

Certification in Requirements Engineering

The Certificate model “Certified Professional for Requirements Engineering”

Requirements engineering (RE) is an effective and important approach for carrying out software projects successfully. This fact is confirmed in studies conducted by the Standish Group. But there are many ways of running RE and the problem often arises, especially in international projects, as to whether the developer in India actually understands what the analyst in London has specified. The International Requirements Engineering Board (IREB) e.V., founded in 2007, has set the goal of standardising RE and creating a basis for communication that can be understood across the globe. This article provides information on IREB and how this organisation came into being. It explores the basic content of the syllabus and the manner in which certification is set up while also providing pertinent facts and figures on the current status of this certification. A final section is devoted to a look ahead to see what IREB is planning in the near future.

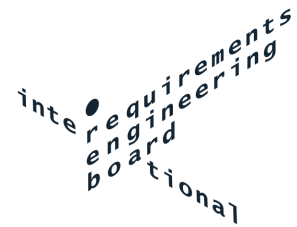
IREB is composed of prominent businesspeople, consultants, researchers and scientists who have joined together to improve training in the field of requirements engineering (see Box 1). To this end, the members have developed a syllabus and a certificate for becoming a “Certified Professional for Requirements Engineering” (CPRE).

Founding Members of IREB e.V.

Karol Frühauf, Infogem AG (treasurer)
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Prof. Dr. Martin Glinz, University Zürich
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Prof. Dr. Barbara Paech, University Heidelberg
Prof. Dr. Klaus Pohl, University Duisburg-Essen
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Box 1: Members of IREB e.V.

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The Origin of IREB

The origin of the *International Requirements Engineering Board (IREB) e.V.* is closely associated with the field of *requirements engineering (RE)*. RE emerged as a separate engineering discipline in the mid-1990s. The work done by Ivar Jacobson in collaboration with Grady Booch and James Rumbaugh was instrumental in bringing about this new field. Known as the “Three Amigos”, the trio produced results that would prove crucial for software development, including UML or working with use cases. The history of RE therefore has a grand tradition in Europe, which has continued to the present day. If you conduct an Internet search on bachelor and master theses on the subject of RE, you will find that over 50 per cent of RE theses are currently produced in Europe, primarily at universities in Britain, Sweden, Germany, Austria and Switzerland. It is no wonder that the roots of IREB are also European. *The Working Group on Software Quality and Continuing Training (ASQF)* and *the International Software Quality Institute (ISQI)* joined forces in 2004 with experts from Austria and Switzerland to create a company-specific certificate entitled “iSQI Certified Professional for Requirements Engineering”.

Two years later, a decision was taken to draw up an independent, internationally recognised certification programme modelled on and compatible with the concept of the *International Software Testing Qualifications Board (ISTQB)*. The result was the establishment of the IREB Certification System for the field of requirements engineering. On 24 October 2006, international experts from the fields of business, research and education gathered in Nuremberg with specialists from training companies to form IREB.

The importance of RE for system development

In the 1990s, the Standish Group shocked the entire software development community with its Chaos Report. In their test of software projects from 1994, the report authors found that 30 percent of all projects had failed, that 53 per cent had had time and cost overruns, and that some of the projects had not even been completed to the satisfaction of the customers. By 2006, the picture had brightened considerably. Failed projects had decreased to fewer than 20 percent of the total, and projects that had pushed time, costs or customers beyond the limit had fallen to four per cent of the total. Jim Johnson, Chairman of the Standish Group, believes that one reason for this positive trend is that requirements are now communicated more clearly. Errors in analysis are therefore the main cause of insufficient software development. Numerous studies show that about 60 per cent of the errors in system development projects originate in the RE stage (cf Boe81]). However, most mistakes are not detected until after systems are in place. People simply rely on the quality of the RE document. If anything is missing, they simply add it through interpretation and this is where costs really start skyrocketing. The later in a development project an error in requirements is remedied, the higher the associated costs. If discovered at the analysis

stage, errors can be taken care of relatively cheaply. By the programming stage, however, the cost of doing so increases 20-fold and by the acceptance stage, 100-fold (cf [Boe81]). What better reason could there be for investing more time in analysis? Analysis is the key to the successful execution of a project. System requirements must be recorded in full and without error. Potential risks must be detected and mitigated to the greatest extent possible. Only then can a project be guided to success efficiently and without elaborate change processes.

One question remains. Why did it take RE until recent years to draw so much attention if it has been an established and known discipline since the mid-1990s? One major reason is the professionalisation in software engineering in and of itself. The broad-based integration of object-oriented programming in the late 1990s shifted the focus strongly toward writing efficient source code and rendered this discipline more professional. The resulting software, however, often had quality defects.

This problem was addressed in a second step by shifting the focus to testing and quality control. Professional testing and the build-up of pertinent expertise have been everyday concerns in software production since the start of the new millennium and will continue to be in the future. With quality control and the introduction of metrics, most of the software tested and created now can be shown to comply with the specification. But substantial defects come to light as soon as software is put to productive use. The fact is most defects are within the specification. The loss of content and quality therefore occurs during the transition from user needs to the outcome of software specification. There are two main determinants of whether a company or team achieves a successful transition:

- their selection of the appropriate process and
- the methods and techniques used in RE.

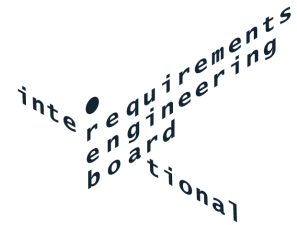
IREB is concentrating on the second factor and pursuing the goal of professionalising RE in a manner similar to what ISTQB did for testing. In these efforts, IREB concerns itself mainly with RE for software products, naturally also considering the system view, which in general can hardly be separated from RE. IREB has developed its syllabus for becoming a “Certified Professional for Requirements Engineering” (CPRE) for this purpose.

The hard road travelled to establish this certificate

Many business and theoretical experts agree that establishing a certificate is a suitable way of standardising necessary knowledge and practical experience in an engineering field and making it available to the public while making the given field more professional in the process. To be successful, a certificate must meet the following requirements:

- The certificate must embody broadly substantiated knowledge and recognised *best practices*.
- The certificate must be propagated internationally.

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- The body vouching for the certificate must be made up of a diversity of experts from business, research and education. This body must act independently and impartially with respect to economic or personal interests.
- The certificate must be able to be integrated clearly in an overall concept for certificates that already exist.
- The syllabus and test must satisfy a high quality standard.

Meeting all these requirements is no mean task. The great effort and dedication of the people involved in creating a successful certificate are not apparent from the certificate, nor is the difficult road taken to establish it. In its requirements, IREB gave top priority to quality content and neutrality from the outset. It took the approach that high quality work results arrived at impartially would gain international recognition. The original nucleus of IREB boasted three internationally renowned professors, five consultancies in the field of RE that were also internationally respected, and three representatives from the IT industry. All these board members were from Germany, England, Switzerland or Austria. The creation of the certificate involved a variety of difficulties. The three highest hurdles proved to be the availability of the members, establishment on the market as an internationally recognised team and marketing for IREB. IREB is firmly committed to quality content and neutrality. Neutrality is assured by the composition of IREB itself from different sectors of industry, theoretical fields and training and further guaranteed by IREB's clear self-definition as an association with no commercial interests.

Each IREB member agrees to provide his or her work and knowledge to the association free of charge. These side conditions mean perforce that the IREB founding members have limited capacity available for actually working out the details of the certificate. The network of supportive volunteers who participated in the specific working groups of IREB to develop the syllabus and test proved valuable assets in this respect. International recognition remains a high hurdle, even though the original nucleus consisted of internationally acknowledged experts. In the meantime, further renowned experts have helped to give IREB a broader international orientation. The organisation is now represented on three continents. The efforts of IREB to create a viable certificate have definitely been crowned with success, as evidenced by the growing number of test participants. Since the launch of the certificate programme in 2007, the pool of test participants has grown strongly. The number of people sitting the test in the fourth quarter of 2008 had more than doubled compared to the same period the previous year. Thus far, 1,803 people have sat the test (546 in 2007 and 1257 in 2008). The largest number did so in Germany (52 per cent), followed by Switzerland (36 per cent) and Austria (12 per cent).

But certificates were also granted in other countries (e.g. Spain, Bulgaria and Malaysia). With an average pass rate of 75 per cent, 1,349 certificates have thus far been issued worldwide.

Structure and organisation of IREB

IREB distinguishes between personal and supporting members. Only personal members are entitled to vote. They decide on the direction of IREB and on issues of content. Personal members are preferably RE experts. In addition, IREB seeks to achieve a balanced mix of personal members hailing from the fields of business, research and education as well as representatives from countries active in the certification programme. IREB also explicitly welcomes the foundation of local boards in countries where the CPRE certificate is represented, although it does not make this step mandatory. If local boards are formed, IREB recommends that their members apply for admission as supporting or personal members of IREB. IREB does its content work in working groups that are formed to meet whatever current needs and work loads there happen to be at IREB. A personal member is always selected to run a working group. The most important working groups are as follows:

- Development of the Foundation Level Syllabus
- Test Questions and Exam for the Foundation Level
- Development of the Advanced Level Syllabus
- Test Questions and Exam for the Advanced Level
- Internationalisation
- Marketing
- Finances

The strategic thrust and work content of the working groups is defined and set in regular meetings of the IREB Steering Committee. The working groups then design and work out the content autonomously. As an organisation explicitly founded without any commercial interest of its own, IREB expects personal and supporting members to devote time to IREB activities by taking an active part in the working groups.

Even if IREB is an organisation with no commercial interests, funding is required to support the infrastructure and activities at IREB. Heading the list are infrastructure expenses for providing, operating and maintaining the electronic exchange and archiving media. Other key items are the expenses for creating marketing materials in coordination with the Internet site and for providing a support team to manage the certificate programme with certification organisations and training providers. Neither personal nor auxiliary members receive pay or compensation for expenses for their involvement in IREB. The incurred costs are covered mainly through the return flow of license fees from certification organisations.

In compliance with the requirements of ISO/IEC 17024:2003, IREB does not conduct the examtests itself. Instead, certification organisations are licensed to conduct the exam for earning the CPRE certificate. A portion of the exam fees that certification organisations collect from the candidate flow back to IREB as license fees. Along with certification institutions, IREB also collaborates with

training providers, who have devised appropriate training for becoming a “Certified Professional for Requirements Engineering”.

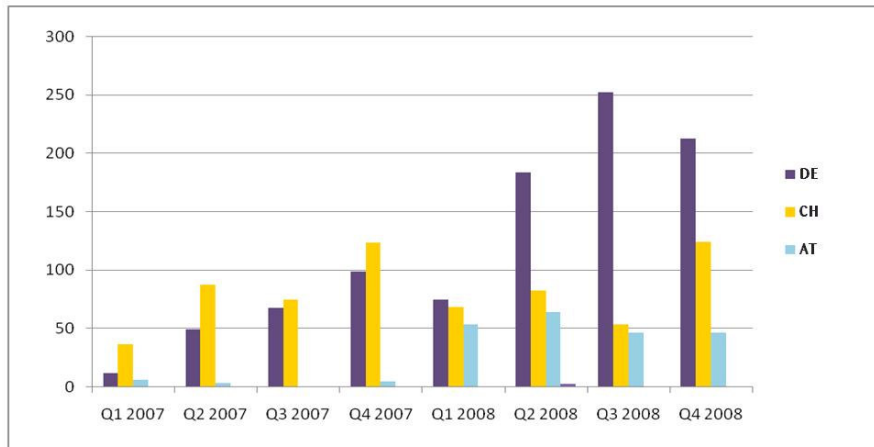


Figure 1: Trend in certification figures since 2007.

Organisation and collaboration with contractual partners

Figure 2 shows the setup for collaboration and the allocation of responsibilities for institutions involved in certification. IREB has the responsibility of devising a syllabus, drawing up the test questions and defining the exam procedures. Based on this syllabus, interested training companies can devise training courses to prepare people for certification as “Certified Professionals for Requirements Engineering”. The test itself is taken at a certification body that has entered into a corresponding contract with IREB. If the participant passes the test, they receive the certificate from the certifying body. Each country has at most two certification bodies. The International Software Quality Institute (iSQI) serves as certifying body for Germany, Future Network for Austria and Swiss Association for Quality (SAQ) for Switzerland. The Malaysian Software Testing Board (MSTB) serves as certifying body for Malaysia and parts of the pacific area. Additionally iSQI conducts certification internationally in the United States, India, Israel and the Netherlands.

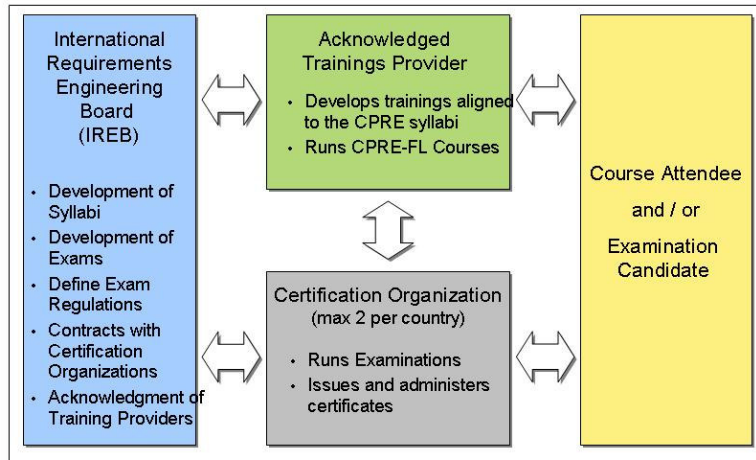


Figure 2: Structure and allocation of responsibilities in CPRE certification.

IREB certification model

The certification model for becoming a “Certified Professional for Requirements Engineering” has two levels.

The *Foundation Level for CPRE* covers the motivations for establishing professional RE and aids in concept formation and in distinguishing this field from others. It delves into the fundamental characteristics and the interplay of methodological approaches such as the means for rendering textual and graphical descriptions or techniques in documentation and data collection. In addition, the motivation and importance of RE is emphasised, an aspect often neglected in textbooks. For practical RE, mere knowledge of the tools and methods is not enough.

The *Advanced Level* will probably be available in early 2010. It will be modular in design to address the different RE target groups with mutually complementary modules. It will focus on and address different professional profiles, from business analyst in data collection to administrative RE management. The requisite knowledge and necessary practical experience will be defined to help in successfully filling out the professional profiles.

The syllabus for the Foundation Level was intentionally designed to encompass both the theoretical basics of all RE disciplines as well as their application in industrial practice. It is based on requirements engineering in the *Software Engineering Book of Knowledge* (SWEBOK) and on scientific and practical experience of the members of IREB. Special attention was also paid to aligning the content with other known software engineering syllabuses, e.g. ISTQB, IPMA, or international standards (DIN ISO and IEEE). Two other basic conditions besides the ones above had to be met in designing the syllabus:

- *Domain-independent RE:* The content must be applicable to all RE domains and not confined to a specific domain such as security-critical systems or classic information systems.
- *Neutrality with respect to established procedural and process models:* The concepts learned had to be practically useable in all process models of software development processes such as waterfall, Rational Unified Process or Scrum. An explicit goal was not to emphasise any particular process for RE.

Outlook for “CPRE Advanced Level”

A new version of the Foundation Level scheduled for release in the third quarter of 2009 is already coordinated with the overall concept for the Advanced Level. The modular design of the Advanced Level addresses the fact that not every sub-area within the far-ranging RE disciplines are relevant for every occupational group that exists. Specialisations are necessary but within the framework of a coordinated overall concept. Figure 3 presents an example of what the structure of the Advanced Level Certificate will be.

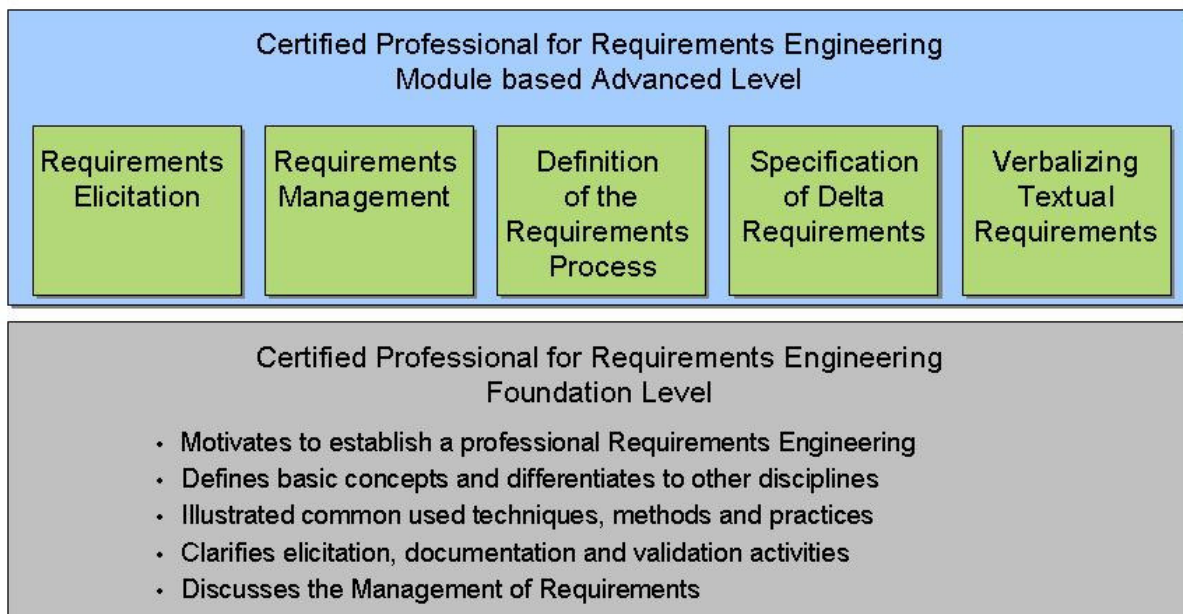


Figure 3: Modular structure of the CPRE Foundation & Advanced Level.

Not all modules will be released at the same time. The order depends on market needs as indicated by members of the IREB. The Board discusses and decides which modules should be implemented in the scope of a consistent overall concept. The IREB organisational structure accommodates this method of creating a professional, market-oriented and coordinated pool of knowledge. If a given industry detects a definite RE need, e.g. the medical technology sector as

regards FDA compliance for medical equipment, IREB provides a platform for formulating this need. An advanced level module, clearly embedded and distinguished from other existing modules, can then be developed to convey the required knowledge.

The IREB calls on advocates of such RE knowledge pools to become actively involved in IREB and to devise a qualification model for the knowledge pool.

Ultimately, companies also derive a benefit from a qualified continuing training programme, namely, well-trained employees, one of the most important factors in business success. Many companies have already recognised this advantage and expressed a desire for having excellent, mutually compatible training paths on the market.

Embedding the CPRE in other certificate models

The list of available certificates is cluttered and constantly changing. Certificates can basically be divided into three types:

- Company-specific certificates
- Intercompany but proprietary certificates
- International and independent certificates following the rules of ISO/IEC 17024:2003

Company-specific certificates are only of value if the company backing them has an established reputation on the market and follows certain ethical principles. Basically speaking, any company can establish a certificate of this kind and offer it to the market. The market decides the value of the certificate. Usually, no attempt is made to coordinate a certificate with other certificates because the company behind a given qualification programme is pursuing an economic objective. Prime examples are the recognised and valuable certificates issued by Cisco, Sun or Microsoft.

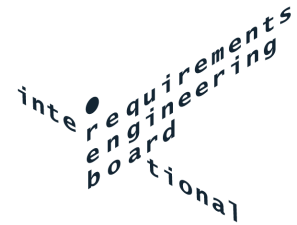
Intercompany yet proprietary certificates are recommended only under certain conditions. On closer perusal, these certificates frequently turn out to be associated with a group of companies with clear economic interests, which use a certificate as a tool and means of marketing.

The third group of certificates that comply with the rules of ISO/IEC 17024:2003 make a clear distinction between the following three responsibilities in independent legal bodies:

- Defining the syllabus and creating the test for the certificate
- Conducting the test
- Training based on the certificate syllabus

Certificates that follow these rules are definitely being recommended. IREB is committed to setting up the certificate in accordance with the requirements of ISO/IEC 17024:2003. The syllabus is also coordinated with other certificates that follow these same rules. There is a close interrelationship between the field of RE and the disciplines of project management, testing, and software architecture. Appropriate certificates are available in all these fields. The best-known certificates

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for project management are those issued by the *Project Management Institute (PMI)* and the *International Project Management Association (IPMA)*. The most widely recognised certificates for testing are those offered by the *International Software Testing and Qualification Board (ISTQB)* and for architecture, those provided by the international *Software Architecture Qualification Board (iSAQB)*.

In developing the syllabus for becoming a “Certified Professional for Requirements Engineering”, IREB drew a careful distinction between this certificate and others. With different certification models, a company can define professional profiles in a career model and describe the attainment of a certain career level in a given professional profile in terms of a quantity of certificates. Thanks to the coordinated syllabuses underlying the certificates, the training content is concurrently standardised. Training companies base their training offerings on these syllabuses, thus doing their part to standardise terminology, techniques and methods.

Certification companies in the various countries consider these trends in qualification. One example of an appropriate combination of qualification measures is the qualification model entitled *Quality Assurance Management Professional (QAMP)* sponsored by the *International Software Qualification Institute (ISQI)*. Certificates of ISTQB and IREB are contained in the QAMP qualification model as modules. In coordination with companies, the QAMP qualification model provides qualification paths that can be configured for specific professional profiles and that are also coupled with verified practical experience. Companies such as Hewlett Packard have successfully incorporated and integrated this construct into their human resource development concepts.

Literature and Links

[IEEE04] IEEE, Software Engineering Body of Knowledge, 2004 , cf: www.swebok.org

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