teaching concept (Caupin et al., 2006), using the weights of individual competences and their groups. IPMA is among other competence standards, regulations and codices regarded as complete and fully suitable for project management. Palma et al. (2011), who in their article focus on a detailed comparison of the IPMA standard with other existing competence standards (e.g. ABET, CDIO, Tuning project), claim that the IPMA standard exceeds its scope in comparison with many other approaches and standards. The present study states that for the teaching of project management and other managerial disciplines the IPMA standard is a fully compliant tool.

Long-term experience in project-based learning is discussed in Ríos et al. (2010) who add that the IPMA standard is a natural support and tool for project-based learning or that it will become a successful tool and support in the course of time. The authors rely on a vast file of student projects and twenty-year experience at the Technical University of Madrid in Spain. The project-based learning and related specialist topics of bachelor's and master's courses should both factually and formally derive from the IPMA standard competences. The concept and contents of the IPMA standard is the basis of many under-graduate university courses as well as

post-graduate courses. It is especially vital to mention a post-graduate course in Rural Development *Agris Mundus* taught at the Technical University of Madrid which uses the IPMA concept (Ríos et al., 2011).

1.2 Requirements for Project Management Education

With existing institutional constraints and opportunities, how can project management courses facilitate the development of skills, awareness and reflective abilities so that the students receive better training for team work and can succeed in the future? Project management educators must take into consideration key components which are important for project management studies. Kostolányová et al. (2011) stresses the importance of teaching the students with regard to their learning styles. Ojiako et al. (2011) point out two substantive components in studying project management, i.e. the development of transferable skills and virtual learning. The transferable skills refer to experimental and non-subject specific skills that can be used in a wide range of contexts (Cryer, 1998). The majority of project management failures are due to human factors such as poor leadership connected with poor communication. The communication and thinking skills represent a critical element of project management competency (Ashleigh et al., 2012). Mengel (2007), Pant and Baroudi (2008) and Stevenson and Starkweather (2010) refer to the importance of leadership skills as teamwork and team development. These competences lead to shared understanding of the project and its goals. Another important recognition is a tendency in learning project management towards softer parameters like empathy and emotion or behavioural competence ethics (Helgadóttir, 2008). Patanakul et al. (2007) acknowledge a growing importance of interpersonal skills compared to technical skills. The interpersonal skills include basic writing, communication and numeric (problem solving) skills.

The IPMA education would be sufficient if teachers found the way how to make it easier for the students to become knowledge creators rather than simple knowledge recipients (Ojiako et al., 2011). Thomas and Mengel (2008) describe knowledge recipients as managers who must be capable of managing and changing organisations. One of the main educational roles is to develop practitioners (students) with ability to synthesize (project complexity). Stevenson and Starkweather (2010) point out that the new way in project management teaching should be focused on the development of ability to communicate at multiple levels, on leadership and ability to deal with ambiguity. This means that students should use knowledge already gained from other courses and apply it to real-based project management projects (Ríos et al., 2010). On the one hand, the students may be seen as costumers willing to pay for education (service), on the other hand they must take greater responsibility for their own learning (Ríos et al., 2010). The educator must become both coach and facilitator of learning. On such level of education, the learner is required to develop a keen level of self-knowledge, intellectual skills to understand existing best practices and adapt them as necessary and emotional skills to motivate and coach team members (Thomas & Mengel, 2008).

Students should be stimulated to improve their critical and creative thinking skills, i.e. future project management education must emphasise transferable skills. Another educational concept is that students are considered as a system with continuous interaction between students. Córdoba and Piki (2012) describe the system which allows students to go through expected and unexpected problems and improve their soft and hard skills such as communication, leadership, argumentation and teamwork, i.e. transferable skills. The ideas of a group as a system also resonate with synergies in learning process. There is also an increasing importance of the ethics competence in project management. Helgadóttir (Helgadóttir, 2008) describes an experiment which includes the ethical dimension in the conceptual framework of creative, logical and ethical thinking. It is the project management risk analysis that benefits the most from the ethical control.

Provided the students must focus on improving their transferable and interpersonal skills, it is also necessary to find key competences important for educators/teachers. Brožová (2011) divides these key competences into three competencies groups, i.e. the content and form of teaching, the organisation of lecture and the personality of teacher. Each group contains competencies very similar to the competencies described above such as teacher's self-presentation, communication skills, the complexity of reading, etc.

The IPMA standard consists of an extended complex of specialist topics that cannot always be presented to students in detail; therefore standard structuring and classification are crucial for learning. The objective of this paper is to propose the arrangement of the IPMA standard competences according to their importance so that they meet the needs of project management and make use of quantitative methods. The paper methodology is based on the application of the Markov chain to set the weights of the IPMA elements. The contribution of this article lies in the definition of a minimal number of the standard competences covering more than one half of the IPMA standard for the needs and development of education with restricted time allowance.

2. Method

2.1 International IPMA Standard

The international standard for project management, referred to in its abbreviated form as IPMA, is issued and certified by the International Project Management Association (IPMA), based in the Netherlands. At present IPMA has more than 45 branches at particular national levels responsible for manager certification in their own countries. In the Czech Republic the standard is represented by Project Management Association (Společnost pro projektové řízení, SPŘ o. s.), residing in Brno. In 2008 the Czech branch issued the translation of the international competencies standard for project management “ICB – IPMA Competence Baseline” in version 3 from 2006 entitled “National competency standard for project management” (Pitaš et al., 2008).

Both the original standard in English (Caupin et al., 2006) and the national standard in the Czech language are based on defining and analysing competencies necessary for project management. Following the first part dealing with general part of certification examination and certification system, the IPMA standard text is divided into three main competence areas. The IPMA standard distinguishes project management competencies as technical, behavioural and context competencies. There are 20 elements in technical area, 15 in behavioural area and 11 in contextual area. The competencies for particular competence areas are always described in a detailed and structured way.

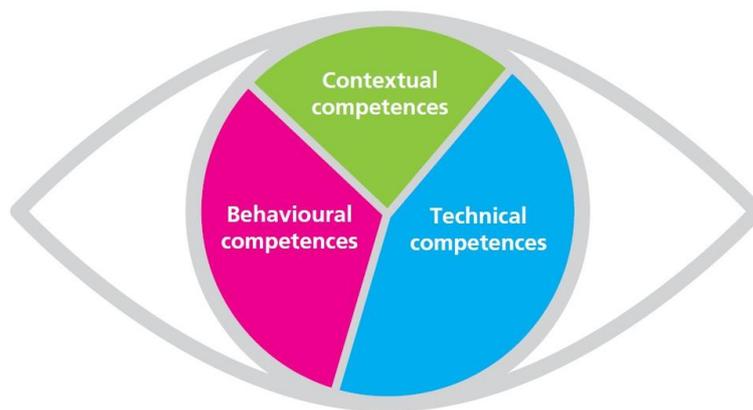


Figure 1. The IPMA standard competence “eye” (Caupin et al., 2006)

The IPMA standard defines competence as follows: “The set of knowledge, personal approach, skills and related experience altogether needed in order to achieve success in a particular position.” Further, the IPMA standard defines skills for project management as competences decomposable into separate elements and describable using particular points. In the IPMA standard, the element of each competence is created by the text which is further divided into the following parts:

- The description of a particular area.
- Possible procedural steps which may be recommended for processing.
- Specialist or professional topics related to competence.
- Key competence which the manager should know and master.
- Relations to the surroundings in the area linked with competence.

The area description is the introduction to the issues and related topics and parts. The procedural steps are presented as lists of tasks and activities, emphasising action with the use of imperative verb forms. The specialist and professional topics are submitted in a brief list of technical terms and entries referring to a professional, specialist or scientific discipline. The key competence can be regarded as the requirements and conditions necessary for meeting the IPMA standard certification grades. The relations to the surroundings and other standard elements, although mentioned in the list of references, can also be understood as a following description of adjacent areas. The overall structure of each IPMA standard element is presented in the form of instructions, entries and references. The full acquisition of project management competences, thanks to the IPMA standard elements, will always be conditioned by a continuous study of the topics as well as training and individual experience.

2.2 IPMA Incidence Matrix

Quantitative methods are applied amply and frequently in education research where competence is a key factor; let us mention for example the works of Goudarzi et al. (2012) and Shahzadi et al. (2012). For the needs of this article an incidence matrix and discrete-time Markov chain, both from the area of quantitative methods, were used.

To find out the connections and relations between competences in the IPMA standard an incidence matrix was set up. In IPMA competence baseline (Caupin et al., 2006) the description of each competence starts with its relations to other competences. These relations were regarded as main indicators of the importance of a specific competence in respect to other competences. The most weighted competence was assumed to be the one with relations to the highest number of competences, i.e. how many competences were indexed and how many competences indexed back.

The prerequisite to develop the weights in this way was supported by the fact that the relations were not bidirectional, i.e. square matrix was asymmetrical. For the summary of the IPMA competences see Table 1.

2.3 Discrete-time Markov Chain

According to Tijms (2003), the Markov model is no exception to the rule that simple models are often the most useful models for analysing practical problems. The theory of Markov processes has applications to a wide variety of fields, including biology, computer science, engineering and operations research. The basic concepts of Markov processes are those of a state and of a state transition. The Markov chain is a random sequence in which the dependency of the successive events goes back only one unit in time. The future probabilistic behaviour of the process depends on the present state of the process only and is not influenced by its past history.

In the present study only Markov chain with time-homogeneous transition probabilities was considered; that is (Tijms, 2003)

$$P\{X_{n+1} = j | X_n = i\} = p_{ij}, \quad i, j \in I, \quad (1)$$

independent of the time parameter n . The probabilities p_{ij} were called the one-step transition probabilities and satisfied (Tijms, 2003)

$$p_{ij} \geq 0, \quad i, j \in I, \quad \text{and} \quad \sum_{j \in I} p_{ij} = 1, \quad i \in I. \quad (2)$$

The long-run behaviour of the Markov chain can be expressed as the equilibrium probabilities that the n -th step probabilities $p_{ij}^{(n)}$ have a limit as $n \rightarrow \infty$. The equilibrium probabilities p_j^∞ are the unique solution to the equilibrium equations

$$p_j^\infty = \sum_{i \in I} p_i^\infty p_{ij}, \quad j \in I, \quad (3)$$

together with the equation

$$\sum_{j \in I} p_j^\infty = 1. \quad (4)$$

To obtain a linear equation system with a regular matrix, it is permitted to delete one of the equilibrium equations (3). The equilibrium probabilities p_j^∞ express a long-run average number of visits to state j . In other words, the equilibrium probability p_j^∞ is the weight of the state j .

2.4 Project Management and Consequence Approach in Present-day Courses

Project management has been lectured and taught at the Faculty of Economics and Management (FEM), Czech University of Life Sciences Prague (CULS Prague) in Bachelor's and Master's Courses and most study fields since the 1990's of the 20th century. It concerns especially the following courses: Project Management, Project Management Methods, Creating and Software Support of Projects and Software Applications of Operations Research Methods. The courses also involve critical path method, creation and work with directive and topical project plan and the analysis of project sources. The last three topics may be included in the IPMA standard technical competence "1.11 Time and project phases" and "1.12 Resources". Although the mentioned topics follow certain IPMA standard elements when lectured at the university, they are neither taught in a wider context of the standard nor are they lectured in sequence with other standard competence elements. At FEM CULS Prague, the IPMA standard is taught independently, without any links to the topics related to technical or other

standard competence. The students adopt the knowledge from the project management field separately, irrespective of the standard principles and recommendations.

The verification of the students' acquired knowledge is carried out through seminar works and tests. However, the verification is not linked to the IPMA standard at all. This leads to a situation in which the students, who graduate from the university courses and acquire professional skills in the field of project management, do not have the opportunity of a full and thorough acquisition of the IPMA competence elements and the IPMA standard as such. However, in a present state of project management only pure and simple specialist knowledge or skill without any hint of project management standards used currently world-wide is rather insufficient. The situation is likely to change as of the academic year 2012/2013 after the new study programme Project Management has been launched. The new programme and its courses should stress the link between IPMA standard and subjects taught at the university.

2.5 Teaching the IPMA Standard Competence Elements

Because of its vast range, it is impossible to teach the whole IPMA standard during one course. The IPMA standard comprises many specialist areas, such as: Operations Research, Finance, Personnel Management, Psychology, Ethics etc. These areas require appropriate learning approaches and appropriate lecturers. For the training of the whole IPMA standard range it is also necessary to take into account training courses that would thematically follow and meet the standard competence elements. The IPMA standard elements are thematically well articulated and fall into several specialist areas at once. Only a small amount of the standard elements could be included in one training course without any further links to follow-up courses. Specialist areas and courses suitable for training and covering the complete IPMA standard can be related to the elements as follows (See Figure 2).

Figure 2 presents specialist areas surrounding the eye of competence that would absorb the scope of the IPMA standard competence elements and that could create further training courses. The specialist areas in Figure 2 are placed around the eye in correspondence to a particular competence scope. Behavioural competences may belong among specialist areas or courses like Psychology, Ethics, Teamwork, Soft skills and techniques, Time Management, Quality Management, and Change Management. Contextual competences will be most represented in courses or specialist disciplines such as Human Resource Management, Economics, Legal, Finance, Accounting, and ITC and Databases. Technical competences can be found especially in Operations Research, Risk Management, Project Management, and ITC and Databases (Bartoška et al., 2011).

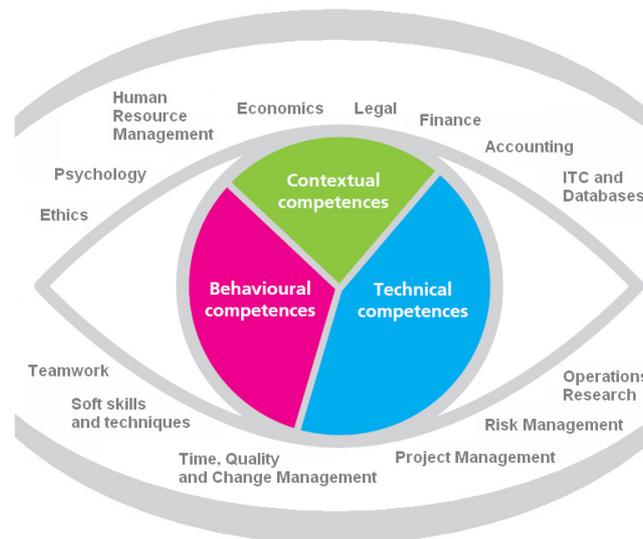


Figure 2. The IPMA standard competence "eye" and related specialist areas and courses

Some study areas, such as Operations Research or Project Management, go beyond the IPMA standard and require a higher number of various specialist courses to cover them. However, for the teaching of the IPMA standard only some topics from the field of Operations Research can be recommended. These include Game theory, Graph theory, Decision analysis, and Simulation. For the purposes of the IPMA standard it is necessary to teach Project Management in its complete range where Project Management will become a unifying and central

topic of the course.

3. Results

The competences mentioned in the IPMA standard make reference to one another. Each competence refers to other competences and is mentioned in the references of other competences. If we depicted each competence as the node of a graph and its every reference as a link to a referred competence, we would obtain a non-oriented cycle graph. The constructed graph would not be evaluated and during its transcription into incidence matrix each existing link could be expressed as numerical value 1, whereas a non-existent link between competences could be expressed by value 0. A similar concept of calculating the weights of the competences is shown in Brožová (2011). In her contribution the author uses Analytical Hierarchical Process (AHP) to set up the structure and obtain weights.

When teaching or learning the IPMA standard, one can assume that after studying a particular competence the student or lecturer proceeds to other competences given in its references. Therefore, when teaching and learning individual competences the Markov chain can be expected (Tijms, 2003). For the incidence matrix of the IPMA standard relations (1) and (2) can be used and values standardised in lines. The standardised values in lines will then express probabilities of transfer between competences during teaching or learning process.

The probabilities of transfer between competences do not express the weight of individual IPMA standard competences where the competence weight stands for its importance and range of lessons. This weight, however, can be obtained as equilibrium probability. With the structure of individual IPMA standard competence references as the Markov chain and relations (3) and (4), the weights of individual learning competences will be as follows (See Table 1).

In Table 1 the competences are ordered from the top according to the weight size from the biggest to the smallest. The competence "1.03 Project requirements and objectives" has the highest weight in the IPMA standard. Of all 46 competences only first 19 have an overall weight 50.3%. The competences presented in Table 1 show the importance of individual competences within the IPMA standard and learning. A competence with a higher priority should be given more time than a competence with a lower priority. If project management learning was to be dealt with in a minimalistic way, these 19 competences (competences presented above a thick line in Table 1) would present minimum for the IPMA standard acquisition. Based on the closeness of competence weight shown with the italic style in Table 1, one must also consider the substitution of competences in respect to their selection for learned or taught minimum.

Moreover, competence areas can be observed within the most important 19 selected competences (Table 2). The highest number of competences with the highest weight belongs to the area of technical competences (Table 2). The areas of contextual and behavioural competences are almost in balance. Relative representation of the competences (Table 2) approximately corresponds with the recommendation for B certification level (if other requirements are omitted, i.e. experience and a project report). The predominance of technical competences over the other areas corresponds with the certification preparation, i.e. technical competences should always mildly or significantly predominate. If one further considers the competences with the italic style described above and their potential substitution, the frequencies of the necessary minimum will more or less stay steady around the recommendation for the B level certification.

Table 1. The IPMA standard competences and weights as equilibrium probabilities

	IPMA competence	Weight	Cumulative weight	IPMA competence	Weight	Cumulative weight
	The selection of competencies for project management teaching	1.03 Project requirements and objectives	3.36 %	3.4%	<i>1.18 Communication</i>	2.09 %
2.14 Values appreciation		2.97 %	6.3%	<i>1.06 Project organisation</i>	2.08 %	63.2%
3.04 Project, programme and portfolio implementation		2.87 %	9.2%	<i>1.17 Information and documentation</i>	2.06 %	65.3%
2.08 Results orientation		2.81 %	12.0%	<i>3.01 Project orientation</i>	2.00 %	67.3%
3.06 Business		2.79 %	14.8%	1.11 Time and project phases	1.97 %	69.2%
1.02 Interested parties		2.76 %	17.6%	2.11 Negotiation	1.96 %	71.2%
2.02 Engagement and motivation		2.75 %	20.3%	2.06 Openness	1.96 %	73.2%
1.13 Cost and finance		2.72 %	23.0%	2.01 Leadership	1.93 %	75.1%
1.10 Scope and deliverables		2.63 %	25.7%	2.05 Relaxation	1.92 %	77.0%
1.01 Project management success		2.57 %	28.2%	3.10 Finance	1.89 %	78.9%
2.04 Assertiveness		2.57 %	30.8%	1.20 Close-out	1.86 %	80.8%
1.14 Procurement and contract		2.55 %	33.3%	2.09 Efficiency	1.81 %	82.6%
3.05 Permanent organisation		2.49 %	35.8%	2.12 Conflict and crisis	1.77 %	84.4%
1.05 Quality		2.46 %	38.3%	1.19 Start-up	1.74 %	86.1%
1.04 Risk and opportunity		2.45 %	40.8%	2.13 Reliability	1.74 %	87.8%
1.16 Control and reports		2.45 %	43.2%	1.09 Project structures	1.71 %	89.5%
1.15 Changes		2.43 %	45.6%	3.07 Systems, products and technology	1.71 %	91.3%
2.10 Consultation		2.35 %	48.0%	2.07 Creativity	1.69 %	93.0%
<i>3.03 Portfolio orientation</i>		<i>2.31 %</i>	<i>50.3%</i>	3.02 Programme orientation	1.62 %	94.6%
<i>2.15 Ethics</i>		<i>2.27 %</i>	<i>52.6%</i>	1.12 Resources	1.62 %	96.2%
<i>2.03 Self-control</i>	<i>2.20 %</i>	<i>54.8%</i>	3.11 Legal	1.48 %	97.7%	
<i>1.07 Teamwork</i>	<i>2.18 %</i>	<i>56.9%</i>	3.08 Personnel management	1.24 %	98.9%	
<i>1.08 Problem resolution</i>	<i>2.09 %</i>	<i>59.0%</i>	3.09 Health, security, safety and environment	1.09 %	100.0%	

Table 2. The frequencies of minimum standard competences per competence area.

	Frequency in the selection for teaching	Relative frequency
TECHNICAL COMPETENCES	10	52.6%
BEHAVIOURAL COMEPETENCES	5	26.3%
CONTEXTUAL COMPETENCES	4	21.1%

The determination of significance and weights of individual IPMA standard competences for teaching or learning can be misleading. The above mentioned results are based on an empirically verifiable basis and exact

calculation. This means that the authors proceeded from the referring to competences as mentioned in the IPMA standard publication, with the Markov chain presupposed in the behaviour of the student or lecturer. The importance of competences based on weights, as presented in Table 1, can be used for creating syllabi, topics or the structure of project management courses.

4. Discussion

University project management training usually comprises a great amount of specialist courses. The number of courses is often restricted by time allowance for classes. Therefore, when creating study plans, it is impossible to incorporate all topics and areas of the given professional discipline into contact lessons. It is necessary to concentrate on key areas of study topics and leave the rest for students' self-study. Although the international IPMA standard is a key model for project management competences, it is not vital for contact classes to its full extent. That is why the possibility of incorporating even the smallest amount of IPMA standard competence elements into teaching alongside with covering the majority of the standard can be a very important and beneficial teaching innovation. Therefore even within a small time allowance it is possible to incorporate a major share of the IPMA standard into teaching. Such approach to education can be considered highly effective because the students become acquainted with the standard maximum with only the minimum of competences used during contact lessons.

Table 3. Comparing the frequencies of particular areas within standard minimum and preparation recommended for certification.

	Frequencies of minimum standard competences per competence area	IPMA's universal four-level-certification system (recommended range of preparation)			
		A Level	B Level	C Level	D Level
		TECHNICAL COMPETENCES	52.6%	40%	50%
BEHAVIOURAL COMEPETENCES	26.3%	30%	25%	20%	15%
CONTEXTUAL COMPETENCES	21.1%	30%	25%	20%	15%

The IPMA standard offers certification in the area of practical project management in four follow-up levels (Caupin et al, 2006) with a recommended range of preparation for individual competence areas. The frequencies of the standard competence minimum established in our article approach B certification level (See Table 3). B certification level is designated for Senior Project Managers with deeper practical experience in project management but lower knowledge of technical competences because they are assumed to have achieved it already. If the established standard competence minimum defined thematic range and content of classes, students would be educated with lower knowledge of technical competences and, conversely, with higher knowledge of behavioural and context (D and C) competences than is required for the first certification degrees. To achieve the basic certification degrees (D and C) students would be obliged to complete approximately 20% technical competences. This fact could be taken care of by establishing optional subjects and courses above the framework of time allowance.

Students often find behavioural and context competences pivotal for obtaining experience in project management. Technical competences can be obtained more easily because they are usually mathematical and managerial tools of planning, management and control, amply described in literature and case studies. If the students have narrower basic knowledge of technical competences, it is not a problem for them to expand the basis. What is the most difficult for self-study and what contact classes may contribute to, thanks to a personal intervention of the teacher, is the acquiring of soft skills and knowledge which form a substantial part of behavioural and context competences of the standard. Therefore the mentioned standard competence minimum frequency (See Table 3) for classes can be regarded as a strong point and opportunity to develop education in the right way.

For the basic knowledge of the IPMA standard the above-mentioned 19 competences with the highest importance weight (See Table 1) should suffice. This fact can be pivotal and it should be a starting point for the preparation and development of project management education since university education should not in principal substitute certification examination preparation only. This is supported by resulting frequencies of the standard competence minimum within competence areas. The resulting frequencies (See Table 2) express real competence distribution in the standard based on the importance and existing requirements of the IPMA standard for

non-purpose and complex project management education. The education as such should be broader and it should present the students with complex training emphasising topics and competences which will help the students penetrate successfully into practical project management.

5. Conclusion

The paper sets up the weights of importance of all IPMA competences. The focus was on demonstrating which competences from the total of 46 were necessary to manage at least 50 % of the IPMA standard. In order to do so an incidence matrix was created, describing the relations between competences. To some extent, the matrix can be considered the indicator of competences that the students, lecturers etc. should focus on. The most important 19 competences (10 technical, 5 behavioural and 4 contextual) where the sum of the weights equalled to 50 % of all 46 IPMA competences were pointed out.

At the beginning of the paper the situation in project management training was described. The majority of approaches emphasise the necessity to improve transferable and interpersonal skills, i.e. leadership, communication. The current or, let us say improved future university education, must correspond with students' expectations. These expectations are highly connected with the requirements from project management companies. Educators and university teachers must find the way how to train students to become knowledge creators rather than simple knowledge recipients. Current trends in project management have a tendency towards the ability to deal with ambiguity.

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