Master Thesis

Project Management

Standards and Approaches

A systematic Comparison

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Abstract

Due to a sharp growth of overall project economy, also standardization in project management gain in importance. This is mainly caused by the high degree of interconnection between different organizations, but also by the strong concentration of companies to its core competences. Project management standards support activities concerning project management with uniform procedure models.

Common used standards like PRINCE2, PMBoK guide, IPMA Competence Baseline or DIN 69901 support efficient execution of a project. Shorter development cycles, an increasing complexity of projects and a high degree of interconnection within and among organizations make a uniform procedure model preferable.

The standardization models, provided by different organizations, differ considerably from each other. Therefore, a detailed comparison has been carried out. The aim of the master thesis is to show up these differences by comparing each standard to a previously developed criteria matrix. The criteria matrix includes aspects of project management standardization and aspects of project requirements necessary to gain a higher degree of project performance.

This thesis communicates also a knowledge base of project management and covers possibilities, methods and tools for a systematic handling of projects.

Kurzfassung

Durch einen starken Anstieg durchgeführter Projekte in der Wirtschaft, hat auch die Standardisierung im Projektmanagement an Bedeutung gewonnen. Die Ursache dafür liegt einerseits an der starken Vernetzung zwischen den Unternehmen, andererseits an der starken Konzentration auf deren Kernkompetenzen, um im Markt konkurrenzfähig zu bleiben. Projektmanagment Standards unterstützen Aktivitäten des Projektmanagements mit einheitlichen Vorgehensmodellen.

Weit verbreitete Standards, wie PRINCE2, PMBoK, IPMA Competence Baseline oder DIN 69901 unterstützen eine effiziente Projektabwicklung. Kürzere Entwicklungszeiten, steigende Komplexität der Projekte und ein hoher Vernetzungsgrad zwischen und innerhalb der Unternehmen machen einheitliche Vorgehensmodelle notwendig.

Modelle zur Standardisierung, die von verschiedenen Organisationen entwickelt wurden, unterscheiden sich deutlich voneinander. Daher wurde ein systematischer Vergleich durchgeführt. Im Rahmen der Masterarbeit werden diese Unterschiede aufgezeigt, indem den Standards eine vorher entworfene Kriterien Matrix gegenübergestellt wird.

Die Kriterien Matrix setzt sich einerseits aus Aspekten der einzelnen Standards, andererseits aus Kriterien der unterschiedlichen Projektanforderungen zusammen.

Die Masterarbeit vermittelt zudem eine Wissensbasis über Projektmanagmenet und deckt Möglichkeiten, Methoden und Werkzeuge zu einer systematischen Projektabwicklung ab.

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List of Abbreviations

ANSI	American National Standard Institute
APM	Association for Project Management
BAC	Budget at Completion
CAPM	Certified Associate in Project Management
CCTA	Central Computer Telecommunications Agency
CPM	Critical Path Method
DIN	Deutsches Institut für Normung
DNA	Deutscher Normenausschuss
EAC	Estimate at Completion
ERG	Efficiency and Reform Group
EVA	Earned Value Analysis
GAPPS	Global Alliance for Project Performance Standards
GPM	Deutsche Gesellschaft für Projektmanagement
ICB	IPMA Competence Baseline
IPMA	International Project Management Association
ISO	International Organization for Standardization
IT	Information Technology
ITPM	IT Project Management
M_o_R	Management of Risks
MSP	Managing Successful Program
NCB	National Competence Baseline
OPM3	Organizational Project Management Maturity Model
P2MM	PRINCE2 Maturity Model
P3M3	Portfolio Program and Project Management Maturity Model
PACE	Property Advisors to the Civil Estate
PERT	Program Evaluation and Review Technique
PfM	Portfolio Guide
PgMP	Program Management Professional
PM	Project Management
PMA	Projektmanagement Austria
PMBoK	Project Management Body of Knowledge

PMI	Project Management Institute
PMI-ACP	PMI Agile Certified Practitioner
PMI-RMP	PMI Risk Management Professional
PMI-SP	Certified Associate in Project Management
PMO	Project Management Office
PMP	Project Management Professional
ROI	Return on Investment
RUP	Rational Unified Process
SE	Systems Engineering
Spice	Software Process Improvement and Capability Determination
SPM	Swiss Project Management Association
TBA	The Buying Agency
TCPI	To-Complete Performance index
TCQ	Total Cost of Quality
VDA	Verband der Automobilindustrie
WBS	Work Breakdown Structure

1 Introduction

An increase of complexity in fast changing market conditions lead to a massively increased pressure on cost savings and competition to organizations. Adapting to these changes, more and more organizations tend to introduce project management (PM) as a key element in existing organizational units.

Organizations see the general benefits of PM in the improved control of projects, increased transparency and a more effective communication to increase competitive ability. An internally subordinate PM-concept increases competences of team members, reduces the variety of methods and tools for PM and regulates project performance through standardized procedures (Pantelic, 2008, p.1).

Nowadays, projects are performed in almost every medium and large organization. Problems elaborated in projects are becoming more complex and have to be solved in shorter time periods. To accept this challenge specific structures have to be introduced. An appropriate PM-system provides supporting functions to satisfy projects requirements. Also standardization in PM supports successful completion of projects. Like in other management disciplines also in PM comprehensive standardizations are supposed to provide a common language to describe similar circumstances.

As the dimension and the complexity of projects increases also probability of failure will raise. Especially large-scale IT projects show an extremely high failure rate. According to a study of the Technische Universität München only 43% of all Information Technology (IT) projects in the last three years were successfully completed. In 48% of all technical projects duration and costs were exceeded or the project results achieved were different as planned (Herbholzheimer & Lüthi, 2008, p.14). In order to prevent such happenings, standardization provides common and proved management tools for a successful performance in projects.

An increasing importance of PM in nearly all business areas and organizations, led to an increasing number of independent standardizations. These standards are equipped with tools, methodologies, procedure models and PM-approaches to enhance handling of projects.

Standardization has a high impact on overall economy. Standards create efficiency in production processes and provide criteria for quality control. Furthermore standards give more security to manufacturers regarding legally aspects (Rosenkranz-Wuttig, 2009, p.321).

1.1 Objective

In the meanwhile PM is regulated by multiple standards and norms. Due to a high influence of standards on overall PM and the high impact of their interfaces to other organizational structures, a comparison between these approaches is carried out. Therefore, the primary goal of this thesis is to provide an overview of the actual approaches in PM.

This master thesis also aims on facilitating the identification of best practices and methods, processes and operations to achieve higher quality, greater efficiency and effectiveness in the use of PM standards.

1.2 Proceeding and Structure of the Thesis

At the beginning of the work, a comprehensive literature research was carried out to get a basic understanding of PM. Therefore different sources like journals, books and other databases were investigated. Within the literature study the different PM standards were identified and investigated. After a clear breakdown and demarcation of PM standards, PM associations were introduced.

The located standards were the starting point for the creation of a systematical comparison. Based on certain characteristics, which are shown by the different PM approaches and project characteristics, a detailed criteria matrix was developed. In the following comparison, major differences, commonalities and procedures of each standard were highlighted. Furthermore, different methods and tools, proposed by each standard are shown. The direct confrontation illustrates also the treatment of different PM aspects in each project phase.

In Figure 1 the basic structure of this thesis is depicted. In the theoretical research four central universal PM standards were identified and analyzed. Criteria and classes were developed to reflect basic attributes and aspects of PM. The comparison is based on a detailed criteria matrix and gives a comprehensive

overview on overall PM standardizations. Specific PM standards which are not suitable for every project are not regarded in the comparison.

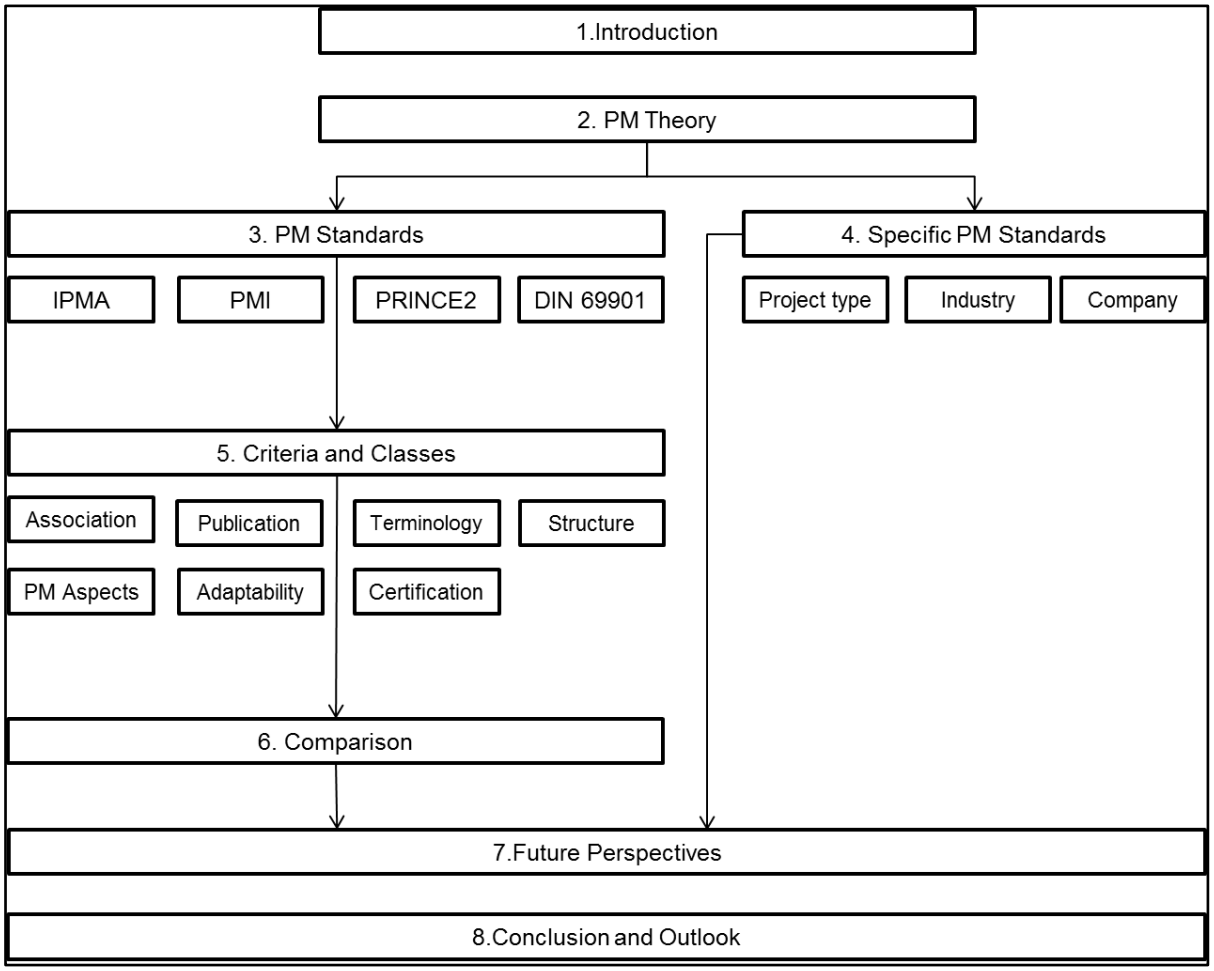

Figure 1: Structure of the Thesis

2 Introduction to Project Management

Projects were evolved already in early civilizations. Examples might be the construction of the great pyramid of Giza or the Great Wall of China. The management of these projects was based mostly on informal techniques. Nowadays, as projects became more complex and people from different fields of expertise were involved, actual management systems had to be rethought. Besides problems in logistics and the high time pressure, also interdisciplinary complications led to a totally new structuring of organizations.

“The Manhattan Engineering District Project” from 1941, which purpose was the development of the first atomic bomb, and NASA´s “Apollo” project at the beginning of the sixties were considered as the beginning of modern PM (Litke, 1995, p.21).

With the Program Evaluation and Review Technique (PERT) and the Critical Path Method (CPM) new planning methods were developed. Other publications dealing with PM in the sixties led to a distribution of new PM approaches in the industrial sector (Litke, 2005, p.7).

The characteristics of modern projects make a high demand on organizations, in their effort of planning, executing and controlling projects. Projects have predefined constraints and objectives, a high degree of innovation and therefore projects are fraught with higher risks than day to day operations. The high degree of complexity in projects demands flexibility and direct communication. Traditional line organizations with their long time objectives, vertical communication channels and their rigid structure cannot meet these specified requirements anymore. To accept the challenge collaboration across several departments becomes necessary.

PM can be seen as a leadership style to master successfully complex problems in inter-functional and inter-sectorial environments. Nowadays projects are a common part of our business life. In the last decades the relative young discipline of PM gain in importance. According to Like (2005, p.7) the number of projects in companies rises from year to year, dimensions and prestige of those projects increase and more and more employees are involved in one or more projects. Projects change our environment in nearly all aspects of business.

Standardization in PM enhances capabilities of carrying out projects by providing a knowledge base and required management processes. Over years, different standards have been developed from different organizational bodies like the International Organization for Standardization (ISO) or the American National Standard Institute (ANSI). Also PM associations like the Project Management Institute (PMI) and the International Project Management Association (IPMA) were established. The aim of these organizations is to ensure an internationally consistent approach to PM with certain procedure models and common rules. Subsequently, basic terminologies in PM are explained, and the standards are broken down in detail.

2.1 Terminology

Before going into further detail on standardization, following basic concepts of PM are explained. From general definitions of a project and PM, specific characteristics are derived.

2.1.1 Project

The aim of a project can be restructuring of organizations, development and implementation of IT systems and new products, construction of a new airport, development of new tools or new machinery and even more. All this examples show performance generation with project character.

The term “project” is derived from the Latin word “proicere” which participle “proiectus” has the meaning “throwing forward”. Basically, it is referred to the time dimension and describes an intention lying in the future. In literature a series of definitions for the term “project” are used.

Jacoby (2010, p.6) defines a project as a *…”intention limited by **time** for creation of a **one-time** product or service”.*

This is a very generic definition and does not regard certain characteristics which a project may have. Turner (2009, p.2) points out the different aspects and constraints of a project and provides a prescriptive definition:

*“A project is an endeavor in which human, financial, and material **resources** are organized in a novel way to undertake a **unique scope** of work, of given*

*specification, within **constraints** of cost and time, so as to achieve beneficial change defined by quantitative and qualitative objectives".*

This approach highlights resources and constraints of a project. One of the first definitions for a project was provided by Steiner (1969, p.489) and is even more detailed:

*"A project is an **organization** of people dedicated to a specific purpose or objective. Projects generally involve large, expensive, unique, or high risk undertakings which have to be completed by a certain date, for a certain amount of money, with some expected level of performance. At a minimum, all projects need to have well defined objectives and sufficient resources to carry out all the required tasks."*

Comparing these definitions several commonalities and differences can be derived. Therefore, within this thesis, a project can be identified by the characteristics showed in Table 1:

A project	has a clear defined or definable objective,	(Haberfellner et al., 2002) (Keplinger, 1991) (DIN , 2009)
	has a defined start and a defined end (restriction of time horizon),	(Jakoby, 2010) (Turner, 2009) (PMI, 2008) (Caupin et al., 2006)
	is in certain circumstances unique (innovative, creative, unique, comprehensive) and therewith fraught with risk,	(Haberfellner et al., 2002) (Turner, 2009) (PMI, 2008)
	is limited to a certain amount of resources (financial, personnel, materials) to achieve its goals,	(Steiner, 1969) (Turner, 2009) (Caupin et al., 2006) (DIN , 2009)
	is commonly extensive and complex,	(Haberfellner et al., 2002) (Keplinger, 1991)
	involves several experts from different fields of expertise,	(Haberfellner et al., 2002) (Keplinger, 1991)
	has a specific structure and organization.	(Steiner, 1969) (Keplinger, 1991) (Murray et al., 2009) (DIN , 2009)

Table 1: Characteristics of a Project

2.1.2 Project Management

The concept of PM is aligned to solve temporary and inter-sectorial tasks. It reduces effort of managerial functions by handling projects. There is more than one definition of PM. One of the first attempts to define PM was Oisen (1971, p.12):

"Project Management is the application of a collection of tools and techniques (such as the CPM and matrix organization) ***to direct*** *the use of diverse resources toward the accomplishment of a unique, complex, one-time task within time, cost and quality constraints. Each task requires a particular mix of these tools and techniques structured to fit the task environment and life cycle (from conception to completion) of the task."*

This definition includes some of success criteria and is still valid for today. Keplinger (1991, p.9) defines PM as follows:

"Project management is understood as a ***holistic leadership****, which aims at ensuring project success. Therefore project management contains all the activities necessary for projects like planning, monitoring, controlling, organizing, personnel- related activities and activities concerning interfaces to the project system."*

PM is thus a style of leadership to manage activities related to a project. Haberfellner (2002, p.5 ff.) classifies PM as an integrated supporting method of Systems Engineering (SE).

The SE-Philosophy supports the problem solving process with Systems Thinking and a general Action Model.

The focus of SE is the problem solving process, which is divided into two parts (Figure 2):

- "Systems Design" creates the content of the Problem Solving Process (e.g. Requirements clarification, problem classification, guidance, searching for solutions and decision making).
- "Project Management" clarifies organizational aspects of the Problem Solving Process (e.g. Allowance of duties, responsibilities and competences, organization of decision making processes or the implementation of decisions made).

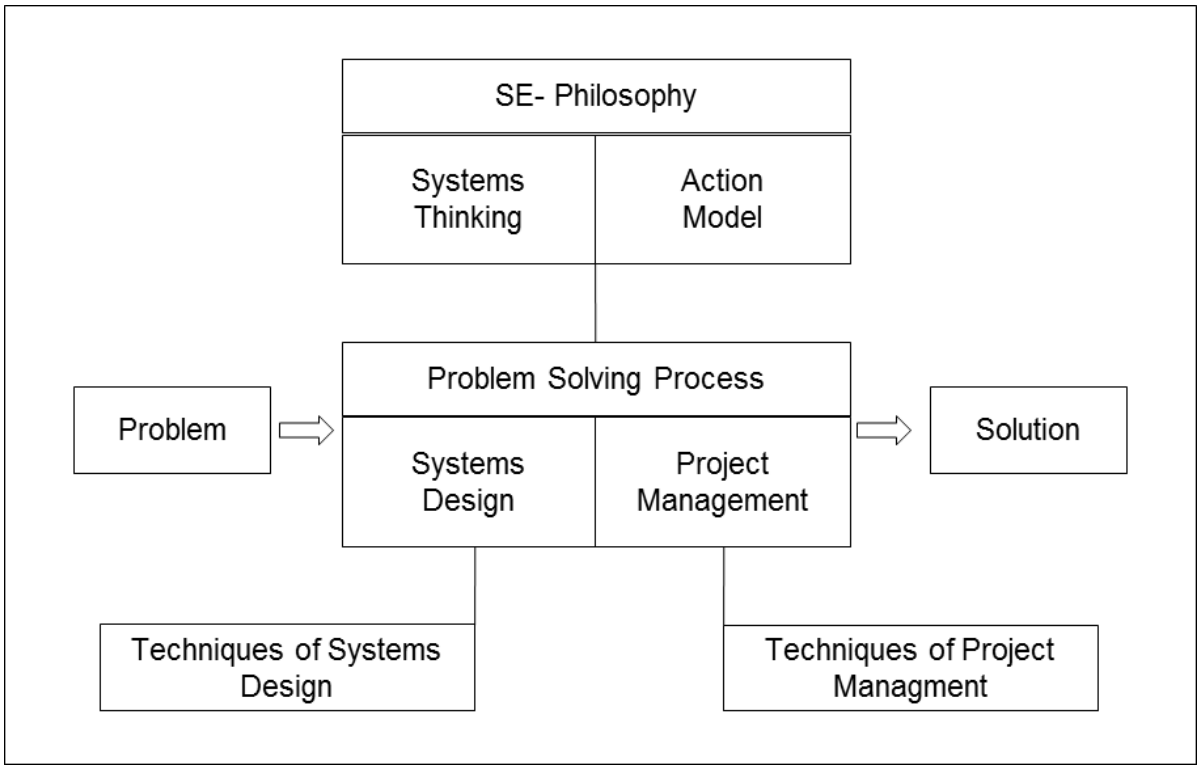

Figure 2: Systems Engineering (Haberfellner et al., 2002, p.1)

2.1.3 Project Life-cycle

A project life-cycle describes a complete period to realize projects until the usage of projects results. Therefore, the project life-cycle starts with the project idea and a first draft, followed by the development and creation of projects results, until the closure of the project (Motzel, 2010, p.124).

Since projects are elaborated in a clear defined period, they can be divided into phases. Most projects go basically through a same life-cycle which can vary according to the dimensions of a project. In literature a variety of phase models are available. Lester (2007, p.37) provides one of them and categorizes the life-cycle in the following phases:

- Concept: Basic ideas, business case, statement of requirements, scope;
- Feasibility: Tests for technical, commercial and financial viability, technical studies, investment appraisal, etc.;
- Evaluation: Application for funds, stating risks, options, Total Cost of Quality (TCQ) criteria;
- Authorization: Approvals, permits, conditions, project strategy;

- Implementation: Development design, procurement, fabrication, installation, commissioning;
- Completion: Performance tests, hand-over to client, post project appraisal;
- Operation: Revenue earning period, production, maintenance;
- Termination: Close-down, decommissioning, disposal.

Another, more generic phase model, has been developed by Pinto and Slevin (2008, p.170 f.). In Figure 3 is shown the division of a project into four project phases along project life-cycle. “Conceptualization Phase” is the initial project phase, within primarily objectives are specified. In the “Planning Phase” the way how to achieve these defined objectives is determined. Planning activities comprise, among others, budgeting, scheduling, and the allocation of resources. In the “Execution Phase” the planned work is performed and monitored. The “Termination Phase” represents the last phase of a project. Once, projects results are produced the project has to be closed. Therefore, resources are released and the achievements of the project are transferred to the client. Additionally to the four project phases, Figure 3 shows the course of organizational effort, which increases with project maturity and decreases quickly towards the end of a project.

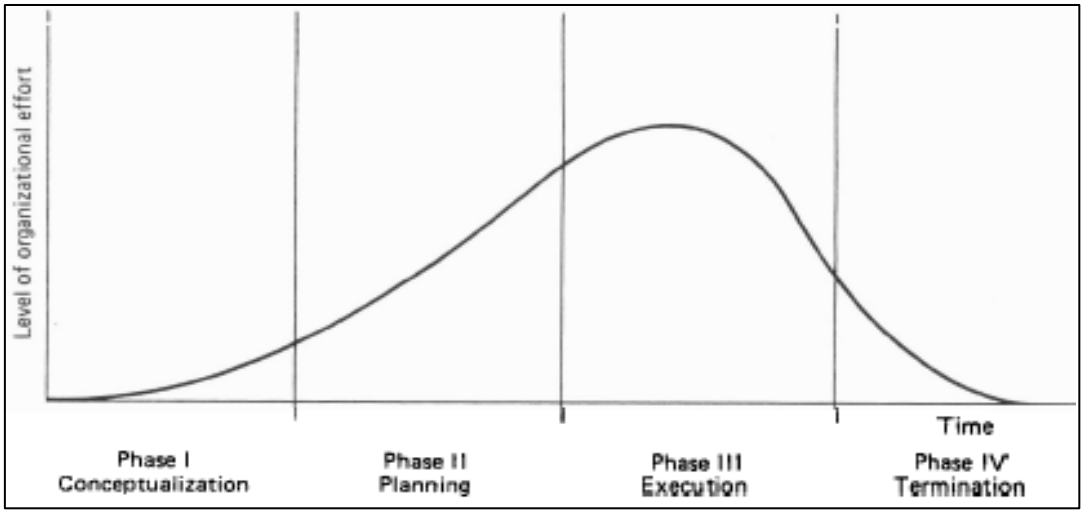

Figure 3: Project Life-cycle (Pinto & Slevin, 2008, p.171)

Out of this generic life-cycle description certain characteristics can be derived. Risk, uncertainty and stakeholder influence are higher at the beginning of a project and decreases with maturity of a project. Moreover, influences on projects output are higher at the beginning of the project and decreases over time due to the rise of the

cost of change towards project completion (PMI, 2008, p.17). Obviously, all phases have a strong influence on project success.

2.1.4 Project Success

Reasons for carrying out projects are to deliver desired values to the customer. Normally, a project is successful, when the output corresponds to the planned objectives. Motzel (2010, p.164) defines project success as follows:

"Completion of contractual agreed deliverables and services in a project in the requested quality and quantity regarding the financial and timely framework under considerations to the approved supplementary requests. Moreover, stakeholders have to be satisfied with the results and have to evaluate the project as positive and successful."

Basically, a project is seen as successful, when four criteria are fulfilled. According to Pinto and Slevin (2008, pp.169-70) these four criteria are achieved, when the project

- comes in on-schedule (**time criterion**),
- comes in on-budget (**monetary criterion**),
- achieves basically all the goals originally set for it (**effectiveness criterion**),
- is accepted and used by the clients for whom the project is intended (**client satisfaction criterion**).

Management of projects involves several areas of activity which are depicted in Figure 4. Those areas are derived from an integrated view of the PM-sub processes like planning, monitoring and controlling and the fundamental project objectives like effort, time and results, which is known as "The Magic Triangle" (Motzel, 2010, p.7).

Every corner of the triangle represents a constraint and cannot be changed without affecting the others. The **time** constraints represent the defined time for the project. The **effort** constraints represent all resources necessary to carry out the project. The **result** constraint highlights result orientation and determines the scope of a project.

Even though, managing projects involves in practice a lot more aspects, "The Magic Triangle" shows basic elements how to lead a project to a successful outcome.

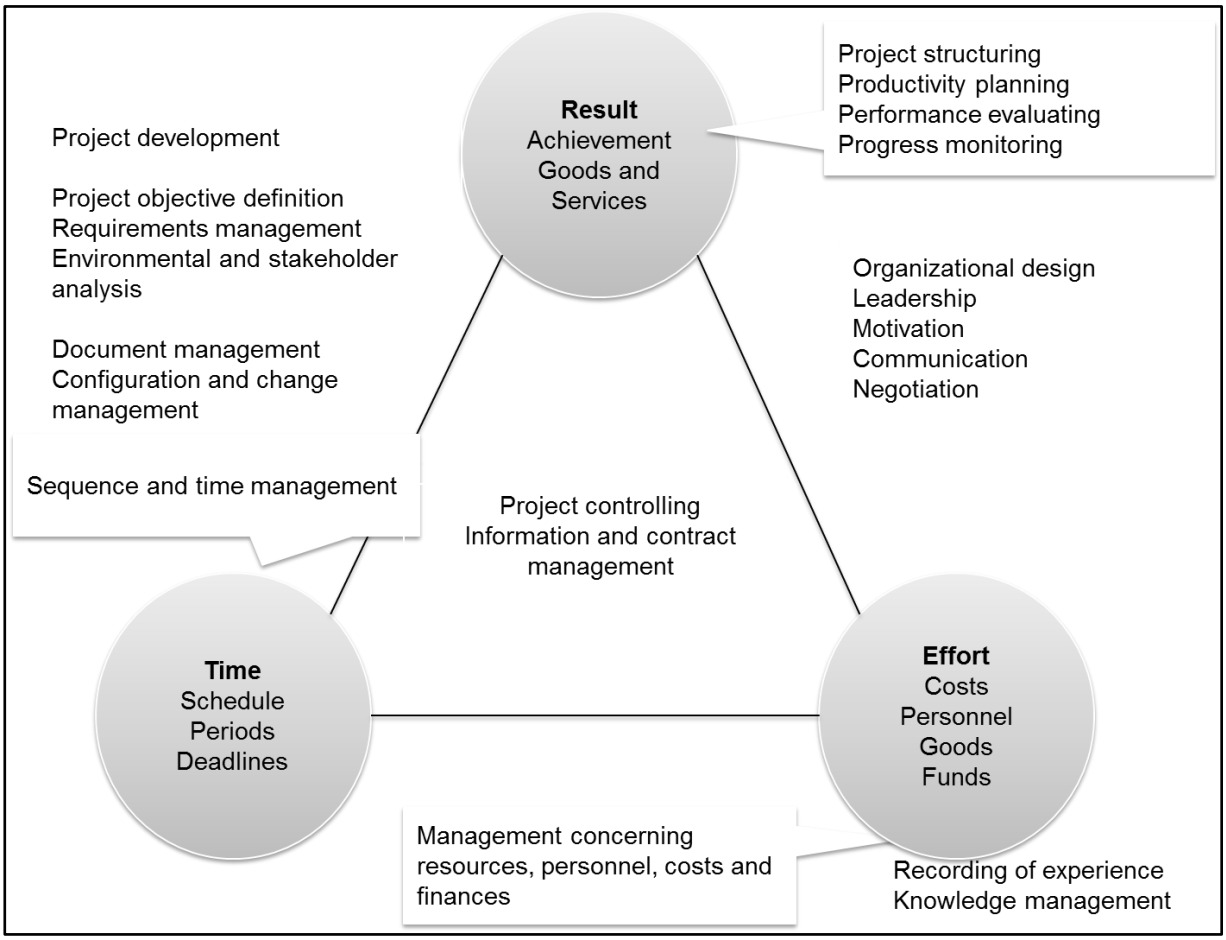

Figure 4: The Magic Triangle of Project Management (Motzel, 2010, S. 8)

2.2 Project Organization within Operational Structures

Since projects are unique and are not in line with the general organization, another style of management is needed. While operations are ongoing and produce repetitive results, projects are temporary and have an end. The business environment, where projects are executed, is supported by operational work. Therefore, the interaction between operational departments and the project team can be significantly high in the course of a project. Interfaces between projects and the core organization have to be established to create a balancing environment (PMI, 2008, p.22 f.).

In organizational theory four basic structures are defined (Marko, 2012, p.410f.):

Single-line system: This approach requires an explicit superiority and subordination of authorities. Like this, every employee has exactly one superior. In huge

hierarchies, this can lead to over organization, by introducing long and ponderous procedures.

Multiple line system: In contrast to a single-line system, several instances are summarized by one authority. The central task of management is distributed on several instances. The aim of this organizational structure is that the employee is able to solve his problems directly with a specialist. Due to direct communication, the upper management level is released. A negative effect can be a problematic dissociation of tasks, responsibilities and competences, contradictions of instructions and a high number of managers.

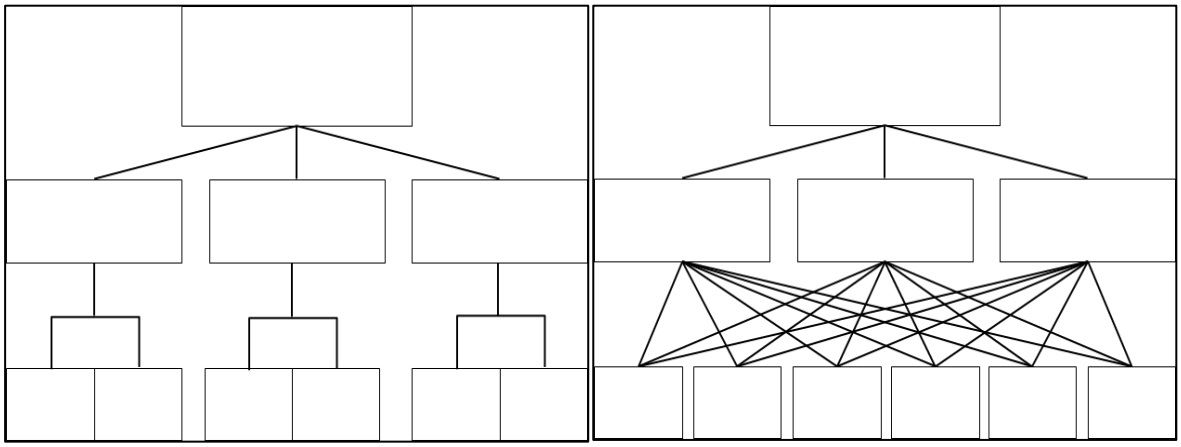

Figure 5: Single-line system and multiple line system (Marko, 2012, p.410f.)

Line and staff organization: It is a derived form of traditional line systems, where general management is assigned to a department for supporting functions. It combines the advantages from single-line systems and multiple line systems by connecting leadership and specialized knowledge in one organizational form.

Matrix organization: Within a matrix organization the function of leadership is divided into functional and object- oriented interfaces. Due to direct communication channels and interfaces, multidimensional integration and coordination can be achieved, which can be useful by realizing complex tasks. Unfavorable is the regulation on the interfaces, which can lead to over organization.

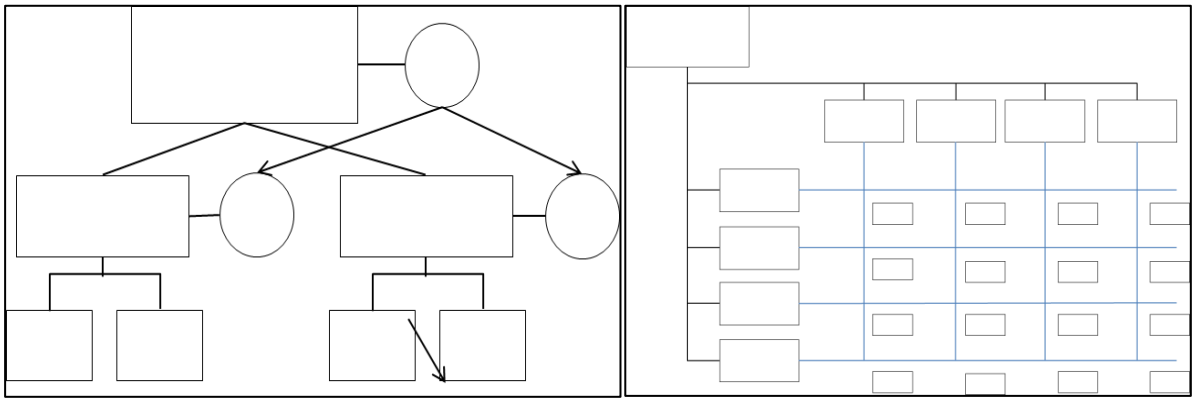

Figure 6: Line and staff organization and a matrix system (Marko, 2012, p.410f.)

These traditional organizational structures, used for PM, have rather a negative effect on project performance. Communication and cooperation between experts in different management levels can be achieved in a better way with a specified project organization. Project organization can be seen as a subtask in PM. Some basic shapes of project organization, regarding criteria like resource independency, autonomy towards corporate organization or project internal structure can be defined and combined individually. Fundamentally, the tendency from vertical towards horizontal organization increases with the degree of complexity and innovation within a project. Furthermore, project organization can be categorized concerning the number of stakeholders or goal orientation of a project (Marko, 2012, p.430ff.).

In-firm projects are performed with

- an influence project organization, where an employee is installed for coordination issues. He does not have management authority towards staff members, but only competences regarding coordination.
- a matrix project organization, within synergies between departments are developed by identifying routine activities. Therefore, project dimension is equally to the existing dimension and functional related competencies overlap with project oriented competencies. Project managers interact directly with other departments and are not controlled by functional managers. The project manager has a moderate to high level of authority.
- an independent project organization, where the project manager possesses also competences about budget and resources. Therefore, employees are released from their functional role and assigned to a certain project. This

organizational structure is particularly recommended for larger projects with a high degree of complexity and innovation.

External projects become necessary when tasks cannot be mastered by a company alone, due to lack of knowledge, high degree of complexity, risk or innovation. In practice, these projects are performed mainly within three forms of project organization (Marko, 2012, p.433ff.):

- Individual order organization: Unique orders of a project are assigned to external partners. The coordination of the task is carried out by the customer. This approach is only useful, when the task can be packed into individual orders and the integration into the whole project does not encounter difficulties.
- General contractor organization: The contracting authority concludes a corresponding agreement for an overall project with an entrepreneur. This entrepreneur inherits project management and overall responsibility.
- Consortial organization: Independent companies join together to perform a project. Therefore, a consortial contract is concluded, within all competencies and responsibilities are agreed.

Project work is mainly performed in teams. **Team organization** helps to overcome hierarchical structures and promotes horizontal communication. On one hand, it enhances autonomy, motivation and satisfaction of employees. On the other hand, complex tasks can be performed more efficient in collaboration of people with the desired knowledge. Therefore, costs can be reduced due to elimination of time consuming hierarchical procedures (Marko, 2012, p.435).

Projects can be implemented over a long time horizon and can have influence on strategic plans of the organization. In large-scale organization, where many projects are carried out, PM is governed by program and portfolio management (Caupin et al., 2006, p.13):

*“A **program** is set up to achieve a strategic goal. A program consists of a set of related projects and required organizational changes to reach a strategic goal and achieve the defined business benefits. A **portfolio** is a set of projects and / or*

programs, which are not necessarily related, brought together for the sake of control, coordination and optimization of the portfolio in its totality".

The following chapter is focused on people or institutions involved in project organizations.

2.3 Stakeholders

In every project several persons are involved. Along every project life-cycle identical roles are defined. Stakeholders are all persons or organizations associated to projects. Zambruski (2009, p.27) defines a stakeholder as…*" an individual representing any organization that* ***contributes*** *to,* ***benefits*** *from, or experiences an impact from a project (either directly or indirectly)".*

PMI (2008, p.23) differentiates between actively involved and affected stakeholders:

"Stakeholders are persons or organizations (e.g., customers, sponsors, the performing organization, or the public), who are ***actively involved*** *in the project or whose interests may be positively or negatively* ***affected*** *by the performance or completion of the project."*

As shown in Figure 7, stakeholders of a project can be classified into external and internal stakeholders:

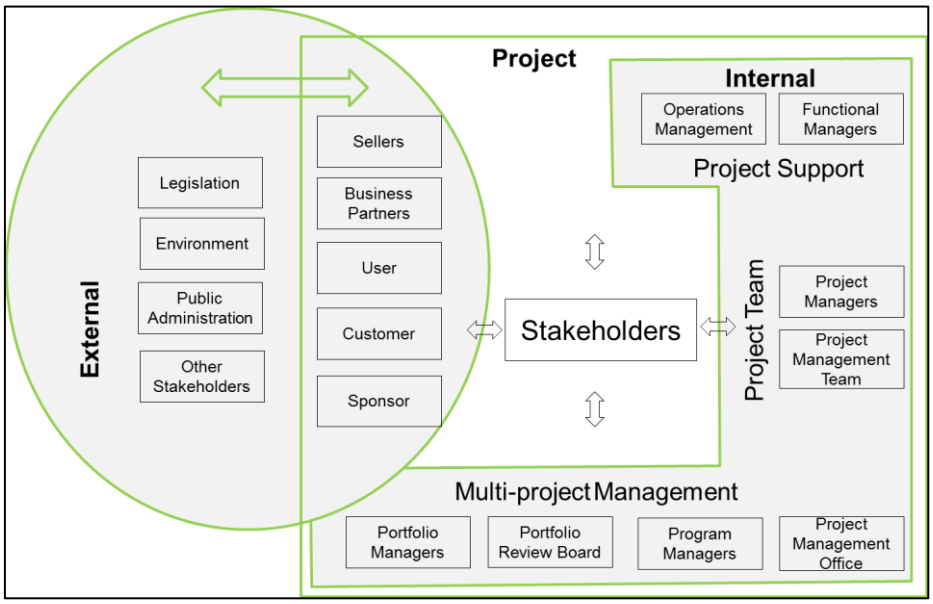

Figure 7: Stakeholders

External stakeholders are sellers, business partners, customers, users and sponsors. Sellers or business partners provide components or services for the

project. Usually, they work on a project with a contractual agreement. A person who benefits from projects outcome can be either a customer or a user. An individual who contributes to a project is regarded as a sponsor and provides financial resources. The sponsor promotes the benefits of a project and plays a significant role by authorizing the project. Also legislation, environment and public administration have strong influence on projects, but are not directly involved in the project itself (PMI, 2008, p.25). Depending on project characteristics, these stakeholders can be more or less integrated into projects activity.

Internal stakeholders are represented by the multi-project management, the project team and the project support. In large-scale organizations more projects run on the same time. Therefore, multi-project management is necessary. Portfolio managers provide high level control of a collection of projects or programs. The portfolio review board is a committee, whose people review each project for the Return on Investment (ROI), for the value of a project, risks and other attributes of a project. Program Managers manage correlated projects in a way to achieve benefits whose would not be available by managing them individually. The Project Management Office (PMO) is an organizational body for centralization and coordination of projects (PMI, 2008, p.25).

The project team is directly involved in project activities. Project managers manage stakeholder expectations. They are responsible to balance interests and to achieve project objectives. A project manager has to be flexible, has to have good judgment, strong leadership and negotiating skills and a solid knowledge about project management practices. The project team involves the project manager, a project management team and other persons who work for the project. A project team comprises experts from different fields and carries out the work of a project (PMI, 2008, p.26).

Project support comprises activities not directly related to the project, but may provide services, material or people to the project. Functional managers are responsible for ongoing work and have a management function in specific area of business, such as accounting, procurement or controlling. Operations Management is directly in contact with organizations result and may provide long term support for

projects. Operations managers have a management role in a core business area, such as design or manufacturing. (PMI, 2008, p.26 f.).

The interactions between all stakeholders are regulated by several PM standardizations whose are introduced and classified in the next chapter.

3 Project Management Standards

The discipline of PM requires expertise and high qualified people to handle specific situations in projects. Standards in PM provide the required knowledge, skills, tools and techniques, procedure models and best practices to solve problems related to the project. Even though, projects are unique, innovative and create something new, a lot of activities are reproducible. PM standards figure out these reproducible activities and provide approaches on how to manage projects.

According to the International Organization for Standardization (ISO) …"*a standard is a document established by consensus and approved by a recognized body that provides, for common and repeated use,* ***rules****,* ***guidelines*** *or* ***characteristics*** *for activities or their results aimed to the achievement of the optimum degree of order in a given context."*

Therefore, standardizing improves common understanding of PM and provides an enhanced performance in systems thinking by predetermining processes. PM standards provide rules and guidelines on how to manage projects. Main advantages of applying standards to PM can be (Ahlemann et al., 2009, p.296):

Standards improve **communication** due to a consistent terminology. Processes get easier elaborated when people involved share **common understanding** of PM terms. PM processes can be implemented faster by referring to a **standardized model**. The **quality of processes** (e.g. reduction of cycle times or process failures) improves by applying standards. Furthermore, standards improve **PM competences** of staff members. The application of standards can lead to **cost savings** by running the project team more efficiently. The usage of standards makes PM systems comparable to other organizational entities. An organization using a standard demonstrates high PM competence to the outside, which can create a significant high advertising effect.

But standards can affect companies also in a negative way. Too much standardization can lead to over-bureaucratization and a decrease in quality of creative processes in areas of innovation or research and development. According to Ahlemann (2009, p.297) main deficiencies of standards in PM can be:

The standard is **too theoretical** and as consequence not applicable efficiently. Also when the standard is **not flexible** enough it cannot be adapted to specific organizational requirements. The implementation of the standard can lead to **high costs** for organizations and therefore the economic benefit is not guaranteed. The operation of the PM system requires too **high administrational efforts**, leading to inefficient processes or practices and non-acceptance by staff members.

A survey, conducted by Ahlemann (2009, p.299 ff.), within 239 companies of various industry and business sectors in Germany and Switzerland were examined, provided these results:

Of all companies only 38,9% use PM standards. The most supported disadvantages were administrational overhead, lack of acceptance or high cost of change. The most recognized benefits were an improvement of communication, process quality and faster implementation of PM processes than without standards.

In Figure 8 a basic categorization of PM standards is shown. **International standards** are widely used and highly recognized in the discipline of PM. The Project Management Body of Knowledge (PMBoK) is the most comprehensive reference book in PM. It states the fundamental publication of the Project Management Institute (PMI). IPMA Competence Baseline (ICB) 3.0 is the main release from the International Project Management Association (IPMA). Projects in Controlled Environment (PRINCE) was primarily developed for the public sector in the United Kingdom and is a trademark of the Office of Government Commerce (OGC). ISO 21500 states the publication of the International Organization for Standardization (ISO). It will be published in August 2012. **National standards** are elaborated on a national basis and support local PM. DIN 69900-1 is a national standard published by the German Institute for Standardization (DIN).

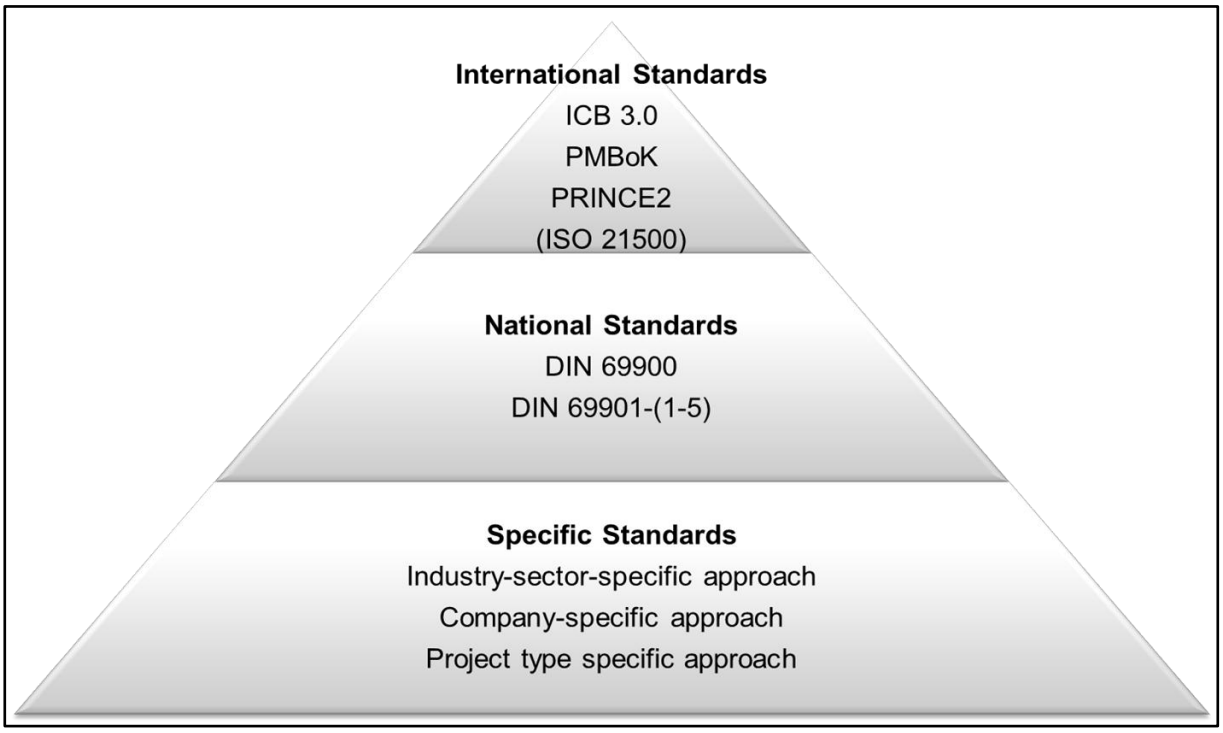

Figure 8: Classification of Standards

International and national standards are universal applicable and not tailored to the specific needs of a project. **Specific standards** are more focused on special project requirements. According to Söderlund (2004, p.186) project-specific approaches can be classified into three groups:

- The Industry-sector-specific approach: Within this group, PM standards are applied in certain industrial sectors. These standards include for example differentiated approaches in the automobile industry (e.g. automotive spice), specifies in the IT-sector (e.g. agile project management, Scrum, ITIL, V-Modell-XT) or different approaches in the building industry (e.g. Construction extension to PMBOK).
- The Company-specific approach: To meet specific requirements large companies tend to develop its own project management approach (e.g. Chestra Siemens AG, ITPM BMW Group).
- The approach according project types or categories: This approach differentiates project types according certain characteristics of projects. Typical characteristics can be project scope, complexity, degree of innovation or urgency of projects (Dierig et al., 2007, p.6).

On the one hand a universal standard seems necessary to provide unification and a common language between project managers. On the other hand, there is a risk of permanent extension of universal standards to satisfy different requirements of projects. This leads to a huge collection of methods and proceedings, whose complexity and comprehension may reduce users convenience. Practitioners claim that PM theory does not meet reality due to missing flexibility and an overload of PM architecture (Dierig et al., 2007, p.4).

In Figure 9 main relevant universal PM standards are shown. IPMA acts as an umbrella association for the Deutsche Gesellschaft für Projektmanagement (GPM), Projektmanagement Austria (PMA) and the Association for Project Management (APM). Also DIN, OGC and PMI are shown.

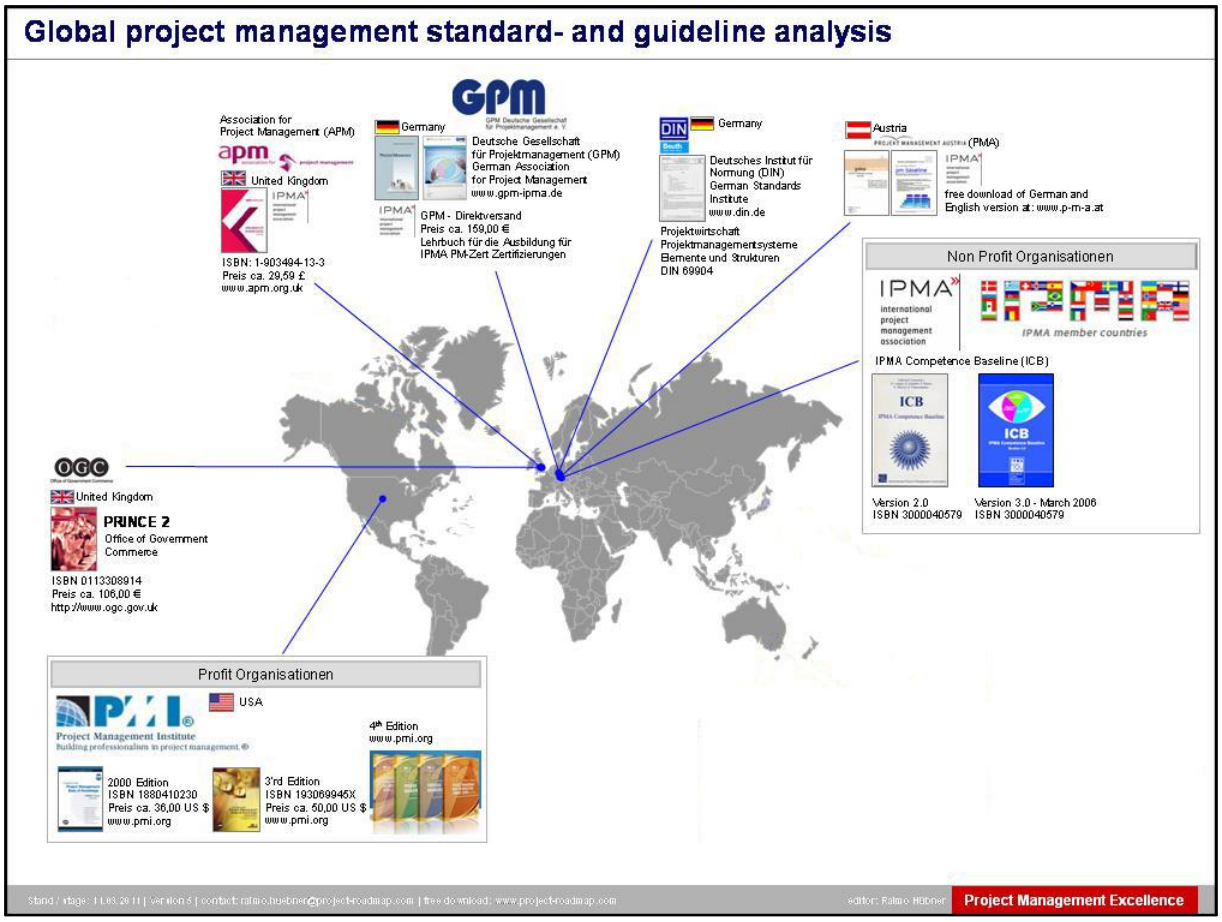

Figure 9: Global Standards in PM (Project Roadmap Community, 2011)

Standards differ in many aspects from each other. In the following Chapter the defined universal PM standards are introduced. Project-specific standards are discussed in chapter 4.

3.1 International Project Management Association (IPMA)

IPMA is a worldwide governing body of several PM organizations. Until 1994 IPMA was known as INTERNET. *"INTERNET was formed in 1965; originally as a forum for European network planning practitioners to exchange knowledge and experience"* (Stretton, 2007, p.8).

Since then IPMA has grown worldwide. The international network of IPMA encompasses presently 50 national organizations and represents over 55.000 members all over the world (Wirtschaftsblatt, 2009, p.11).

Over the years IPMA has developed the world's leading certification program and played a major role in the promotion and progress of PM as a profession (IPMA, 2011a).

3.1.1 IPMA Competence Baseline (ICB)

The basic concept of comprehension of PM is expressed in the ICB. The document is currently available in its 3rd edition, published in 2006. It is an update from the ICB 2.0 published in 2001 and is used as a common framework document for all IPMA member associations to ensure using equal standards in PM. Furthermore ICB includes a certification scheme for all member associations which is globally accepted. To take into consideration also cultural aspects, the ICB is available in different languages as a National Competence Baseline (NCB).

3.1.2 Basic Principles

Competence based Approach

The basic approach to PM is competence oriented, which is understood as follows:

"The optimum situation for a project organization is that all the people, the project teams and resource providers involved in project management are competent to carry out their work and to take individual responsibility" (Caupin et al., 2006, p.3).

Consequently, the success in PM depends on first instance on the competences of involved people. Only people with acceptable competences can act successfully in a dynamic environment. Therefore, ICB provides not a guidance on how to manage projects, furthermore it focuses on people involved in projects and gives them the

right attitudes and skills to deal with certain situations in projects. According to ICB the term competence is limited to these definitions: (Caupin et al., 2006, p.9)

"A competence is a collection of knowledge, personal attitudes, skills and relevant experience needed to be successful in a certain function."

"Competence is the demonstrated ability to apply knowledge and/or skills, and, where relevant, demonstrated personal attributes."

According to these definitions, competence is composed out of the required knowledge and the application of knowledge to certain situations. All competences required are grouped into three ranges: (Caupin et al., 2006, p.9)

The **technical competence** range covers the PM content. It contains 20 competence elements.

The **behavioral competence** range covers attitudes and skills of a project manager. It contains 15 competence elements.

The **contextual competence** range covers management between line organization and PM. It contains 11 competence elements.

All elements are represented in the "Eye of Competence" (Figure 10), which illustrates the view of project manager evaluating a specific situation of a project considering all PM competences. According to the ICB, each competence element has equal importance (Caupin et al., 2006, p.10).

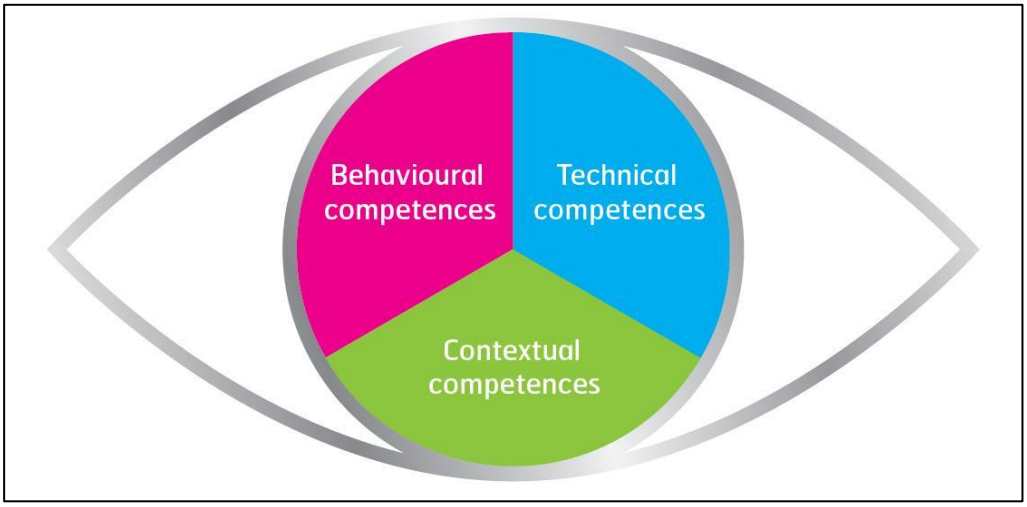

Figure 10: The Eye of Competence (Caupin et al., 2006, p.I)

National Considerations

IPMA involves about 50 national PM associations. For example, in Austria IPMA is represented by the Projektmanagement Austria (PMA) , in Germany by the Deutsche Gesellschaft für Projektmanagement (GPM) and in Switzerland the Swiss Project Management Association (SPM) is interlinked to IPMA.

To overcome cultural differences a national section per each competence element can be added by different member associations. Furthermore member associations can add even other competence elements. The certification of project managers is valid in all member countries. This requires harmonization of the national certification schemes (Caupin et al., 2006, p.10).

Four-Level Certification Scheme

IPMA defines four levels of competences from level A (highest qualification) to level D (lowest qualification). Different assessment procedures assure the qualification of the candidates in each level (see Chapter 3.1.5).

3.1.3 Structure

Each competence element is described in terms of knowledge and experience required. Afterwards the purpose of each element gets explained. Possible process steps are shown to emphasize the handling of specific situations in projects and to apply the addressed competence element in the right way. “Topics addressed” refer to further information sources. Moreover, the ICB describes knowledge and experience required for each competence element at each certification level. Finally, relations between other competence elements are highlighted (Caupin et al., 2006, p.10).

From Table 2 to Table 4 each of the 46 competence elements is shortly described. (Caupin et al., 2006, p.37 ff.):

Technical Competence	Description
Project management success	Appreciation of PM results by the relevant interested parties
Interested Parties	People or groups, who are interested in the performance and/or success of the project, or people who are constrained by the project
Project requirement and objectives	Identification, definition and agreement of the project to meet the needs and expectations of interested parties
Risk and opportunity	Ongoing process to identify, assess risk and opportunities and to introduce adequate response measures
Quality	The degree to which a set of inherent characteristics fulfills the project requirements
Project organization	Group of people and associated infrastructure with an arrangement of, authority, relationships and responsibilities aligned to the business or function's processes
Teamwork	Management and leadership of team building, operating in teams and group dynamics
Problem resolution	Problem solving activities
Project structures	For creating order within the project
Scope and deliverables	Definition of boundaries and assets created by the project
Time and project phases	Structuring, sequencing, duration estimating and scheduling of activities and work packages, including monitoring and controlling their timely execution
Resources	Identification and allocation of resources with the appropriate capability.
Cost and finance	Sum of all the actions required for planning, monitoring and controlling costs during the project life-cycle
Procurement and contract	Involves obtaining the best value for money from suppliers of goods or services to the project
Changes	Handling of change request during a project
Control and reports	Integrated control and reporting of the project
Information and documentation	Modeling, gathering, selecting, storing and retrieving project data
Communication	Effective exchange and understanding of information between parties
Start up	Activities related to a successful start-up of a project
Close out	Completion of the project, after the results have been delivered

Table 2: Technical Competence Range(Caupin et al., 2006, p.37 ff.)

Behavioural Competence	Description
Leadership	Providing direction and motivating others in their role to fulfill the objectives
Engagement and motivation	Personal buy-in from the project manager to the project and from the people inside and associated with the project considering peoples skills and experience, their personal attitudes, circumstances and their intrinsic motivations
Self-control	Systematic and disciplined approach to handle daily work, changing requirements and stressful situations
Assertiveness	Ability to state views persuasively and authoritatively
Relaxation	Ability to unload tension in difficult situations
Openness	Ability to make others feel they are welcome to express themselves, so that the project can benefit from their input, suggestions, worries and concerns
Creativity	Ability to think and act in original and imaginative ways
Results Orientation	Ability to focus on key objectives to obtain the optimum outcome
Efficiency	Ability to use time and resources cost-effectively to meet the requirements
Consultation	Competence to reason, to present solid arguments, to listen to the other point of view, to negotiate and to find solutions
Negotiation	Competence to resolve disagreements and to arrive at a mutually satisfactory solution
Conflict and crisis	Ways of handling conflicts and crises that can arise between different individuals and parties involved in a project
Reliability	Delivering right products in time to the quality agreed
Values appreciation	Ability to perceive the intrinsic qualities in other people and understand their point of view
Ethics	Embraces the morally accepted conduct or behavior of every individual

Table 3: Behavioural Competence Range(Caupin et al., 2006, p.37 ff.)

Contextual Competence	Description
Project orientation	Orientation of organizations by managing projects and by development of PM competence
Program orientation	Covers the definition and attributes of programs and of their management
Portfolio orientation	Covers the definition and attributes of portfolios and of their management
Project, program and portfolio implementation	Processes of establishing and continuously improving project, program and portfolio management in organizations
Permanent organization	Relationship between project and program organizations, which are temporary, and the permanent entities of line management
Business	Impact of business issues on managing projects
Systems, products and technology	Linkage between project and the organization regarding systems, products and technology.
Personnel management	Covers aspects of human resource (HR) management including planning, recruitment, selection, training, retention, performance assessment, and motivation.
Health, security, safety and environment	Covers activities that help to ensure appropriate behavior in the context of health, security, safety and environment
Finance	Covers the financial context within the organization operates
Legal	Describes the impact of the law and regulations on projects

Table 4: Contextual Competence Range(Caupin et al., 2006, p.37 ff.)

3.1.4 Definitions of Project and Project Management

*"A **Project** is a time and cost constrained operation to realize a set of defined deliverables (the scope to fulfill the projects objectives) up to quality standards and requirements"* (Caupin et al., 2006, p.13).

***"Project Management** (PM) is the planning, organizing, monitoring and controlling of all aspects of a project and the management and leadership of all involved to achieve the project objectives safely and within agreed criteria for time, cost, scope and performance/quality. It is the totality of coordination and leadership tasks, organization, techniques and measures for a project. It is crucial to optimize the parameters of time, cost and risk with other requirements and to organize the project accordingly"* (Caupin et al., 2006, p.128).

3.1.5 Certification

The required knowledge and experience for each competence element is described in each element section in the ICB. To verify each individual`s competence IPMA introduced a four level certification system where four categories of managers are specified:

- Certified Project Management Associate (IPMA Level D)
- Certified Project Manager (IPMA Level C)
- Certified Senior Project Manager (IPMA Level B)
- Certified Projects Director (IPMA Level A)

In Table 5 requirements and core competences of each level are specified. Furthermore it gives information about examination procedures. In level D only knowledge is certified, while in other levels competence, which is composed out of experience and knowledge, is assessed by requesting reports and interviews. The reports describe the application of PM competence in real cases and are an important base for the following interview. Each certification level expires after a certain period and the individual has to be re-assessed.

	Level D	Level C	Level B	Level A
Entry requirements	•Not compulsory PM experience Application form: •Curriculum vitae •Self-assessment	•3 years of PM experience Application form: •Curriculum vitae •Project list •References •Self-assessment	•5 years of PM experience of which 3 years in a responsible leadership function Application form: •Curriculum vitae •Project list •References •Self- assessment	•5 years of portfolio-, program- or multi-PM experience of which 3 years in a responsible leadership function Application form: •Curriculum vitae •Project list •References •Self- assessment
Core competence	The candidate shall have PM knowledge in all compe-tence elem-ents.	The candidate shall be able to manage projects with limited complexity.	The candidate shall be able to manage complex projects.	The candidate shall be able to manage portfolios or programs.
Additional requirements	•The candidate can practice in any compe-tence element. •He works as a project team member and •has broad PM knowledge and the ability to apply it.	•The candidate can manage a project with limited complexity. •He is able to apply common PM processes, methods, techniques and tools.	•The candidate is responsible for all competence elements. •He has a general management role as manager of a large PM teams •and uses adequate PM processes, methods, techniques and tools.	•The candidate is responsible for an important portfolio. •He contributes to the strategic management of the organization •and develops and implements PM requirements.
Exam	•Written Exam	•Written Exam •Optional: Workshops and short reports, interviews	•Written Exam •Optional: Workshops and short project report, interviews	•Written Exam •Optional: Workshops, projects director report, interviews
Validity	10 years	5 years	5 years	5 years

Table 5: Certification Scheme of IPMA (Caupin et al., 2006, p.17 ff.)

3.1.6 Application Field

The ICB guidelines provide basic understanding of PM and are mostly applied as follows (Knöpfl et al., 2009, p.25):

- They are useful for self-assessment of competences for project-, program- and portfolio managers.

- They are a basis for creation of manuals and other standards for project-, program-, or portfolio management.
- They are a guideline for development and actualization of teaching material of basic education or advanced training.
- They are used as reference document for all experts who need information of applied project-, program-, and portfolio management.

In addition, every year, IPMA hands over awards to the most successful project teams. Participants of all over the world and nearly all industrial sectors are awarded. In the following award- and prize- winners of 2010 are listed (IPMA, 2011a).

Category: Project Excellence in Medium-Sized Projects

Organization: Construction Management and Real Estate Department, Tongji University (China)

Project: Overall Construction Program Management Consultancy of EXPO 2010 Shanghai

Category: Project Excellence in Big-Sized Projects

Organization: Nuovo Pignone S.p.A. - General Electric S.p.A. (Italy)

Project: Darwin G4 Project (Oil and Gas)

Category: Project Excellence in Mega-Sized Projects

Organization: CNOOC Huizhou Refinery (China)

Project: CNOOC Huizhou Refinery Project (Oil and Gas)

Organization: Siemens, I MO RS PT HI (Germany)

Project: Velaro RUS (Transport)

Organization: Morvarid Petrochemical Co. (Iran)

Project: Assaluyeh 5th Ethylene Project

3.1.7 Resume

In the ICB each competence element is generally described. The categorization into ranges gives an overview about knowledge and experience required in PM.

ICB focuses on people dealing with projects. It is the only standard where behavioral competences, which are extremely important to PM, are emphasized.

The certification scheme is universal and accepted in all member countries over the world. For practitioners, to every competence element, possible process steps and required key competence at each level are identified.

IPMA provides no process model. ICB can be seen as a comprehensive reference book for employee development, but it is not sufficient to introduce a PM methodology.

Methodologies, methods and tools are not included. ICB argues that organizations should define methods and tools for them self. The task of the project manager is then to choose appropriate methods and tools for a particular project situation (Caupin et al., 2006, p.5).

3.2 Project Management Institute (PMI)

PMI was formed in 1969 in North America, Pennsylvania. Today, *"PMI is the world's leading not-for-profit membership association for the project management profession, with more than half a million members and credential holders in more than 185 countries"* (PMI , 2011). PMI promotes the PM profession through globally recognized standards and certifications.

PMI standards are widely recognized in the profession of PM. PMI developed over the years twelve standards, categorized into three groups (PMI , 2011):

- **Foundational standards** (e.g. the PMBoK-Guide, Organizational Project Management Maturity Model (OPM3) ,Portfolio and Program Management)
- **Practice standards and frameworks** (e.g. Guides to use processes, tools or techniques defined in the PMBoK)
- **Standard extensions** to foundational standards for specific projects or industrial sectors (e.g. construction and risk extensions)

3.2.1 Project Management Body of Knowledge (PMBoK)

PMBoK tries to collect all common recognized practices in PM and gives a comprehensive overview and appropriate knowledge, skills, tools, and techniques used in PM. Since its first publication in 1987 PMBoK has established itself as leading guidance support for project managers. It is actually available in its 4th edition. In 2004 ANSI honored PMI`s contribution to PM and made PMBoK an ANSI standard (Ahlemann et al., 2009, p.293). It is widely recognized as the "Best Practice Toolbox" in PM and it is continuously updated and developed by PMI practitioners. The provided process model is designed to be applicable across a wide range of projects.

3.2.2 Basic Principles

Process based Approach

PMI follows a process based approach to PM. Each process is composed out of inputs, tools and techniques to elaborate the input, and the resulting output. PMBOK distinguishes two kinds of processes (PMI, 2008, p.37):

- **Project management processes** ensure the effective flow of the project throughout its existence
- **Product-oriented processes** specify and create the projects product.

Projects consist of Project Management Process Groups

To manage projects successfully effective application of appropriate processes is necessary. *"A process is a set of interrelated actions and activities performed to achieve a pre-specified product, result, or service"* (PMI, 2008, p.37). 42 processes are defined and grouped in five categories:

- Initiating Process Group
- Planning Process Group
- Executing Process Group
- Monitoring and Controlling Process Group
- Closing Process Group

Process groups are overlapping activities that occur throughout the project and so they interact with project phases. Consequently the output of a process becomes an input to another process.

Knowledge Areas

PMBoK is structured in nine knowledge areas to address different facets of PM. A knowledge area includes all the processes which have to be accomplished within the specified field. The knowledge areas are (PMI, 2008, p.67):

- Project Integration Management
- Project Scope Management
- Project Time Management
- Project Cost Management
- Project Quality Management
- Project Human Resource Management
- Project Communications Management
- Project Risk Management
- Project Procurement Management

Projects are divided into Phases

"Project phases are divisions within a project where extra control is needed to effectively manage the completion of a major deliverable" (PMI, 2008, p.18). Like this, the project is divided into logical subsets.

Work Breakdown Structure (WBS)

"The Work Breakdown Structure (WBS) is a deliverable-oriented hierarchical decomposition of the work to be executed by the project team to accomplish project objectives and create the required deliverables" (PMI, 2008, p.452).

Work packages are the lowest level of the WBS and contain the planned work. Within the WBS, costs can be estimated and work packages can be scheduled, monitored and controlled. This principle establishes the central control element in projects and is essential for defining the scope.

Tailoring

The PMBoK is not an "all in one" solution. Processes have to be adapted considering organizational process assets and environmental factors. The project manager, in collaboration with the project team, is responsible for tailoring the standard in a way, to meet specific needs of the organization and the project. He is responsible to determine appropriate processes and to apply them in the necessary extent (PMI, 2008, p.38).

Common Vocabulary

"The PMBoK-Guide provides and promotes a common vocabulary within the project management profession, for discussing, writing, and applying project management concepts. Such a standard vocabulary is an essential element of a professional discipline" (PMI, 2008, p.4).

Reference Book

The PMI sees this standard as foundational project management reference for its professional development programs and certification (PMI, 2008, p.4).

3.2.3 Structure

The PMBoK is broken down into three sections. Section one provides a basis for understanding PM. Section two focuses on PM processes and section three describes all knowledge areas (PMI, 2008, p.XXIII).

The whole standard is structured in knowledge areas, within all aspects of PM are explained. Therefore, further investigations were not necessary. Each knowledge area is described with processes required to be accomplished. Tools and techniques, used to modify the input of processes, are recommended. Furthermore, each knowledge area is related to at least one process from the PM process groups.

In Figure 11 the matrix structure of PMBoK is depicted (PMI, 2008, p.43). The knowledge areas can be seen on the left side. The consecutive numbering of the knowledge areas corresponds to the referred chapter of the PMBoK guide. Processes, related to a certain knowledge area and certain project management process group are shown within the matrix.

Knowledge Areas	Project Management Process Groups				
	Initiating Process Group	Planning Process Group	Executing Process Group	Monitoring & Controlling Process Group	Closing Process Group
4. Project Integration Management	4.1 Develop Project Charter	4.2 Develop Project Management Plan	4.3 Direct and Manage Project Execution	4.4 Monitor and Control Project Work 4.5 Perform Integrated Change Control	4.6 Close Project or Phase
5. Project Scope Management		5.1 Collect Requirements 5.2 Define Scope 5.3 Create WBS		5.4 Verify Scope 5.5 Control Scope	
6. Project Time Management		6.1 Define Activities 6.2 Sequence Activities 6.3 Estimate Activity Resources 6.4 Estimate Activity Durations 6.5 Develop Schedule		6.6 Control Schedule	
7. Project Cost Management		7.1 Estimate Costs 7.2 Determine Budget		7.3 Control Costs	
8. Project Quality Management		8.1 Plan Quality	8.2 Perform Quality Assurance	8.3 Perform Quality Control	
9. Project Human Resource Management		9.1 Develop Human Resource Plan	9.2 Acquire Project Team 9.3 Develop Project Team 9.4 Manage Project Team		
10. Project Communications Management	10.1 Identify Stakeholders	10.2 Plan Communications	10.3 Distribute Information 10.4 Manage Stakeholder Expectations	10.5 Report Performance	
11. Project Risk Management		11.1 Plan Risk Management 11.2 Identify Risks 11.3 Perform Qualitative Risk Analysis 11.4 Perform Quantitative Risk Analysis 11.5 Plan Risk Responses		11.6 Monitor and Control Risks	
12. Project Procurement Management		12.1 Plan Procurements	12.2 Conduct Procurements	12.3 Administer Procurements	12.4 Close Procurements

Figure 11: Process Model of PMI (PMI, 2008, p.43)

3.2.4 Definitions of Project and Project Management

*"A **Project** is a temporary endeavor undertaken to create a unique product, service or result"* (PMI, 2008, p.5).

*"**Project management** is the application of knowledge, skills, tools, and techniques to project activities to meet project requirements"* (PMI, 2008, p.6).

3.2.5 Certification

PMI was the first organization who started a certification program for project managers. Its certifications are globally recognized and are still global standard. PMI offers three certification levels in the field of overall PM for practitioners of all education and skill levels (PMI , 2011):

- **Program Management Professional** (PgMP) certificates the ability to oversee multiple related projects.
- **Project Management Professional** (PMP) demonstrates education and competency to lead and direct projects.
- **Certified Associate** in Project Management (CAPM) demonstrates understanding of basics of effective project management.

To assess competences of candidates firstly education and experience is reviewed. Afterwards the candidate is examined by answering different scenario-based questions. For the PgMP and PMP examination, the candidate has to pass also a multi-rater assessment (PMI, 2011a). To maintain a PMI certification the candidate has to earn professional development units (PDU) (PMI, 2011b, p.4). *"The professional development units are the measuring unit used to quantify approved learning and professional service activities"* (PMI, 2011b, p.35). After reporting required PDU`s the candidate is accepted for the renewal process.
Table 6 lists up the different levels of certification regarding entry requirements, core competences, additional requirements, exam procedures, and validity.

	CAPM	PMP		PgMP
Entry requirements	•High school degree and at least 1.500 h experience or 23 h of PM education	•Bachelor degree and at least 3 years of PM experience, with 4.500 h leading and directing projects and 35 h of PM education	•High school degree with at least 5 years of PM experience, with 7.500 h leading and directing projects and 35 h of PM education	•Bachelor degree, with at least 4 years of PM experience and 4 years of program management experience •High school degree, with at least 4 years of PM experience and 7 years of program management experience
Core competence	The candidate has basic knowledge about terminology and processes of effective PM.	The candidate has experience, education and competency to lead and direct projects successfully.		The candidate has proven competency to oversee multiple, related projects and their resources to achieve strategic business goals.
Additional requirements	•No additional requirements	•Under general supervision, the candidate can lead and direct teams. •He has knowledge and experience to apply a methodology to projects.		•The candidate is able to oversee the success of a program. •He is able to group related projects together to realize organizational benefits.
Exam	•Audit process •135 Multiple-choice questions	•Audit process •200 Multiple-choice questions • Multi-rater Assessment		•Audit process •170 Multiple-choice questions •Multi-rater Assessment
Validity	•5 years	•3 years •Earn and report 60 PDU		•3 years •Earn and report 60 PDU

Table 6: Certification Scheme of PMI (PMI, 2011a; PMI, 2011b; PMI, 2011c)

Furthermore, PMI provides also specialized certification levels for certain activities in PM (PMI , 2011):

- PMI Scheduling Professional (PMI-SP)
- PMI Risk Management Professional (PMI-RMP)
- PMI Agile Certified Practitioner (PMI-ACP)

In Table 7 these certifications are shown.

	PMI-ACP	PMI-RMP	PMI-SP
Entry requirements	•High school degree with at least 2.000 h of PM experience, within 1.500 h using agile methodologies and 21 h of agile PM education	•Bachelor degree, with at least 3.000 h of project risk management experience and 30 h of project risk management education •High school degree with at least 4.500 h of project risk management experience and 40 hours of project risk management education	•Bachelor degree, with at least 3.500 h of project scheduling experience and 30 h of project scheduling education •High school degree with at least 5.000 h of project scheduling experience and 40 h of project scheduling education.
Core competence	The candidate has a specialist role by using agile practices in PM.	The candidate has a specialist role in project risk management.	The candidate has a specialist role in project scheduling
Additional requirements	•The candidate is able to use agile practices in PM and increases his professional versatility	•The candidate is able to assess and identify project risks •He is able to mitigate threats and to capitalize on opportunities.	• The candidate is able to develop and maintain project schedules.
Exam	•Audit process •120 Multiple-choice questions	•Audit process •170 Multiple-choice questions	•Audit process •170 Multiple-choice questions
Validity	•3 years •Earn and report 30 PDU	•3 years •Earn and report 30 PDU	•3 years •Earn and report 30 PDU

Table 7: Specialized Certifications of PMI (PMI, 2011d; PMI, 2011e; PMI, 2011f)

3.2.6 Application Field

Due to its universal distribution in all industry sectors it is not possible to figure out in which branches PMBoK is used the most. Like IPMA also PMI has an award system where all kind of successful accomplished projects can be nominated. The award system is categorized in four groups which represent outstanding achievements in related fields of PM (PMI , 2011):

- Awards to honor project professionals
- Awards to honor organizations for successful and innovative projects
- Awards to honor PM researchers and educators
- Awards to honor PM literature authors

3.2.7 Resume

PMBoK is a comprehensive collection of methods, tools and knowledge of PM and allocates all knowledge required to execute projects, programs or portfolios. It is the most common used reference book around the world and supports project managers in nearly all situations. It is also known as “Best Praxis Toolbox”. In 2004 it became an ANSI standard. This strengthens the influence of PMI to PM. Furthermore, PMBoK is updated continuously by practitioners and considers PM approaches proved in practice.

Through its uniform writing style and its utilization of explanations all concepts are clear and understandable. Interfaces to other PMI standards are well described and so the standard is open to be implemented with other methodologies and standards.

“*PMBoK is a guide rather than a methodology. One can use different methodologies to implement the framework”* (PMI, 2008, p.4).The standard describes PM very generic to be adaptable to all kind of projects. Even though, project processes are described in a consequently detailed way.

The PMBoK guide is structured by Knowledge Areas. Every chapter describes PM processes of a knowledge area concerning inputs, outputs as well as tools and methodologies. This structure differs from the real work sequence. This might be an obstacle for inexperienced practitioners in PM (Bölke, 14.09.2009, p.3).

PMBoK is not a finished solution; it has to be adapted to the application area, industry, project size, and scope, time, budget and quality constraints, to create an individual methodology. It refers only to responsibilities of the project manager and the project team for adaption of the right PM system. Tailoring is not described in a sufficient way.

Reading and understanding the PMBOK guide can supplement practical experience of project managers, but it cannot replace it. In many projects rise specific challenges, that cannot be covered by standards in a necessary degree of detail (Bölke, 14.09.2009, p.3).

3.3 Office of Government Commerce (OGC)

"OGC was founded after the 1999 Gershon report which recommended bringing together a number of governmental bodies that had a 'commercial' remit, including the Central Computer Telecommunications Agency (CCTA), Property Advisors to the Civil Estate (PACE) and The Buying Agency (TBA)" (Smith, 2011).

It is an independent office build to support the government. It produces policy standards in PM, procurement and estate management (OGC, 2011a).

Today OGC is part of the Efficiency and Reform Group (ERG) in the Cabinet Office. This partnership brings together all the cross-governmental operational functions, including procurement, PM, IT, civil service workforce and reform functions (Cabinet Office, 2010).

OGC owns the rights on PRINCE2. Furthermore it provides other guidelines and publications to help organizations manage their projects. The guidelines can be categorized into three groups (Murray et al., 2009, p.6):

- **Models:** Portfolio Program and Project Management Maturity Model (P3M3), PRINCE2 Maturity Model (P2MM)
- **Guides:** PRINCE2, Managing Successful Program (MSP), Portfolio Guide (PfM)
- **Extensions:** OGC Gateway Review Process, Achieving Excellence in Construction, ITIL Service Management Practices, Management of Risks (M_o_R)

3.3.1 Projects in Controlled Environment (PRINCE)

PRINCE was published the first time in 1989 by the CCTA and became a de-facto standard in all government information system projects. PRINCE can be seen as the successor of PROMPTII, developed in 1979 to overcome problems in IT project management. PRINCE was seen as too unwieldy, too rigid and applicable only to large projects. In 1996 PRINCE2 was developed. This revision was made more generic, applicable and scalable to projects in all industry sectors. Since then PRINCE2 was continuously updated. The actual, 5th edition was published in 2009 with the title "Managing successful projects with PRINCE2" (Haughey, 2011).

Nowadays, Prince 2 is extensively used in more than 150 countries around the world (Murray, 2011, p.3).

3.3.2 Basic Principles

PRINCE2 is a best practice PM methodology, where management, controlling and the organization of projects is treated. It is aligned to practical application and based on seven principles (Murray et al., 2009, p.11 ff.).

Continued Business Justification

In PRINCE2 the business case establishes the reason of the project. According to the philosophy of PRINCE2, every project has to have an economic value for organizations. With the creation of the business case a project is justified and clear objectives are established. Furthermore, the business case is reevaluated and monitored during a project.

Learn from Experience

A project is temporary and unique in order that it cannot be managed by existing line management or other functional elements. This makes it challenging for project teams. According to the PRINCE2 methodology, previous experience has to be documented and be applied during the whole life-cycle of the project.

Defined Roles and Responsibilities

"A PRINCE2 project has defined and agreed roles and responsibilities within an organization structure that engages the business, user and supplier stakeholder interests." (Murray et al., 2009, p.12)

Typical PRINCE2 roles are (Murray et al., 2009, p.269 ff.):

- "The Project Board" is responsible for project`s success and has the authority to delegate change authority or project assurance tasks.
- "The Executive" ensures that the project is focused on its objectives throughout its life-cycle. He is also responsible for the business case.
- "The Senior User" identifies the requirements of project`s outcome to meet customer satisfaction.
- "The Senior Supplier" ensures that project`s results show the desired quality characteristics.

- “The Project Manager” runs the project on a day to day basis. He is responsible for projects products.
- “The Team Manager” ensures the production of primarily defined products to the right quality and the right costs at the right time.
- “The Project Assurance” is independent from the project manager and covers primarily stakeholder interests.
- “Change Authority” is delegated by the project board. The chosen individual has the authority to elaborate change requests.
- “The Project Support” contains supporting functions for the project (e.g. configuration management)

Management by Stages

A project is broken down into stages. Every stage is equipped with control points, where the business case and other plans are reviewed and decisions for further actions are taken. Introducing a stage management process allows to broaden the planning horizon. Detailed plans can be done in each management stage.

Management by Exception

Within this principle authority is delegated from one level of management to the next. Due to Management by Exception an appropriate steering and controlling of the project gets possible. *“A PRINCE2 project has defined tolerances for each project objective to establish limits of delegated authority”* (Murray et al., 2009, p.13). Tolerances establish limits like cost, time, quality, scope, risk and benefit. When tolerances exceed, the next higher management layer gets activated. PRINCE2 defines four levels of management to support projects on a day to day control (Murray et al., 2009, p.33f.).

Focus on Products

To fulfill stakeholder expectations PRINCE2 is focused on products. A product is every output from a stage or from a finished project. With this approach all the activities are in line with projects purpose and it helps to control business justification through the whole project structure. To define an interface between PM and the proper product creation, product descriptions are used. Progress and quality can be measured by the facts (Rother, 06.07.2009, p.3).

Tailor to suit the Project Environment

PRINCE2 is a universal PM methodology which can be applied in different organizations and branches on every project. The principle of tailoring ensures that the method relates to project`s environment and controls are based on the project`s scale. To use PRINCE2 in an appropriate way, it is suited to conventions of the project. Therefore, it can be applied on every project regarding project scale, geography, culture or complexity.

3.3.3 Structure

PRINCE2 addresses PM considering four integrated elements of principles, themes, processes and the project environment (Murray et al., 2009, p.5).
In Figure 12 the structure of PRINCE2 is shown. It consists out of seven principles, seven themes and a process model with seven processes.

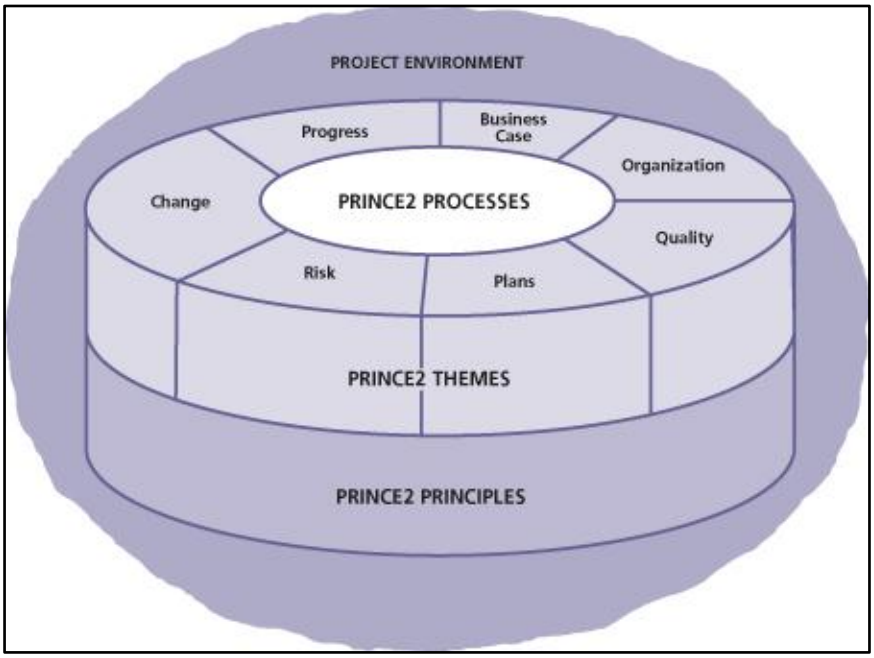

Figure 12: Structure of PRINCE2 (Murray et al., 2009, p.6)

The principles were already described in the previous chapter. Themes are used to describe aspects of PM and they have to be controlled throughout the project. PRINCE2 themes are “Business Case”, “Organization”, “Quality”, “Plans”, “Risk”, “Change” and “Progress”. Every theme is firstly defined and detailed by its purpose. Afterwards, the PRINCE2 approach to the theme is explained. With help of a responsibility-matrix possible responsibilities are shown. Useful techniques from actual project knowledge complete the themes.

In Figure 13 the process model of PRINCE2 is depicted. The seven processes are related to the corresponding management level in the corresponding stage. Along the PRINCE2 manual, processes are described by its purpose, objective, context and activities. A process turns defined inputs into defined outputs and contains activities. Each activity contains a set of recommended actions. To define clear accountabilities for a product in a process, every activity comprises a matrix delegating activities (Buhr, 2010, p.32). Figure 13 shows how processes get used along the project life-cycle.

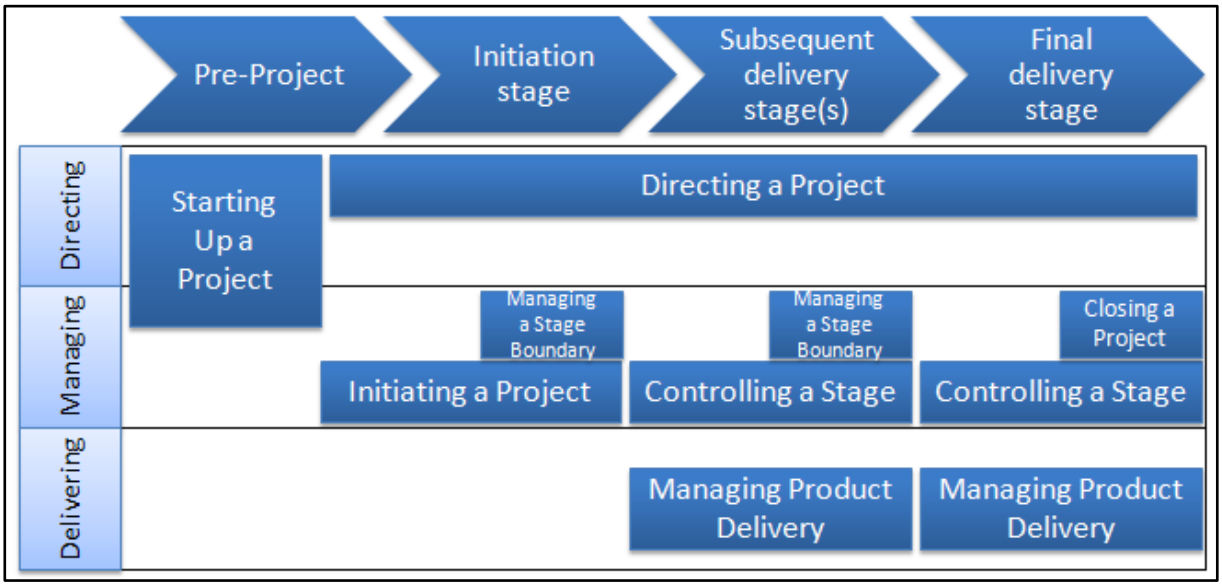

Figure 13: PRINCE2 Processes (Murray, 2011, p.5)

The process “Starting up a Project” describes activities to initiate and authorize a project. It takes place in the “Pre-Project” stage. “Directing a Project” is used along the following stages. This process includes mainly activities to control and delegate management authority to lower management levels. The process ”Initiating a Project” covers all activities to define a clear project plan with six project performance targets: time, cost, quality, scope, risk and benefit. “Managing a Stage Boundary” is set up to deliver the required information to confirm stage success and business justification to the Project Board. This process is used at the end of each stage. “Controlling a Stage” covers all activities regarding execution, documentation and reporting of the project within a stage. “Managing Product Delivery” refers to the detailed work of projects products. “Controlling a Stage” and “Managing Product Delivery” are optional processes and depend on the complexity of a project. The process “Closing a

Project" covers activities for closing and evaluating the project *(Murray et al., 2009, p.113f)*.

"Management Products" are another special element of PRINCE2. All in all 26 Management Products with different purpose are defined (Murray et al., 2009, p.235):

- **Baseline products** are those that define aspects of the project.
- **Records** are dynamic management products that maintain information regarding project progress
- **Reports** are management products providing a snapshot of the status of certain aspects of the project

The fourth integrated element of PRINCE2 discusses the project environment. PRINCE2 has to be tailored to meet specific requirements of the project and the organization. *"Tailoring refers to the measures taken to apply the method properly to an individual project, ensuring that the amount of governance, planning and control is appropriate"* (Murray, 2011, p.5).

3.3.4 Definitions of Project and Project Management

*"A **Project** is a temporary organization that is created for the purpose of delivering one or more core business products according to an agreed business case"* (Murray et al., 2009, p.3).

*"**Project Management** is the planning, delegating, monitoring and control of all aspects of the project, and the innovation of those involved, to achieve the project objectives within the expected performance targets for time, cost, quality, scope, benefits and risks"* (Murray et al., 2009, p.4).

3.3.5 Certification

The PRINCE2 qualification scheme was developed by the Association of Project Management (APM) in partnership with the OGC and The Stationery Office (TSO) (PRINCE, 2011). There are two certification levels: The Foundation and the Practitioner examination. In Table 8, these certifications are explained regarding entry requirements, core competences, exam procedures and validity.

	Foundation	Practitioner
Entry requirements	•No requirements	•Successful accomplishment of the Foundation exam
Core competences	•The candidate has sufficient knowledge and understanding of PRINCE2 to be able to work effectively with, or in a PM team.	•The candidate has sufficient understanding of how to apply and tailor PRINCE2 in a scenario situation.
Additional requirements	The candidate has knowledge of: •Characteristics and context of a project and the benefits of adopting PRINCE2 •Purpose of the PRINCE2 Roles, Management Products and Themes • PRINCE2 Principles •Purpose, objectives and context of the PRINCE2 Processes	•The candidate understands the relationships between the roles, management products, principles, themes, techniques and processes. •He is able to apply the principles, themes and processes to a project. •He is able to create and assess management products.
Exam	•75 Multiple Choice questions •Closed Book	•Objective Testing Format- 9 questions •Open book
Validity		3-5 years

Table 8: PRINCE2 Certification Scheme (OGC, 2011, pp.1-2)

3.3.6 Application Field

The standard is universally applicable and due to appropriate tailoring also useful for simple or complex projects. Over 20.000 organizations around the world benefit from this method (Murray, 2011, p.3). Examples are: Fujitsu, Siemens, City University London, Barclaycard (Finance), FC Chelsea, Bank of England (Finance), NHS (Health), Deutsche Post AG (Logistics) (Cupe Projects, 2011).

3.3.7 Resume

The various management roles and responsibilities involved in a PRINCE2 project are clearly defined and are adaptable to suit the complexity of the project and the organizational environment.

The PRINCE2 project can be carried out in a controlled and organized way. The method establishes projects in organizations as an independent management environment with defined roles and processes. Like this, regulated control form project start to end is achieved (Buhr, 2010, p.30).

Another advantage of PRINCE2 is its focus on the business case to justify projects purpose. The business case gets continuously reviewed, not only by the project board, but also by practitioners.

Projects have a product based planning and are arranged in management and technical phases. Clear decision points for continuation or determination of projects are defined. All activities are described in processes, structured and adopted to projects requirement (Buhr, 2010, p.30).

"However, the strength of PRINCE2 is the way which the seven themes are integrated, and this is achieved because of the specific PRINCE2 treatment of each theme, i.e. they are carefully designed to link together effectively" (Murray et al., 2009).

PRINCE2, being a structured methodology that is widely recognized and understood, provides a common language for all the participants of the project.

The principle "Management by Exception" provides an efficient and economic use of management time in all levels. Due to the definition of tolerances within this principle, boundaries are clear for all participants and stakeholders get involved at the right time. Thus, expensive management time is saved.

The user is involved in projects progress and can participate on the decision-making process so that projects requirements can be clearly achieved.

PRINCE2 does not provide specialist aspects, because it is widely applicable, detailed techniques or leadership capabilities are skipped. Furthermore, PRINCE2 is not complete and not all aspects of PM are included. The procurement part is completely missing.

3.4 Deutsches Institut für Normung (DIN)

The German Institute for Standardization (DIN) was founded in 1917 in Berlin. DIN elaborates in collaboration with experts and interested circles norms and standards as a service for economy, government and the society (Rosenkranz-Wuttig, 2009, p.321).

In 1975 the federal republic of Germany and DIN close a contract, where DIN is the responsible organization for standardization in Germany and it is accredited also from other similar organizations in Western Europe (Bahke, 2008, p.1).

3.4.1 DIN for Project Management

The work on standardization for PM started at the end of the sixties. In 1967 the association for network planning technique was founded as a part of the German Standardization Committee (DNA - later known as DIN). During the years the standard for PM was developed and upgraded continually. In the seventies the series of standards DIN 69900 ff. including seven standards for PM, was published.

In 2003 the series of standards was comprehensively reworked and a process model was introduced. Under significantly attendance of the German Association for Project Management (GPM) the actual standards were developed. In 2009 the new standards of PM, DIN 69900 (network planning technique) and DIN 69901 (project management systems) with the parts one to five were published (DIN , 2009, p.V).

3.4.2 Basic Principles

Process Orientation

DIN follows a process oriented approach. According to DIN (2009, p.46) a desired result can be achieved more efficiently when activities and associated resources are mapped through processes. On the one hand it facilitates orientation in the course of a project, while on the other hand a good basis for an enterprise wide networking and continuous improvement is established.

Model based

According DIN, a complete and detailed description of reality, covering structures, tasks and processes in PM is not possible. Therefore, the standard is based on an abstract picture of the reality, a model. The model describes an idealized PM system

and has to be adapted to the specific needs of the corporate organization (DIN , 2009, p.46).

Essential characteristics

According DIN (2009, p.36) a project management system has to have these essential characteristics:

- **Flexibility:** The system can be adopted to current or new changed constraints
- **Universality:** The system allows multifunctional utilization
- **Modularity:** The system is composed out of several subsystems and can be extended and developed in modules. In process design by choosing interfaces possibilities are created to support, optimize and accelerate processes.
- **Compatibility:** Systems, subsystems, and elements are suitable for connection to conterminal systems in order to create conditions of texturing and formation of synergetic effects.
- **Transparency:** The system makes visible procedures and interrelations.
- **Prevention:** The system supports the operating principle: “Prevention instead of reaction”.

Divergence

DIN describes its model trough processes and is limited to basic rules for PM. This way, a universal applicable standard is set up which is focused on essential management steps to increase common understanding of PM.

3.4.3 Structure

The process model forms the core statement of the standard. All other parts are grouped around the model. In Figure 14 the five parts of the standard DIN 69901 are shown and the relationship among the parts can be seen (DIN , 2009, p.33).

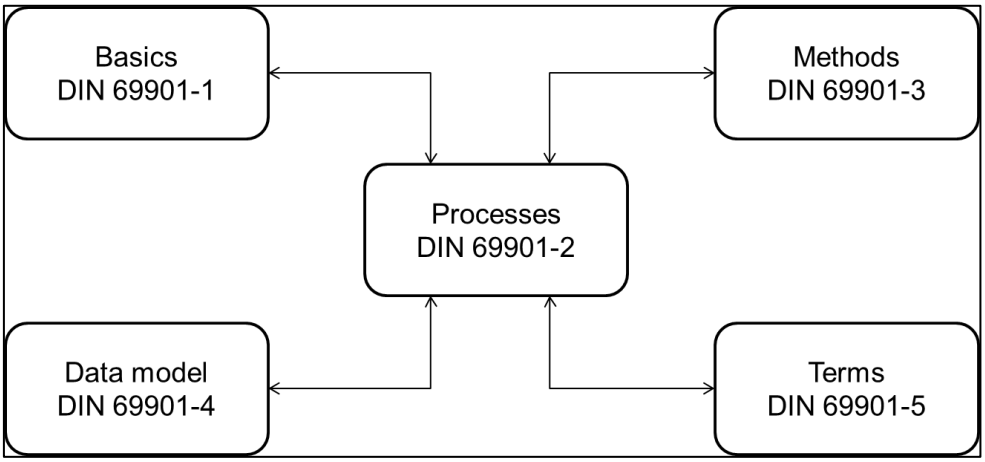

Figure 14: Relationships among the parts of DIN 69901 (DIN , 2009, p.33)

DIN 69901-1 gives a short introduction to the standard. It idescribes the model character, essential charachteristics, goals and expectations of a functional PM system. Support functions of the organisation, as well as documentation procedures are mentioned. Finally basic rules for PM processes are introduced (DIN , 2009, p.46).

The DIN 69901-2 process model is the essential part of this standard. Before introducing the model, DIN gives an overview on how PM is embedded in an organization. The “Process House” depicts all relevant process groups of an organization. It classifies four process groups (DIN , 2009, p.46):

- “Management Processes” are subordinate to PM and include multi-project management processes.
- “Project Management Processes” are all processes needed to accomplish single projects.
- “Supporting Processes” are those processes not directly related to PM (e.g. HR, Purchasing).
- “Processes for Value Creation” are those processes directly related to projects results.

In Table 9, the process model is shown. It classifies all PM processes regarding the “Project Management Phases” and the “Project Subdivisions”. Project management phases contain several PM processes necessary to complete a phase. Furthermore, process subdivisions arrange thematically associated PM processes. All PM processes are described uniformly and are graphically depicted in the same format.

	Process Subdivisions	Project Management Phases				
		Initialisation	*Definition*	*Planning*	*Control*	*Conclusion*
Project Management Processes	*Procedures and Time-limits*		•Define Milestones	• Plan Procedures • Create Time Schedule • Create Project Plan	•Activate Procedures •Control Time-limits	
	Changes			• Plan handling with Changes	• Control Changes	
	Information/ Communication/ Documentation	• Accord Approval	• Configure Information, Comunication and Reporting System • Define Projectmarketing • Accord Approval	•Plan Information, Comunication, Reporting System and Documentation • Accord Approval	•Control Information, Comunication, Reporting System and Documentation •Accord Acceptance	•Develop Final Report •Archive Project Documentation
	Cost and Finance		•Estimate raw Efforts	•Develop Cost- and Financeplan	•Control Cost and financial Resources	•Create post Calculation
	Organisation	•Clarify Competence •Choose PM Processes	•Establish Project Core Team	•Plan Project Organisation	•Execute kick-off •Establish Project Team •Develop Project Team	•Carry out a Conclusion Discussion •Appreciate Achievments •Close Project Organisation
	Quality		•Define Success Criteria	•Plan Quality Assurance Control	•Assure Quality	•Assure Project Experience
	Ressources			•Create the Resource Plan	•Control Ressources	•Recycle Resources
	Risk		•Determine Handling of Risks •Analyse Project Environment /Stakeholder •Evaluate Feasabilty	•Analyze Risks •Plan Risk Response Measures	•Control Risks	
	Project structure		•Create Structure	•Create Project Structure plan •Describe Work Packages •Describe Procedures		
	Contracts and additional demand		•Define Handling of Contracts •Determine Content of Contracts with Client	•Determine Content of Contracts with Supplier	•Carry out Contract with Supplier and Customer •Control Additional Demand	•Close Contract
	Objectives	•Sketch Objectieves	•Define Objectives •Define Project Content		•Control Objective Attainment	

Table 9: Process Model of DIN (DIN, 2009, p.51)

By adapting PM processes to the desired context, on the one hand it has to be decided what process is relevant to the project, and on the other hand it is also important to clarify how the chosen process is applied within the project. Key processes are labeled, to facilitate the tailoring. This adaption should occur in the initiation stage. In repeatable projects the responsible organization should determine an assortment of processes to increase acceptance among the staff (DIN , 2009, p.50).

DIN 69901-3 gives an overview on methods used to support process functionality. A systematic collection of all methodologies and tools is given in the Appendix p. 122. DIN 69901-4 comprises a data model for storage and processing project-specific data. This part is set up to provide a uniform programming language in used PM software. Finally, DIN 69901-5 represents a dictionary with uniform explanation of the terms used in PM.

Additionally to DIN 69901, the Handbook 472 for PM comprises the following standards:

- DIN 69900: Network planning techniques (Netzplantechnik)
  Organizational and Process structures
- DIN ISO 10007: Quality management – A Guide to Configuration Management
- DIN-Fachbericht ISO 10006: Quality Management Systems – A Guide for Quality Management in Projects

3.4.4 Definitions of Project and Project Management

*A **project** is...an intention that is characterized essentially by uniqueness in its general conditions in its totality, e.g.* (DIN , 2009, p.155)*:*

- *Set target,*
- *restrictions due to time, financing or personnel,*
- *differentiation from other intentions,*
- *Project specific organization.*

***Project management** is…the entirety of executive functions, management organization, leadership techniques, and management instruments for initiation, definition, planning, steering and closing of projects"* (DIN , 2009, p.158).

3.4.5 Certification

DIN does not provide certification schemes for PM practitioners. Since also GPM worked on the development of DIN 69900ff the DIN standard may be considered in the certification program of GPM.

3.4.6 Application Field

"The standard is applicable by both big, complex project management systems and smaller, simple systems" (DIN , 2009, p.34).

3.4.7 Resume

For the first time also a data model to store and process project specific data has been developed. This data model enhances the compatibility between project data files and systems from different producers of PM software (Wagner & Waschek, 2009, p.29).

DIN 69901-2 illustrates a complete cycle of a project with its associated processes and can easily be adopted from practitioners to meet their requirements (Wagner & Waschek, 2009, p.30).

DIN is especially useful for practitioners because it provides precise descriptions to realize projects. For example, an organization can duplicate a PM process from DIN 69901-2 and make it usable as an internal PM standard. This is mainly possible due to the modular structure of the process model. But processes can also be customized and modified to meet the requirements of a specific project (Wagner & Waschek, 2009, p.30).

Due to a compatible design between the interfaces of the process model to other management systems, synchronization is facilitated. The process model demonstrates an excellent basis for the synchronization of internal PM activities to activities from external project partners (Wagner & Waschek, 2009, p.30).

Due to a uniform vocabulary and clearly elaborated concepts, DIN advances common comprehension in PM and supports organizations by introducing and synchronizing processes, methods and PM data (Wagner & Waschek, 2009, p.30).

The process model of DIN 69901 has also strong influence on the elaboration of the international PM standard of ISO 21500. Therefore, the process model is globally recognized.

4 Variations of PM-Standards

By applying universal standards to different project types and line organizations, the standard has to be tailored to meet specific needs. This results in different variations of standards and other PM systems. Besides universal standards, also differentiated standards whose are applicable to specific projects are distributed worldwide. These standards provide a specific procedure to follow and are detailed on certain situations in specific projects. Due to a high level of detail, available standards differ strongly from each other (e.g. terminology, procedure models, maturity models etc.).

4.1 Industry-sector-specific Standards

Standards, tailored to certain industry requirements, range across several sectors of the industry (e.g. automotive, IT, construction etc.). These approaches are based on differentiation, development or innovation of PM methodologies in the applied sector. Hereinafter, a few chosen standards are explained.

4.1.1 Automotive SPICE

Software Process Improvement and Capability Determination (SPICE) or ISO/IEC 15504 is an international standard for assessing processes. Automotive Spice is a variation of ISO/IEC 15504. Its purpose is the evaluation of the capability in development processes of suppliers in automotive industry. Automotive SPICE is a registered trademark of the Verband der Automobilindustrie e.V. (VDA) and was published in 2005 by the Automotive Special Interest Group.

Automotive Spice is basically composed out of two dimensions:

In the “Process Dimension”, processes are defined and classified into process categories. Processes are grouped into “Primary Life Cycle Processes” (Acquisition, Supply and Engineering), “Organizational Life Cycle Processes” (Management, Process Improvement and Reuse) and “Supporting Life Cycle Processes” (Quality, Documentation, Change etc.) (Automotive SIG, 2010, p.13).

In the “Capability Dimension”, a set of process attributes, whose are grouped into capability levels, are defined. The process attributes allow the measurement of characteristics of the process capability. *”A capability level is a set of process attribute(s) that work together to provide a major enhancement in the capability to*

perform a process" (Automotive SIG, 2010, p.13). In automotive SPICE six capability levels are defined. In Figure 15 the relationship among the two dimensions is shown.

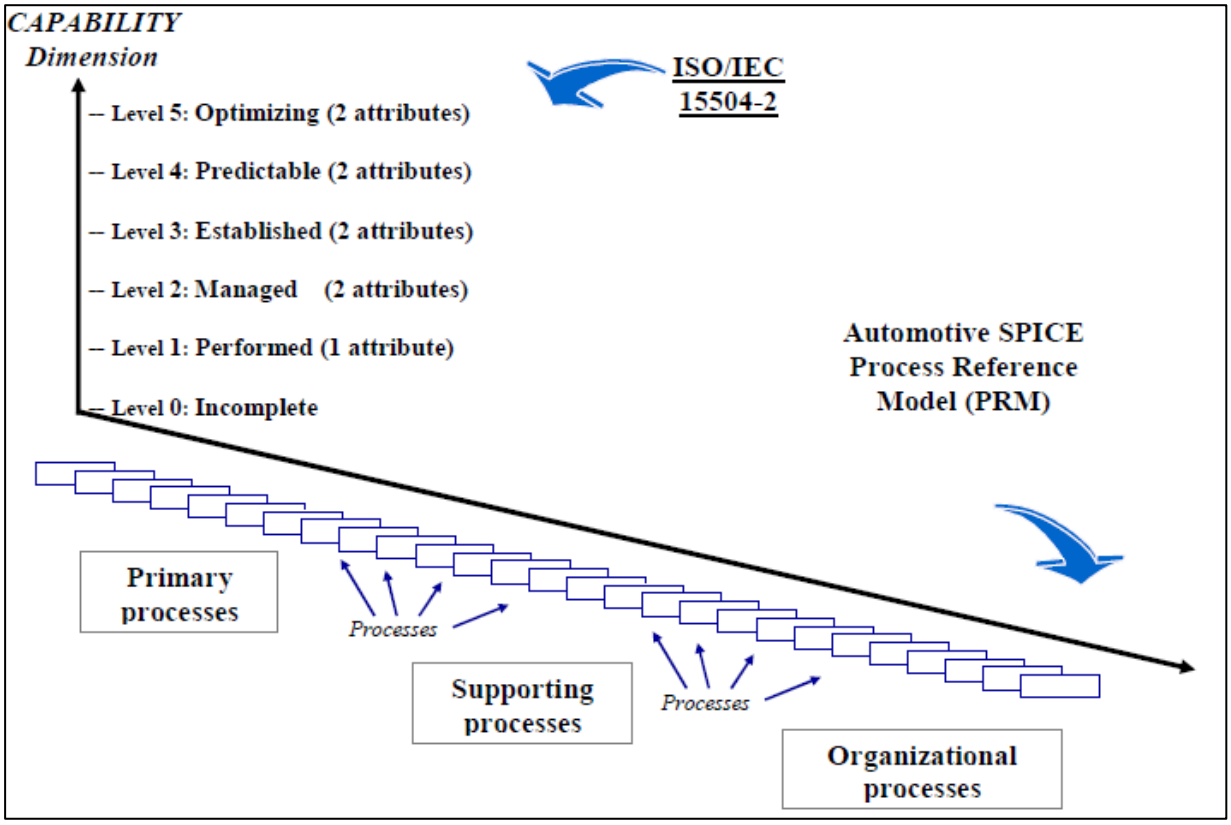

Figure 15: Automotive Spice (Automotive SIG, 2010, p.13)

4.1.2 IT-Infrastructure Library (ITIL)

IT-Infrastructure Library (ITIL) provides a framework of best practice guidance for IT service management. Service management ensures that IT-services are aligned to the business needs and support business on a day to day basis. ITIL is available in its 3rd version and was developed by the CCTA. Nowadays, it is a registered trademark of OGC.

ITIL comprises a complete service lifecycle and is based on five books (Cartlidge et al., 2007, p.5):

"Service Strategy" transfers service management into strategic assets. ITIL describes the conceptual and strategic background of IT-services.

"Service Design" defines and designs services on the base of strategic goals and business requirements.

“Service Transition” ensures that developed designs of strategic requirements are provided efficiently within schedule for operational use considering risks and dependencies.

“Service Operation” performs services according to agreed service levels. Service Operation is responsible for ensuring execution and provides the required value contribution to customers.

“Continual Service Improvement” gives guidelines in maintaining, creating and improve the implemented system.

In Figure 16 the coordination of all elements in ITIL is shown. The outer ring represents complementary publications whose are supposed to support the five core books.

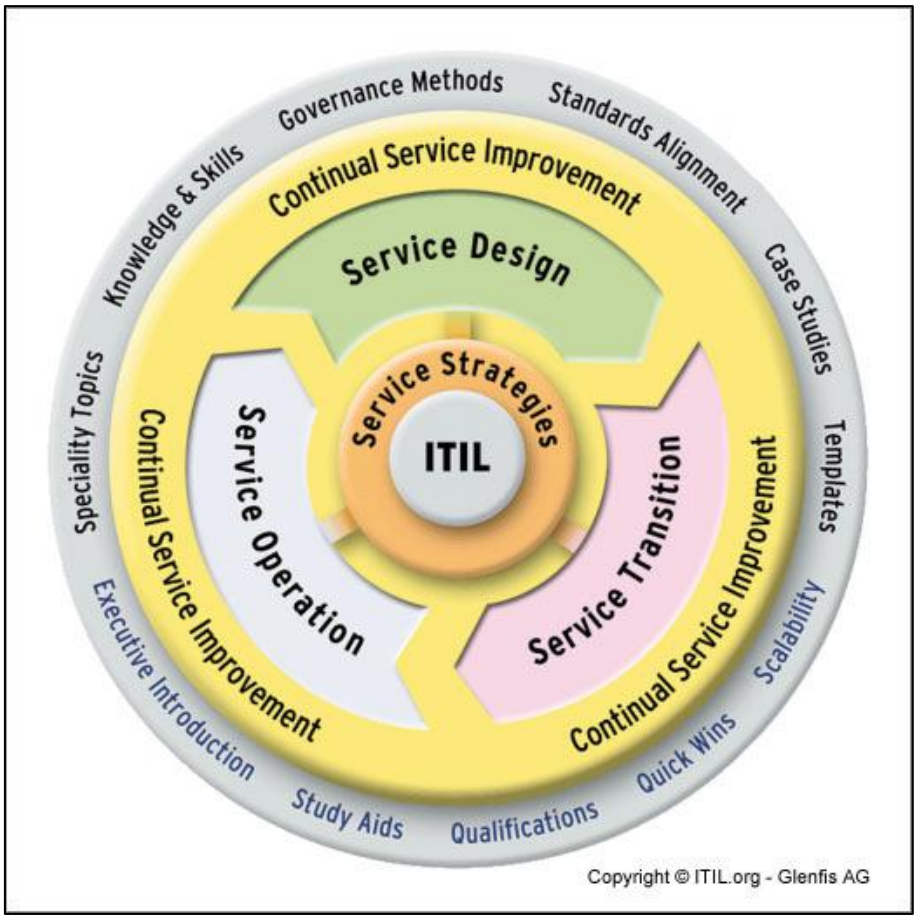

Figure 16: Integrated Service Life-cycle approach (Cartlidge et al., 2007, p.1)

4.1.3 Rational Unified Process (RUP)

The Rational Unified Process (RUP) is a Software engineering process. It has iterative, requirements driven and architecture focused approach to software development (Ambler, 2005).

"It provides a disciplined approach to assigning tasks and responsibilities within a development organization. Its goal is to ensure the production of high-quality software that meets the needs of its end-users, within a predictable schedule and budget" (Rational Software , 1998, p.1).

RUP defines nine disciplines and four phases, as shown in Figure 17**:**. "Disciplines" describe the content of the method. Furthermore, the organizational effort to each discipline in each phase is depicted.

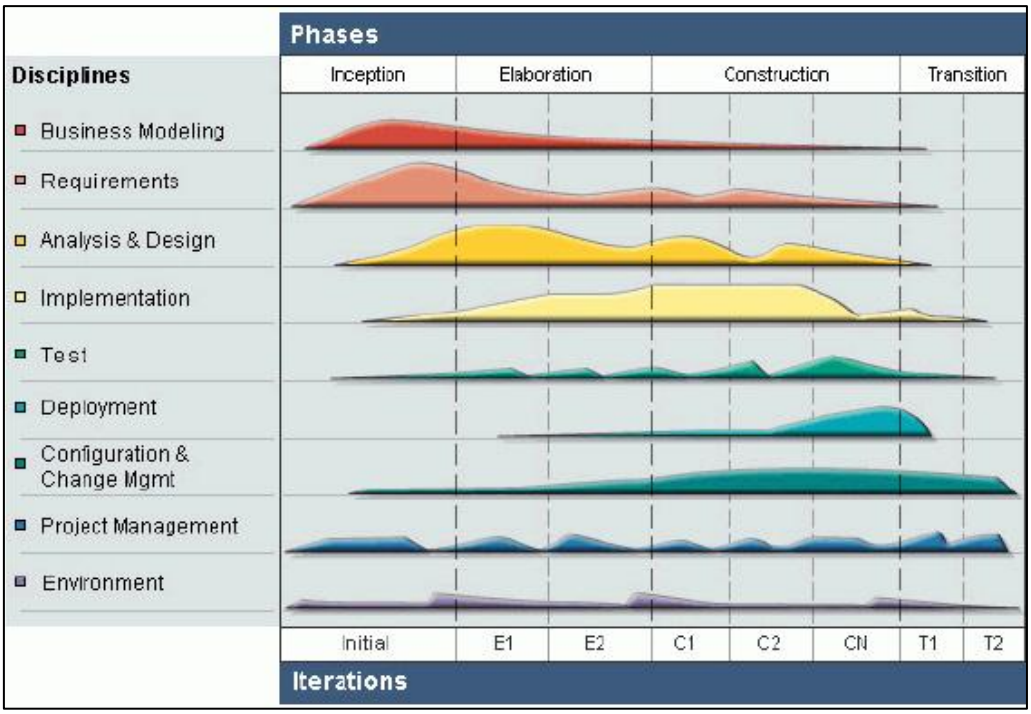

Figure 17: The Rational Unified Process (Rational Software , 1998, p.3)

"Business Modeling" ensures that software meets business needs. In "Requirements" is described what the system should be able to do. The discipline "Analysis and Design" shows how the system will be realized in the implementation phase. (Rational Software , 1998, p.11). The aim of the "Implementation" discipline is to transform the design into an executable code. In the "Test" discipline an evaluation is performed to ensure quality. In the "Deployment" discipline the successful product releases are delivered to its end users. "Configuration and Change Management"

describes workflows on how to manage access to numerous products. Not only versions are tracked over time, also possible changes are managed. In “Project Management” activities regarding the project are managed. The “Environment” discipline ensures that supporting processes and tools are available for the development team (Ambler, 2005, p.10).

4.2 Company-specific Standards

To overcome difficulties in carrying out projects, organizations tend to develop their own approach to PM. As a result many differentiated PM standards are available. One of the main benefits is that the internal standard is directly tailored to the organizational- and the project environment. Therefore less administrational effort and time are required during project performance. However, those standards have the disadvantage that there is a lack of compatibility to external standards. In the following two, out of a variety of company-specific standards, are introduced.

4.2.1 The methodological Framework Chestra (Siemens)

The PM culture of Siemens Business Services (SBS) is based on the methodological framework Chestra. Since 2011 SBS is part of Atos Origin and provides IT- services like consulting, System integration, management of IT-infrastructure as well as software development.

Chestra is derived from the two terms “Chess” and “Orchestra” and describes the right strategy and the mechanisms of coordination to implement project objectives and to perform projects successfully. It combines content of traditional PM methods with content of systematical PM methods. With this approach the methodological framework develops PM from a primary supporting function to a total transformation of the corporate strategy. Therefore, it combines methodology and philosophy.

Chestra is based on business processes and regards enterprise as the sum of all business processes. Within the methodology, business objectives are translated into business process performance objectives. Next, business processes are designed as long as they meet defined performance objectives. The view on the organization is process-oriented and not functional- based. Therefore, Chestra uses a variety of methodologies (Klein, 2001, p.340 ff.).

Chestra is composed out of principles, framework, methodologies, and techniques (Withalm, n.d., p.4 ff.).The future organizational model should serve as driving force for the development. The present situation is treated as a past state. Chestra supports iterative learning. A system cannot be accomplished perfectly at first instance. Therefore, Business re-engineering, transfers the focus on efficiency of single tasks to cross-functional business processes and highlights technologic potential. The requirements of users should be met at the date of delivery. Therefore a detailed requirements specification is avoided until design phase. Chestra supports a successive realization of single modules in shortest possible time, to avoid exaggerated specifications. It is aware on the changing business environment. The system has to be integrated in overall business environment to deliver its full potential. Chestra offers a framework for decisions in every working area. Corporate vision has to be connected to system design through a framework which supports a coordinated procedure and therefore leave enough scope for organizational learning. It focuses on the benefit for users and not only on perfect technological functionality. Chestra creates a win-win situation for all participants by involvement of all stakeholders.

Chestra`s framework allows an iterative development within a superordinate architecture. It has an adaptable and flexible structure to plan, execute and integrate business change. Below the framework level, Chestra provides detailed methodologies and techniques for project planning and project monitoring.

4.2.2 IT-Project Management (BMW)

IT-Project Management (ITPM) is a general IT-method, which was developed from the BMW-Group for internal use. All IT projects in BMW have to be carried out according ITPM guidelines; therefore it is formulated in a very generic manner. It is split into phases, and allows an iterative course through the phases two to five.

It is based on four key principles which are valid for all IT processes within the BMW-Group (Jug, 2004, p.11ff.).

Deliverables are planned and agreed. A fold card provides a compact summary of typical and important project results. It helps to plan important deliverables at the right time, the handover is always kept in mind and also not so urgent topics are always visible. At the beginning of a new phase, deliverables have to be planned,

and then activities are defined. Like this, clear agreements are achieved. Checklists are developed during the execution to meet acceptance criteria.

Tailoring enables, within a defined scope the adaption of regulations of ITPM on a specific situation. Adapted are extent, depth, roles and responsibilities, methodologies and techniques, and execution of the acceptance test.

Roles are defined within the project to create an environment with clear accountabilities and responsibilities. This ensures fewer discussions by performing. It is important that true names are listed and not placeholders.

In a gateway, deliverables are tested and accepted. The project team tests whether the maturity of deliverables is sufficient. Assessors check deliverables based on the checklists and give their recommendation. Afterwards, the management decides to stop or go on. All processes are described individually.

4.3 Project- Type-specific Standards

Projects can be categorized according to criteria whose affect directly the project. Typical characteristics can be for example highly innovative, risky projects, or projects with high urgency and complexity (Dierig et al., 2007, p.6). Also in this category a lot of specialized literature is available.

One example might be the Management of Risk (M_o_R), which is a trademark of OGC and was firstly published in 2002. Since 2009 it is available in its 3rd edition. It is compatible to other OGC publications like PRINCE2 and it is consistent to the new international standard on risk management (ISO 31000). The PRINCE2 risk approach is based on M_o_R. The standard is based on four core concepts (Williams, 2010, p.3):

“M_o_R Principles” are an essential part of the standard. This approach enhances risk management as an internal control mechanism in organizations. The Risk Management system is therefore regulated with these principles:

- Alignment with objectives
- Fitting the context
- Engaging stakeholders
- Providing clear guidance

- Informing decision-making
- Facilitating continual improvement
- Creating a supportive culture
- Achieving measurable value

The “M_o_R Approach” describes how these principles can be applied in individual organizations. Therefore, a Risk Management Policy, Process Guide and Strategies, supported by the use of Risk Registers and Issue Logs, have to be defined.

The part “M_o_R Processes” describes how risks are identified, assessed and controlled.

“Embedding and Reviewing M_o_R” is set up to control and improve continuously the application principles, approach and processes across the organization. In Figure 18 the relationships among the concepts are shown.

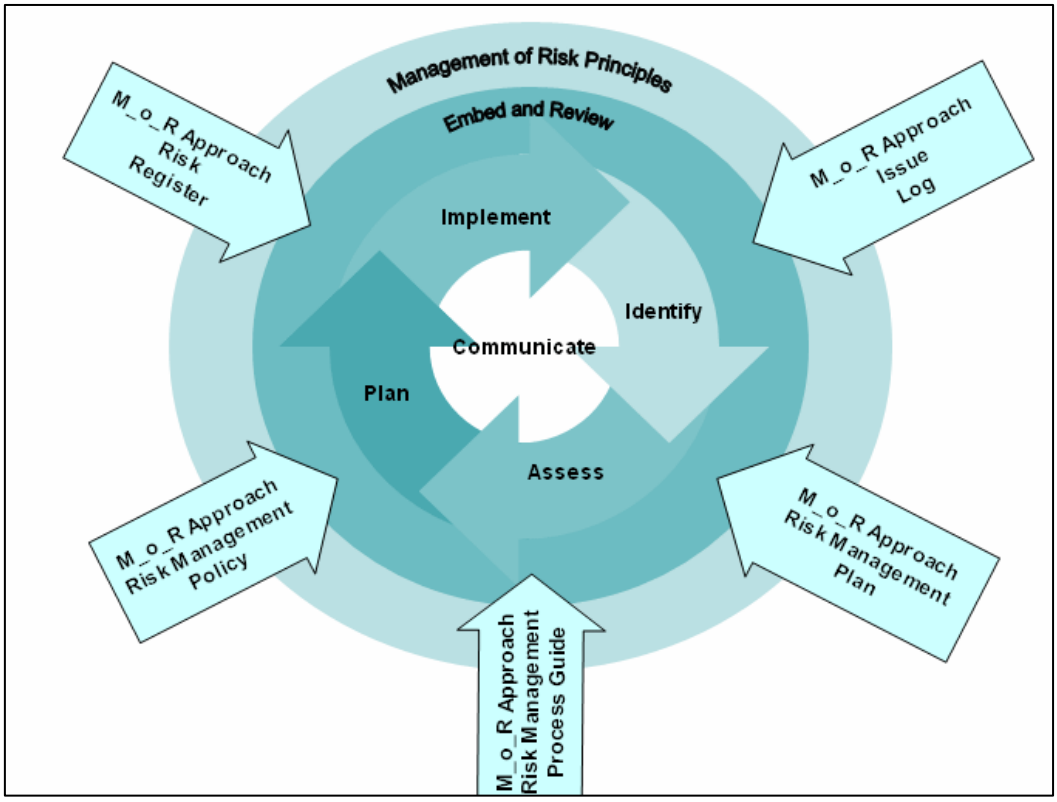

Figure 18: M_o_R Framework (Williams, 2010, p.2)

5 Development of consistent Criteria and Classes

Projects differ from each other in many ways. Due to a wide distribution, specific application of PM all over the world, cultural influences and different fields of expertise a complete systematical classification of projects is difficult. In PM theory several attempts are made. Criteria for classification can be (Motzel, 2010, p.159):

- Project objective or project scope
- Project sponsors (internal/external-, private/public projects)
- Degree of innovation, degree of repetition, level of difficulty (pioneering/routine projects)
- Interested parties involved (national/ international/ multi-cultural projects).

Other dimensions for classifications of projects can be (Gessler, 2009, p.34 ff.):

- Business Value (strategic/ tactical projects)
- Complexity of projects: According to Dierig (2007, p.11) every project can be categorized by a few relevant dimensions of complexity. With these dimensions profiles for all project categories can be developed and an appropriate PM system can be derived. The dimensions contain number and type of networking, goal orientation and degree of innovation.
- Project organization: Motzel (2010, p.185) distinguishes between three project organization types. In an impact project organization, the project board has a consulting and coordinating function and the authority remains in the line. In a matrix- project organization the authority is divided between the line and the project board. Therefore, project staff is controlled by more superiors. In an independent project organization the project board has responsibility and complete authority of the overall project.
- Project control (technocratic/ agile projects)

Commonly projects are a mix of many project types, therefore a classification is difficult. In practice, projects are broken down roughly in the “classic” project categories, which are investment projects, research and development projects, organizational projects and IT-projects (Motzel, 2010, p.160).

A universal PM approach has to be valid for all specific project situations and project categories. Although, between universal standards some commonalities are visible, they differentiate in PM aspects, explanations and approaches enormously. Main commonalities can be seen in the functional decomposition of PM and process descriptions.

All standards contain a functional decomposition of PM. This decomposition reflects main aspects of PM and is helpful for orientation by applying the standards. PMI calls them knowledge areas, in PRINCE2 themes structure the methodology, DIN arranges its processes in process subdivisions and IPMA groups all competence elements in three ranges.

To sequence PM tasks, process descriptions are provided by three of the four standards. IPMA does not support the process approach but it refers to possible process steps to provide a meaningful sequence to practitioners. In the other standards processes are used to describe what have to be done before the process starts, how the process can elaborate the input and what purpose the process have.

Terminology and phase models show already some differences. Also the structure, organization, and adaption of each standard are different. Classes and criteria are chosen to reflect main relevant PM aspects.

In Figure 19 an overview of the developed criteria and classes is shown. On the one hand, criteria and classes are established regarding project attributes. On the other hand criteria are derived from the standard itself and brought into a consistent matrix.

Seven generic terms define the compared fields. “Association” gives an overview of the organization itself and especially where the standard is used the most. In “Publication”, the evolution of the main publications is described. “Terminology” outlines major differences of definitions in the area of PM. “Project Structure” focuses on project execution. Each standard defines different project phases or stages and to ensure progression different areas are considered. The handling of decision points within an organizational structure is highlighted. “Project Management Criteria” comprise areas related to a project. Those are compared at detailed level. The direct confrontation shows which processes, tools and methodologies are defined by each standard and how different aspects are treated. In “Adaptability”, embedding of standards into existing line organizations, which obviously is a decisive success

factor for project performance, is considered. Finally, the certifications offered by three associations are compared by defining the level of qualification reached by each certification level.

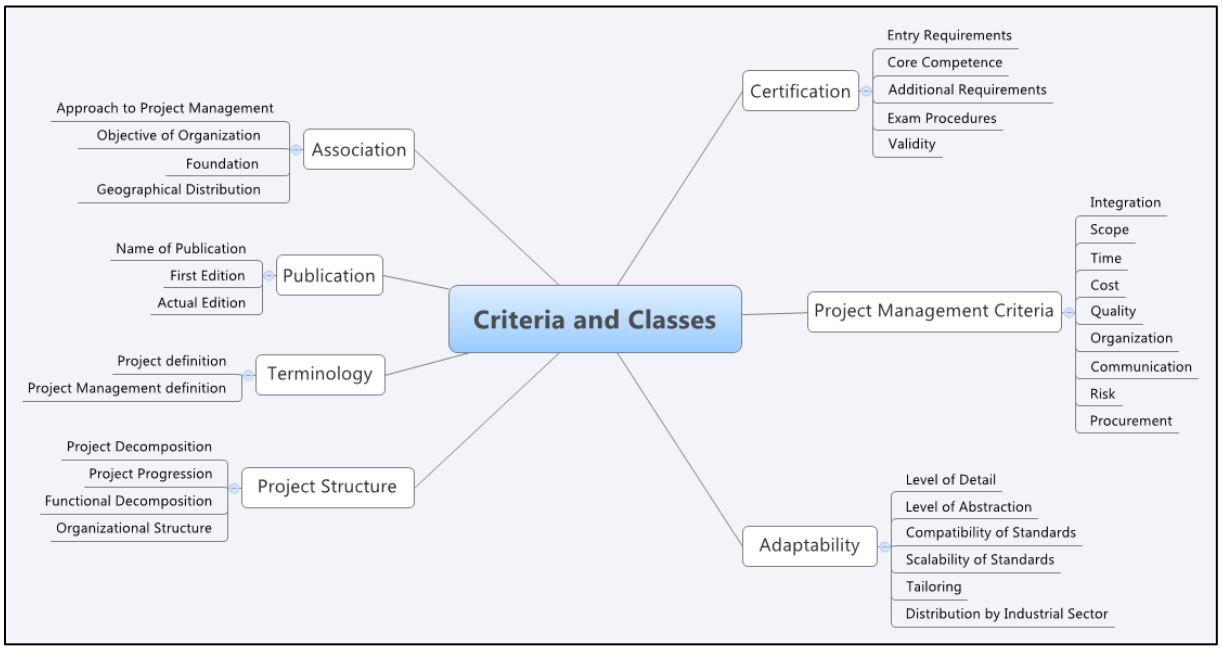

Figure 19: Criteria and Classes

To make standards comparable to each other, some assumptions and compromises have to be found. Since IPMA has not a process based approach, competence elements with the most common features related to the compared area are shown. Three standards have a process-based approach to PM. The processes include different activities and cannot be directly allocated to each other. PM criteria are structured according PMI`s Knowledge Areas.

6 Systematic Comparison

The following comparison outlines the developed criteria and classes. The direct confrontation of the universal PM standards to the criteria matrix highlights the differences. To refine comparison`s results, seven generic fields (Association, Publication, Terminology, Project Structure, Adaptability, Project Management Aspects and Certification) are chosen.

6.1 Association

6.1.1 Approach to Project Management

All associations have a different approach to PM. IPMA focuses on competences of people involved in the project. PMI, OGC, and DIN follow a process oriented approach. While PMI covers all areas and aspects of PM, OGC covers only parts relevant to the PRINCE2 methodology. With PRINCE2, OGC provides a methodology with clear instructions to manage and control projects. “Business Case”, “Quality” or “Changes” as well as principles like “Manage by Stages” and “Manage by Exception” appoint the regulation framework of PRINCE2. Product based planning as a central method underlines the stronger focus on products (Bölke, 14.09.2009, p.2). DIN`s approach is based on a model. Therefore, only functions relevant to the model are considered. In Table 10 the different approaches to PM are summarized.

IPMA – ICB	PMI – PMBoK	OGC – PRINCE2	DIN 69901
•Competence oriented PM approach	*•Process oriented PM approach* *•Knowledge based approach*	*•Process and practical oriented PM approach* *•Methodology*	*•Process oriented PM approach based on a model*

Table 10: Approach to Project Management

6.1.2 Objective of the Organization

IPMA focuses on the qualification of people involved in a project, classifying three ranges of competence. Due to the competence based approach to PM, the certification of project managers is a main concern of IPMA.

PMBoK, as the central reference book of PMI, scores with a comprehensive collection of best practices in PM. It represents a pool of tools and methods whose

can be applied in projects. Therefore, PMI focuses on a comprehensive collection of knowledge for PM.

OGC and DIN are public institutions. While OGC is focused on public services like Government estate management and PM, DIN elaborates standards as a service for economy, government and the society. In Table 11 the main objectives of the four different organizations are shown.

IPMA – ICB	PMI – PMBoK	OGC – PRINCE2	DIN 69901
•Focus on the education of project managers	*•A collection of knowledge in PM* *•Reference book*	*•Business solutions for Government and PM*	*•Norms and standards as a service for the economy*

Table 11: Objective of the Organization

6.1.3 Foundation

In the late sixties PM became institutionalized. In this time, the two major professional project management bodies were established. Also in Germany, DIN recognized the importance of PM and started its work on network planning technique in 1967.

PRINCE was developed in the late eighties by the CCTA. Later on CCTA became part of OGC. Since 2010, OGC is part of the new Efficiency and Reform Group (ERG) within the Cabinet Office (OGC, 2011a). In Table 12 foundation details are summarized.

IPMA – ICB	PMI – PMBoK	OGC – PRINCE2	DIN 69901
•Founded in 1965 as an association for project managers *•Since 1979 registered seat in Switzerland*	*•Founded in 1969 in Pennsylvania, USA* *•Since 2004 ANSI Standard*	*•Founded in 1999 in the United Kingdom* *•Since 2010 part the Cabinet Office*	*•Founded in 1917 in Berlin, Germany* *•Since 1967 network planning technique*

Table 12: Foundation

6.1.4 Geographical Distribution

All standards are used around the world and are globally recognized. PMI is the de facto standard in North America and is the global market leader. OGC`s PRINCE2 was developed for the public sector in the United Kingdom and is still used by the government. Due to its benefits it became known around the globe and supports various organizations by carrying out projects. IPMA acts as an umbrella organization

with around 53 member organization worldwide. Also DIN, as a national standard, has a strong influence on ISO 21500 and hence will support standardization in PM around the globe. In Table 13 the distribution of each standard is shown.

IPMA – ICB	PMI – PMBoK	OGC – PRINCE2	DIN 69901
•*International used* •*Coming from Europe* •*Mostly used in Europe and USA*	•*International used* •*Coming from North America* •*Market leader* •*Mostly used in Europe and USA*	•*International used* •*Coming from the United Kingdom*	•*National used* •*Coming from Germany* •*Strong influence on ISO 21500*

Table 13: Geographical Distribution

In Figure 20, PMI and IPMA are compared by its global distribution. The Figure shows that both standards are represented in nearly all European countries, while in North America, Asia, South America and Australia PMI is used the most. This strengthen PMI`s market leader position and its influence on PM.

Figure 20: Geographical Distribution of PMI and IPMA (IPMA, 2011b)

6.2 Publication

In Table 14 the different publications of the organizations are shown. Compared to the other publications, the ICB was updated earliest and is therefore the oldest publication. PMI was newly released in 2008, while PRINCE2 was republished in 2009. DIN started to deal with PM in 1974 and published its standards under the category “Projektwirtschaft". In 2009 all standards of PM were republished within the new standards of DIN 69901-(1-5)

IPMA – ICB	PMI – PMBoK	OGC – PRINCE2	DIN 69901	IPMA – ICB
Name of the Publication	*IPMA Competence Baseline (ICB)*	*A Guide to the Project Management Body of Knowledge*	*Managing Successful Projects with PRINCE2*	*DIN 69900 DIN 69901-(1-5) DIN ISO 10007 DIN -Fachbericht ISO 10006*
First Edition	*1999*	*1987*	*1996*	*1974*
Actual Edition	*2006 Version 3.0*	*2008 4th edition*	*2009 5th edition*	*2009*

Table 14: Publications

6.3 Terminology

Within each standard explanation are clear and are used consequently throughout a project. This is important to avoid major misunderstandings. But among the standards differences in explanations are visible, which can affect interlinked projects in a negative way. In this chapter, some of these differences are clarified.

6.3.1 Project Definition

Even though the term “Project” is defined in a similar way, all association are following a different key aspect. IPMA focuses on time and cost restrictions to achieve the objectives, while PMI highlights the uniqueness of project`s result. Furthermore, PMI emphasizes the differentiation between a product, a result and a service. In PRINCE2 this differentiation does not occur, all results are appointed as products. PRINCE2 emphasizes the organization of the project and the Business Case as a continuous justification of the project.

For DIN a project is an intention that is characterized essentially by uniqueness in its general conditions in its totality. Therefore, a project is unique and differs

fundamentally from the daily business. A project has a clear goal orientation, limited resources, clear project boundaries and a specific organization.

To develop universal applicable guidelines, all definitions of projects are kept in general. On the one hand it has the advantage that a variety of tasks and intentions are within these definitions, but on the other hand these definitions are not specified to certain project categories. In Table 15 the key statements of the definitions are summarized.

IPMA – ICB	PMI – PMBoK	OGC – PRINCE2	DIN 69901
•***Time*** *and* ***cost*** *constrained operation to fulfil project`s* ***objectives***	•***Temporary*** *endeavour to create a* ***unique product****,* ***service*** *or* ***result***	•***Temporary organization*** *to deliver business* ***products*** *according to an agreed* ***Business Case***	•***Intention****, characterized by* ***uniqueness*** *in its* ***general conditions*** *in its totality*

Table 15: Project Definition

6.3.2 Project Management Definition

IPMA and OGC use similar definitions. The primary objectives of their definitions are specific leadership functions to evolve projects within its constraints. IPMA mentions that objectives in a project have to be achieved in a safely way, while OGC points out the innovative capacity necessary to evolve projects successfully. IPMA`s agreed criteria are identical to OGC`s performance targets and comprise time, cost, scope, quality and performance as project constraints.

PMI´s definition includes also the fact that knowledge, skills, tools and techniques have to be applied to PM. PMI does not refer to project objectives, but it mentions project requirements. These definitions are kept rather generic. DIN`s definition concentrates on project activities needed to elaborate the Project Management Phases like initiation, definition, planning, steering and closing of projects. In Table 16 the different views on PM of the organizations are summarized.

IPMA – ICB	PMI – PMBoK	OGC – PRINCE2	DIN 69901
•***Planning, organizing, monitoring,*** *and* ***controlling*** *of a project to achieve the project objectives* ***safely*** *and* ***within agreed criteria***	•***Application*** *of* ***knowledge, skills, tools*** *and* ***techniques*** *to project activities to meet* ***project requirements****.*	•***Planning, delegating, monitoring and control*** *of the project and* ***innovation*** *to achieve the project objectives within the* ***expected performance targets***	•*Totality of* ***executive functions, organization, leadership techniques,*** *and* ***management instruments*** *for performing DIN`s* ***Project Management Phases***

Table 16: Project Management Definition

6.4 Project Structure

The project structure refers to the functional decomposition and overall handling of projects to ensure progression and a fast detection of primary considerations during the course of a project. In this chapter, also organizational aspects are considered.

6.4.1 Project Decomposition

Since all organizations have different approaches to PM, also their views to the decomposition of a project are different. Every project can be subdivided into project phases. Project phases are sections within the project life-cycle whose include major deliverables or decision points. The end of a project phase can be appointed with a major milestone. Definition of milestones and major decision points are primarily the responsibility of the project manager.

Table 17 outlines the definitions of the decomposition of a project. A project can be divided into project phases, and, on the other hand a project is categorized by grouping logic related activities. These differences are clearly visible in Table 17 and finally, a comprehensive explanation of all terms is shown.

IPMA – ICB	PMI – PMBoK	OGC – PRINCE2	DIN 69901
Project Phase: *•A discrete time period of the project sequence with major deliverables and decisions*	***Project Phase:*** *•A collection of logically related activities, usually culminating in the completion of a major deliverable* ***Project Management Process Group:*** *•A logical grouping of PM processes*	***Technical Stage:*** *•Set of techniques used* ***Management Stage:*** *•Review and decision points with major deliverables*	***Project Phase:*** *•Timely coherent sections* ***Project Management Phase:*** *•Logic coherent activities*
Project Phases: *• Preparation* *• Design* *• Execution* *• Completion*	***Project Management Process Groups:*** *• Initiating* *• Planning* *• Executing* *• Monitoring and Controlling* *• Closing*	***Management Stages:*** *• Pre-Project* *• Initiation stage* *• Subsequent delivery stage(s)* *• Final delivery stage*	***Project Management Phases:*** *• Initialisation* *• Definition* *• Planning* *• Control* *• Conclusion*

Table 17: Project Decomposition

IPMA has not a process oriented approach. Therefore a detailed comparison is not possible. However, in the competence element “Time and project phases” IPMA refers to project phases and gives the following definition (Caupin et al., 2006, p.60):

“A project phase is a discrete time period of the project sequence, which is clearly separate from other periods. A project phase includes both major project deliverables and decisions which are the basis for the next phase. Phases have defined objectives and may have specified time limits.”

It does not differentiate between project phases and PM phases and is kept generic without further guidelines. In an example IPMA mentions four project phases, which are preparation, design, execution and completion (Caupin et al., 2006, p.33).

PMI´s handling of project decomposition is closer to practice. The PMBoK defines a project phase as a collection of logically related activities in a project life-cycle. As typical criteria for conclusion of a project phase it specifies the completion of a major deliverable. Furthermore it does not differentiate between project- or PM phases.

Phases can overlap or be sequentially executed. *“Project phases are divisions within a project where extra control is needed to effectively manage the completion of a*

major deliverable" (PMI, 2008, p.18). A project phase should not be confused with a Project Management Process Group. Phases have the following characteristics (PMI, 2008, p.19):

- *When phases are sequential, the closure of a phase ends with some form of transfer or handoff of the work product produced as the phase deliverable. This phase end represents a natural point to reassess the effort underway and to change or terminate the project if necessary. These points are referred to as phase exits, milestones, phase gates, decision gates, stage gates, or kill points.*
- *The work has a distinct focus that differs from any other phase. This often involves different organizations and different skill sets.*
- *The primary deliverable or objective of the phase requires an extra degree of control to be successfully achieved. The repetition of processes across all five Process Groups provides that additional degree of control, and defines boundaries of the phase.*

Phases are important for the upper management level to get an overview of the project itself and the status. A project phase provides a basis for control. Decisions can be made with the help of previous deliverables. A project phase ends with a review of deliverables to determine completeness and acceptance.

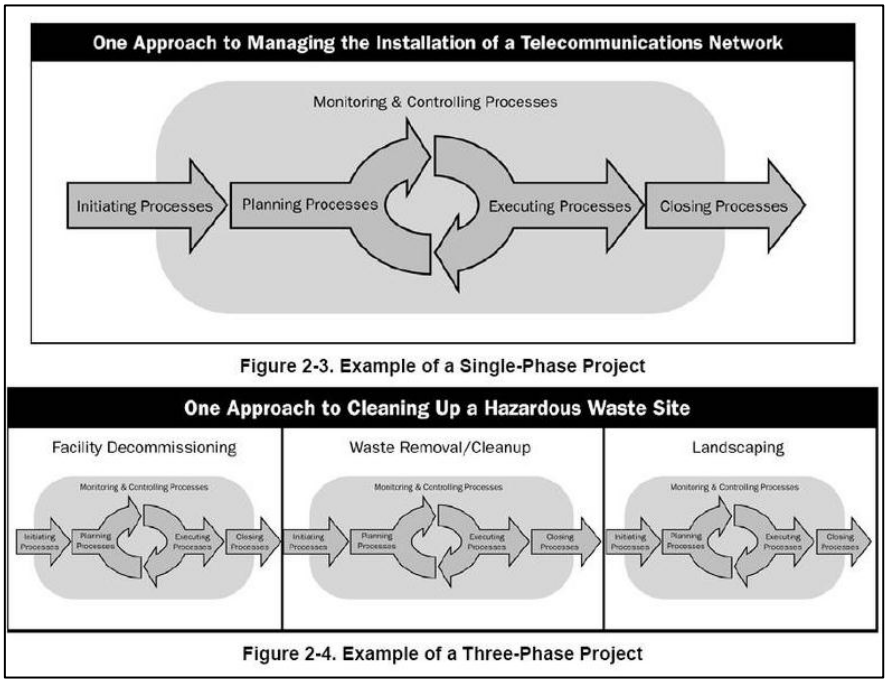

Figure 21: Example of project phases (PMI, 2008, p.19)

In Figure 21 examples of project phases are shown. In Figure 2-3 a single phase project is depicted, while in Figure 2-4 a three phase project is shown. Furthermore, phases have a relationship to each other (PMI, 2008, p.21):

- A sequential relationship is achieved, when the next phase can only start when the previous phase is completed.
- An overlapping relationship can occur when the next phase starts prior the actual phase is completed.
- In an iterative relationship only one phase is planned, and the planning as deliverable for the next phase, is done in the current phase.

Project Management Process Groups are required for any project. They have clear dependencies and are performed sequentially (PMI, 2008, p.41). These five process groups are defined as follows (PMI, 2008, p.443):

"*A logical grouping of project management inputs, tools and techniques, and outputs The project management process groups include initiating processes, planning processes, executing processes, monitoring and controlling processes, and closing processes. Project management process groups are not project phases."*

PRINCE2 defines Management Stages and Technical Stages. Management Stages are completely uncoupled from the processes. There is no conclusion stage but a process "Closing a Project". The feasibility study is accomplished before the project starts. Management Stages are performed sequentially and do not overlap. It is not possible to pass into a next stage until all stage products are delivered, the Business Case is assessed and a plan for the next stage is developed (Murray et al., 2009, p.105).

Stages have decision points and contain a collection of activities and products. Defining stages is a compromise between planning horizon, necessary decision points and risk. A PRINCE2 project has at a minimum one initiation stage. Following amount of stages can vary according to the project complexity. A typical PRINCE2 project is performed as follows (Murray et al., 2009, p.113):

- Pre-Project: A project mandate is given by the upper management. Before setting activities, it is important to evaluate business justification. The Project Board decides also the level of authority of the project manager.

- Initiation stage: The project is planned in detail, controls are defined and the Business Case is developed.
- Subsequent delivery stage(s): The project manager provides day to day control on a stage by stage basis. Work is assigned and progress monitored. Eventually, corrective actions have to be executed.
- Final delivery stage: The project resources are released, the documentation archived and project`s products are passed into operational use.

Another way how to categorize projects work is by breaking it down into Technical Stages. Technical Stages get described by the set of techniques used or the products created. Instead of Management Stages, Technical Stages do overlap (Murray et al., 2009, p.105). Figure 22 illustrates an example of different overlapping Technical Stages in a project life-cycle. Therein, specialists work like designing is broken down into three parts. Overall design is part of the first Management Stage, while detailed and peripheral design is part of the following Management Stages (Murray et al., 2009, p.106).

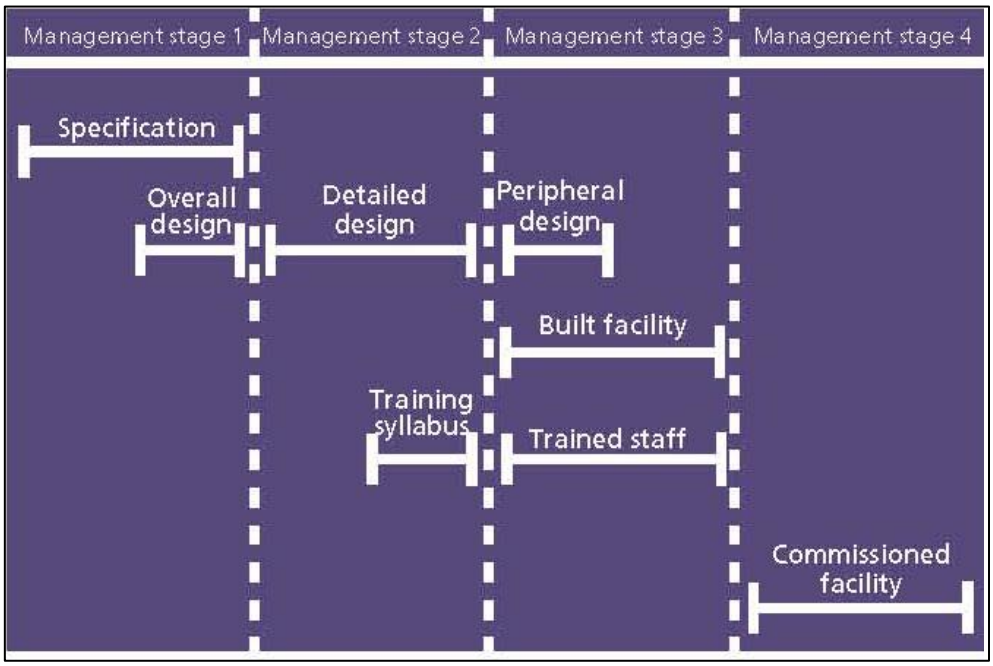

Figure 22: Technical Stages (Murray, 2011, p.106)

DIN differentiates between Project Phases and Project Management Phases. The project life-cycle, from its initiation to closure is subdivided into coherent sections (DIN , 2009, p.48):

- Project Phases subdivide the project life-cycle in timely coherent sections and reflect in that way the course of the project with all its activities.
- The phase classification on the level of PM instead, is oriented on logic coherent activities. The standard distinguishes five Project Management Phases: Initiation, Definition, Planning, Steering and Closure.

Project Management Phases are no chronological phases, but logic coherent phases. Due to this definition an iterative run through the phases and its processes is possible. Project Phases describe the chronological procedures of the project. Therefore DIN`s phases are not comparable to PRINCE2`s Management Stages or PMBoK`s Process Groups and Phases.

6.4.2 Project Progression

In this criterion is shown how project progression is ensured by each standard. In the technical competence range, IPMA describes how a project can be carried out. It uses 20 competence elements to outline technical aspects in project progression. Contextual competences describe promotion of the project and how permanent organisation can support project activities. It should be noted that all competence ranges have to be considered during the course of a project. Since other standards represent a process character, their content is primarily covered in the technical and contextual competence range. But especially behavioural competences are a key success factor in projects, and only IPMA outlines competences regarding interpersonal skills sufficiently.

PMI mentions the importance of soft skills and provides short explanations of interpersonal skills in Appendix G of the PMBoK. To ensure project progression, PMI has 42 PM processes, structured by Knowledge Areas. The driving force in a project is the Work Breakdown Structure (WBS).

In PRINCE2 several activities are grouped in seven processes and in the theme “Progress”, progression is ensured.

DIN bases its model on 56 PM processes. The process subdivision “Procedures and Time-limits” ensures progression. In Table 18 a summary is shown.

IPMA – ICB	PMI – PMBoK	OGC – PRINCE2	DIN 69901
•20 Technical Competence Elements *•11 Contextual Competence Elements*	*• 42 Project Management Processes*	*•7 Processes with a Set of Activities*	*•56 Project Management Processes*

Table 18: Project Progression

6.4.3 Functional Decomposition of a Project

The functional decomposition of a project reflects different aspects of PM. In all standards the project is broken down into functional parts, but each standard uses different terms. PMI defines its Knowledge Areas as follows (PMI, 2008, p.443):

"An identified area of project management defined by its knowledge requirements and described in terms of its component processes, practices, inputs, outputs, tools, and techniques." In Table 19 the different areas are shown.

IPMA – ICB	PMI – PMBoK	OGC – PRINCE2	DIN 69901
• 3 Ranges	*• 9 Knowledge Areas*	*• 7 Themes*	*• 11 Process Subdivisions*

Table 19: Project Areas

To compare project areas, a direct confrontation has been carried out. Since each standard has its peculiarities and different numbers of project areas, it has to be noted, that the comparison is related to contextual criteria. Furthermore, areas are considered as identical when primary activities are in conformity with each other. IPMA does not follow a process oriented approach; therefore this standard is not included in the comparison.

PMI`s Knowledge Areas	PRINCE2 Themes	DIN`s Process Subdivisions
Project Integration Management	*Combined Processes and Themes Change*	*Several Processes Changes*
Project Scope Management	*Plans* *Business Case* *Progress*	*Project Structure* *Objectives*
Project Time Management	*Plans* *Business Case* *Progress*	*Procedures and Time-limits*
Project Cost Management	*Plans* *Business Case* *Progress*	*Cost and Finances*
Project Quality Management	*Quality* *Change (Configuration Management)*	*Quality*
Project Human Resource Management	*Organization*	*Organisation Resources*
Project Communications Management	*Progress*	*Information/ Communication/ Documentation*
Project Risk Management	*Risk*	*Risk*
Project Procurement Management	*Not covered*	*Contracts and Additional Demand*

Table 20: Direct Comparison of Project Areas

Table 20 shows the project areas in accordance with each other. When comparing PM criteria, this table is taken as basis (see chapter 6.6).

6.4.4 Organizational Structure

In this chapter, the proposed project organization of each standard is discussed. IPMA does not recommend a specific organization for projects, but it defines Interested Parties as*…" people or groups, who are interested in the performance and/or success of the project, or who are constrained by the project"* (Caupin et al., 2006, p.42). Furthermore, IPMA differentiates between permanent- and project organization. In the competence element "Project Organization" the organizational structure of a project is designed and maintained.

Also PMI defines stakeholders (See Chapter 2.3) and refers to a strong influence of the corporate organization to the project. The establishment of the right organization is explained in the Knowledge Area "Human Resource Management".

In PRINCE2 the project organization is a key aspect of the methodology. To establish a structure with clear accountabilities and responsibilities, four levels of management are defined (Murray et al., 2009, p.33f.):

The "Corporate or program management" is outside the project organization. It commissions a project and defines tolerances. In the "Directing" level the project board directs the project. In the "Managing" level the project manager provides day to day control. In the "Delivering" level the team manager is responsible to deliver projects products.

DIN refers to the "Process House" (see chapter 3.4.3), but no roles are defined. In the process "Clarify Competences", accountabilities and responsibilities are distributed. In Table 21, the organizational structures of each standard are summarized.

IPMA – ICB	PMI – PMBoK	OGC – PRINCE2	DIN 69901
• *Definition of Interested Parties* • *Differentiation between Permanent- and Project Organisation*	• *Definition of Stakeholders* • *Strong influence of corporate organization to the project*	• *Four Levels of Management with predefined Tolerances* • *Clear defined roles and Responsibilities*	• *Process House, no definition of roles* • *Clarify competences*

Table 21: Organizational Structure

6.5 Adaptability

To implement one of the evaluated standards executive managers have to consider different aspects. Usually, particular elements or the complete concept is adapted.

Also the terminology has to be adapted to existing guidelines and documents of the corporate organization. In these guidelines most important elements, process steps, and tools of the PM system are described. Based on this, training courses are offered to future project team members (Pantelic, 2008, p.2).

Because of a high range of choices, selection of the right PM standard can be a challenging task. The challenge is to identify a standard that (Ahlemann et al., 2009, p.292)

- is widely used among project partners and stakeholders so that consensus can be established,
- is applicable for this type of organization and the type of projects so that it can be implemented efficiently and
- unfolds real benefits for the organization so that it is effective.

Project types have different requirements to PM methods or tools. While in IT projects a high demand on communication, planning and control of resources is necessary, in engineering, procurement, costs and quality need more control (Pantelic, 2008, p.5).

Modularization and splitting projects into phases encourages the utilization of standards. Nevertheless, a standard has to be adapted to the specific needs of the project and the organization. A standard cannot be used as an overall solution, but rather as a reference model with best practices or as a template for implementing the right PM processes.

6.5.1 Level of Detail

The level of detail gives information on how detailed aspects of PM are described in each standard. Even though, all standards are set up to manage projects successfully, each organization emphasizes different aspects of PM. In Table 22 the level of detail in PM from each standard are shown.

IPMA – ICB	PMI – PMBoK	OGC – PRINCE2	DIN 69901
High Level of Detail: *• Soft Skills* ***Low Level of Detail:*** *• Activities*	***High Level of Detail:*** *•Methods and Tools (descriptive)* *•Processes* ***Low Level of Detail:*** *•Roles and Responsibilities* *•Soft Skills* *•Supporting Documentation*	***High Level of Detail:*** *• Roles and Responsibilities* *• Processes* *• Supporting Documentation* *• Tailoring* ***Low Level of Detail:*** *• Methods and Tools (referenced)* *• Soft Skills*	***Low Level of Detail:*** *•Short Description of the Processes* *•Few Methods*

Table 22: Level of Detail

6.5.2 Level of Abstraction

The level of abstraction defines the practical application of the standards. The ICB shows a high level of abstraction due to the renouncement of a process model. Therefore, no processes, methods or tools are defined and the standard is not directly applicable by a corporate organization.

The PMBoK represents a reference book. It provides processes with numerous methods and tools for practitioners. The missing part for practical application is the organizational aspect. Therefore, a middle level of abstraction is justified.

In PRINCE2 the organizational aspect is well elaborated. Within the principle “Management by Exception” clear tolerances are defined. Therefore, a functioning organisational structure with clear defined roles and responsibilities can be established. The level of abstraction is respectively low and the method is strongly praxis oriented.

DIN shows a middle level of abstraction due to a low number of methods and tools for process support. In Table 23 a summary of the standard is shown.

IPMA – ICB	PMI – PMBoK	OGC – PRINCE2	DIN 69901
High Level of Abstraction: *• Describes PM in general* *• No Process Definitions* *• No Methods and Tools*	***Middle Level of Abstraction:*** *• Process Definitions* *• Numerous Methods and Tools*	***Low Level of Abstraction:*** *• Methodology* *• Process Definitions with clear Instructions*	***Middle Level of Abstraction:*** *• Process Definitions* *• Methods and Tools maybe insufficient*

Table 23: Level of Abstraction

6.5.3 Compatibility to Standards

In this chapter the compatibility of the PM standards to each other and to other standards is analyzed. Due to the high level of abstraction of the ICB and its competence orientation, a detailed comparison has not been carried out.

PMBoK, as an ANSI standard is compatible to other standards and maturity models published by PMI.

The basic approach to quality management is compatible with that of the International Organization for Standardization (ISO). Therefore it is compatible with proprietary approaches and non-proprietary approaches like Total Quality Management (TQM), Six Sigma, Failure Mode and Effect Analysis (FMEA), Design Reviews, Voice of the Customer, Cost of Quality (COQ), and Continuous Improvement (PMI, 2008, p.190). Furthermore, PMI is compatible to Scrum and other agile project management methods (Drach, 2011).

PRINCE2 is compatible to ITIL. According to Holdt (2011, p.1) organizations with implemented ITIL processes are able to establish a framework for PRINCE2 projects and support project work with specific know-how. The ITIL-organization may be seen as day to day business which activates projects and accepts deliverables as a client.

PRINCE2 is also compatible to Scrum. *"The careful and tailored application of Scrum and PRINCE2 can create a synergy that results in a dynamic yet controlled product development environment"* (Rankins & Kearns , 2008, p.1).

"With careful thought and an adequate understanding of the principles of PRINCE2 and Scrum, the two methods can be integrated in such a way that the organisation as a whole remains in control of the project, while allowing the sprint team to adjust the scope of sprints in a flexible manner, while still meeting the priority needs of the responsible Product Owner" (Rankins & Kearns , 2008, p.6).

Compatibility is a basic principle of DIN 69901. Due to its modular structure, systems, subsystems, and elements are suitable for connection to conterminal systems in order to create conditions of texturing and formation of synergy effects. In Table 24 the main compatible standards are shown.

PMI – PMBoK	OGC – PRINCE2	DIN 69901
• *ANSI Standard* • *Compatible to other PMI Frameworks* (PMI, 2008, p.105) • *ISO/IEC 17024* • *ISO 9000 series* (PMI, 2008, p.190). • *Scrum procedure model and agile methods* (Drach, 2011)	• *IT Infrastructure Library (ITIL)* (Holdt, 2011) • *Compatible to other Frameworks of OGC* (Murray et al., 2009, p.6) • *Scrum* (Rankins & Kearns , 2008).	•*Compatibility is an essential principle of DIN 69901* (DIN , 2009, p.36)

Table 24: Compatibility to Standards

6.5.4 Scalability of Standards (Project Dimensions)

The scalability of standards describes for which project dimensions a standard is appropriate. IPMA has a competence oriented approach to PM; therefore, it does not provide a PM system like the other standards do. Certainly, the ICB can be used regardless to project dimensions, but due to its competence orientation, a comparison on this criterion is not possible.

All standards claim to be adoptable to projects of different scales. It is a question of Tailoring the standard in a way that the requirements of the projects are fully covered. In Table 25 a summary is shown.

PMI – PMBoK	OGC – PRINCE2	DIN 69901
• *Due to tailoring, the standard can be applied to all project dimensions* (PMI, 2008, p.37).	• *PRINCE2 can be used regardless of the project scale* (Murray et al., 2009, p.221). • *Danger of over-bureaucratization is avoided due to appropriate tailoring* (Buhr, 2010, p.30).	• *The standard is applicable by both big, complex PM systems and smaller, simple PM systems* (DIN , 2009, p.36).

Table 25: Scalability of Standards

6.5.5 Tailoring

Processes of standards define terms and procedures for repeatable work sequences. Since standard models differ from concrete projects and corporate organizations, the standards have to be embedded and tailored. In this chapter proposals for tailoring of the standards are discussed.

IPMA does not provide an adaptable process model and describes PM in general. Due to its competence oriented approach the standard is extremely abstract.

Therefore, it can be assumed that the ICB cannot be tailored, but with its knowledge an appropriate PM system can be established.

The PMBoK refers to organizational process assets (e.g. organizational policies, templates, communication requirements) and enterprize environmental factors (e.g. organizational culture, infrastructure, market place conditions), which need to be considered when tailoring the standard (PMI, 2008, p.37). The project manager with the project team is responsible for adopting the right PM system to the requirements of the organization and the project (PMI, 2008, p.38).

In PRINCE2 “Tailoring” is one of the seven principles. To tailor the standard to the project requirements, PRINCE2 refers to external factors (e.g. corporate standards) and project factors (e.g. project dimensions) (Murray et al., 2009, p.215). Tailoring is described in a very comprehensive way and provides real examples from praxis. *“The Purpose of PRINCE2 is to provide a project management method that can be applied regardless of project scale, type, organization, geography or culture.”* (Murray et al., 2009, p.11)

The modular design of DIN 69901 allows the adoption of processes without any change. The processes are tightly structured and contain only a small number of activities. Therefore, the process model of DIN 69901 contains more processes than the other standards. In “Choose PM Processes” processes are estimated to meet the right projects requirement. In Table 26 the main characteristics and process steps regarding tailoring are summarized.

PMI – PMBoK	OGC – PRINCE2	DIN 69901
•*Selection of appropriate processes* •*Definition of an approach that can be adopted to meet the requirements* •*Conformation of the requirements to meet stakeholder expectations* •*Balancing the competing demands of scope, time, cost, quality, resources and risk (PMI, 2008, p.37)*	• *Adaption of Themes* • *Revision of Terms and Language* • *Revision of Product Description* • *Revision of Role Description* • *Adjustment of Processes (Murray et al., 2009, p.216)*	• *For normal important projects directly adaptable* • *For bigger projects additional processes have to be defined* • *For smaller projects processes can be summarized (DIN , 2009, p.36)*

Table 26: Tailoring

6.5.6 Distribution by Industrial Sector

Since the rules and guidelines are kept in general, all standards are universally applicable. Through its certification scheme, IPMA focuses primarily on education and qualification of project managers. Also PRINCE2, as a methodology, is widely used in different industrial fields.

IPMA – ICB	PMI – PMBoK	OGC – PRINCE2	DIN 69901
•*Mainly educational purpose* •*Personal development in organizations*	•*Universal applicable*	•*Universal applicable* •*Public and private sector*	•*Universal applicable*

Table 27: Distribution by industrial Sector

6.6 Project Management Aspects

PM aspects define characteristics which have to be taken into account when carrying out projects. The following tables show the handling of each standard of the specific PM aspect. The competence ranges of IPMA are labeled. Competence elements related to the PM aspect are listed below the respective competence range. The processes of PMI are labeled and tools and methods proposed by PMI are listed below. The column of DIN 69901 is structured in the same way. In PRINCE2, being a methodology, related themes and main activities are labeled, while tools and Management Products are listed below. Furthermore, tools and methods are marked with a point and explained in the appendix.

6.6.1 Integration

“Integration” clarifies how processes and activities are identified, defined, combined, and coordinated by each standard (PMI, 2008, p.411). These are crucial activities to complete projects successfully.

In Table 28, relevant elements of each standard are shown.

IPMA – ICB	PMI – PMBoK	OGC – PRINCE2	DIN 69901
Technical Competence: •*Start up* •*Change* •*Control and reports* •*Close out* ***Contextual Competence***	***Develop Project Charter:*** •*Expert judgement* ***Develop Project Management Plan:*** •*Expert judgement* ***Direct and Manage Project Execution:*** •*Expert judgement* •*Project management information system* ***Monitor and Control Project Work:*** •*Expert judgement* ***Perform Integrated Change Control:*** •*Expert judgement* •*Change Control meetings* ***Close Project or Phase:*** •*Expert judgement*	***Several Processes:*** ***Directing a Project*** ***Starting Up a Project*** ***Initiating a Project*** ***Several Themes:*** •*Plans* •*Business Case* •*Change* •*Progress* ***Establish controls*** ***Issue and Change Control:*** ***Management Products:*** •*Configuration Management Strategy* •*Priority and Severity MoSCoW:* •*Configuration Items Records* •*Product Status Account* •*Daily Log* •*Issue Register* •*Issue Report*	***Combined Process Subdivisions*** ***Changes*** ***Plan handling with Changes*** ***Control Changes***

Table 28: Integration

In the ICB no processes are defined. Therefore, in Table 28 the competence ranges related to the integration aspect are shown. In the “Technical Competences” competence elements like “Start up”, “Change”, “Control and reports” or “Close out” are treating related topics, while in the “Contextual Competences” all competence elements reflect aspects of “Integration” (see chapter 3.1.3).

The PMBoK provides a series of documents like the “Project Charter” or the “Project Management Plan”. The “Project Charter” authorizes a project and includes among several other analyses of organization, environment and project work, also the Business Case. The “Project Management Plan” is the result of all other planning activities. To perform and control project`s work, defined in the “Project Management Plan” the processes “Direct and Manage Project Execution” and “Monitor and Control Project Work” are specified. Also changes during project`s course are considered. Therefore the process “Perform Integrated Change Control” is set up. To close all activities regarding a project, the process “Close Project or Phase” is set up (PMI, 2008, p.71).

In PRINCE2, “Integration” is elaborated among several processes and themes. In the theme “Plans”, a baseline management product “Plan” is evolved which is broken down into project-, stage- and team plans (Murray et al., 2009, p.250). In PRINCE2, from this Plan several further steps are derived. Authorization is performed by the Project Board in the process „Directing a Stage” (Murray et al., 2009, p.136). To ensure project execution, in the theme “Progress” appropriate control functions are defined (Murray et al., 2009, p.102).

While PMI has the process “Perform integrated Change Control“, “Change” is elaborated in an own Theme. In “Issue and Change Control“, several control mechanisms are proposed. Issues are any unplanned events affecting the project, which require additional management treatment (Murray et al., 2009, p.91). Several “Management Products” support control functions. A “Configuration Management Strategy” describes the way issues are handled. “Configuration items records” describes information about status, version and variant of each configuration item. The “Product Status Account” gives information about the status of a project. A ”Daily Log” is used to record problems and in the “Issue Register” information of issues are captured and maintained. The “Issue Report” lists up all change requests. To deal

with change requests, problems and concerns, issue and change control is integrated (Murray et al., 2009, p.92ff.).

DIN 69901 provides two processes (“Plan handling with Changes” and “Control Changes”) wherein the change aspect is elaborated. Other aspects of “Integration” are defined among several Process Subdivisions. The authorization for project execution is elaborated in the process “Accord Approval”, part of the Process Subdivision “Information, Communication, Documentation”. The Project Plan, which is identical to PMI´s Project Management Plan, is developed in the Process Subdivision “Procedures and Time-limits”. Therein, also monitoring and controlling of project work is performed. For closing a project or phase, DIN provides several processes for documentation, communication and calculation of project results. For identifying the right processes DIN uses the process “Choose PM processes” (DIN , 2009).

6.6.2 Scope

The scope criterion compares the standards on how the required work is defined and broken down. "*The project scope defines the boundaries of a project"* (Caupin et al., 2006, p.58). In Table 29 relevant procedures are shown.

IPMA – ICB	PMI – PMBoK	OGC – PRINCE2	DIN 69901
Technical Competence: *Project requirements and objectives* *Scope and deliverables* *Project structures* ***Contextual Competence:*** *Business*	***Collect Requirements:*** *•Interviews* *•Focus groups* *•Facilitated workshops* *•Group creativity techniques* *•Group decision making techniques* *•Questionnaires and surveys* *•Observations* *•Prototypes* ***Define Scope :*** *•Expert judgement* *•Product Analysis* *•Alternatives identification* *•Facilitated workshops* ***Create WBS:*** *•Decomposition* ***Verify Scope:*** *•Inspection* ***Control Scope:*** *•Variance analysis*	***Business Case:*** ***Starting up a Project Initiating a Project*** ***Plans:*** ***Use product-based planning:*** *•Write the Project Product Description* *•Create the Product Breakdown Structure* *•Write the Product Descriptions* *•Create the Product Flow Diagram* ***Progress:***	***Objectives:*** ***Sketch Objectives:*** *•Objectives description* ***Define Objectives :*** *•Balanced Score Card (BSC)* *•Objectives description* ***Define Project Content :*** ***Control Objective Attainment:*** *•Project controlling** ***Project Structure:*** ***Create Structure:*** *•Project structuring** ***Create Project Structure Plan:*** *•Project structuring** ***Describe Work Packages:*** ***Describe Procedures:***

Table 29: Scope

In the ICB, the scope is defined in the "Technical Competence" and "Contextual Competence" ranges. In the competence elements "Project requirements and objectives", "Scope and deliverables", "Project structures" and "Business" this aspect is considered (see chapter 3.1.3). Due to IPMA´s different approach to PM a further comparison on this aspect has not been carried out.

PMI differentiates between product scope and project scope. The Project scope refers to the work necessary to deliver project`s outcome, while the product scope characterizes project`s outcome. With the process "Collect requirements" stakeholder needs are defined to meet project`s objective. "Define Scope" provides a detailed description of the project and the product. The decomposition of the work is executed in the process "Create WBS". It is a central element for further project course,

because it defines the total scope of a project. In the process “Verify Scope”, the scope gets controlled and reviewed by different stakeholders to obtain acceptance of deliverables by customers and sponsors (PMI, 2008, p.103).

While the PMBoK and the ICB refer to customer requirements by defining the scope of a project, PRINCE2 uses its Business Case. The Business Case includes all aspects of a project and establishes mechanisms to evaluate project`s purpose during the whole project life-cycle. The outline Business Case is developed in the process “Starting up a Project”. The detailed Business Case is developed in the process “Initiating a Project” and contains the outline Business Case, the Project Plan and a Risk Register. After its development, it gets maintained, verified and confirmed trough out project life span (Murray et al., 2009, p.22f.).

To define and analyze products, the method “Product-based planning” is used. It is based on four parts: “Write the Project Product Description” defines what the project must deliver in order to gain acceptance. In “Create a Product Breakdown Structure” the plan is broken down into its major products until an appropriate level of detail. ”Write a Product Description” is evolved to bring customer requirements in accordance with predefined quality criteria. “Create the Product Flow Diagram” defines the sequence of activities, in which the products are developed. Furthermore, interdependencies between products can be estimated (Murray et al., 2009, p.64). This method was internally developed and contains also other aspects of PM.

In the theme “Progress” the scope gets controlled and continually reviewed (Murray et al., 2009, p.101).

DIN uses two Process Subdivisions to elaborate the scope aspect. In “Objectives” the goal of a project gets defined and controlled. In the process “Sketch Objectives” a project proposal is elaborated to a first draft. In “Define Objectives”, the project manager, in collaboration with project sponsors, defines project`s objectives. The scope is defined and controlled continually in the processes “Define Project Content” and “Control Objective Attainment”. In the Process Subdivision “Project Structure” the decomposition of a project is evolved by using the processes “Create Structure”, “Create Project Structure Plan”, “Describe Work Packages” and “Describe Procedures” (DIN , 2009).

6.6.3 Time

In the time criterion the standards are compared by its time management. Table 30 provides an overview of the different approaches to this criterion.

IPMA – ICB	PMI – PMBoK	OGC – PRINCE2	DIN 69901
Technical Competence: *•Time and project phases* *•Resources* *•Control and reports*	***Define Activities:*** *•Expert judgement* *•Rolling wave planning* *•Templates* *•Decomposition* ***Sequence Activities:*** *•Precedence diagramming method* *•Applying leads and lags* *•Dependency determination* *•Schedule network templates* ***Estimate Activity Resources:*** *•Expert judgement* *•Alternatives analysis* *•Published estimating data* *•Bottom up estimating* *•Project Management Software* ***Estimate Activity Duration:*** *•Expert judgement* *•Analogous estimating* *•Parametric estimating* *•Three point estimates* *•Reserve Analysis* ***Develop Schedule:*** *•Schedule network analysis* *•Critical path method* *•Critical chain method* *•Resource levelling* *•What-if scenario analysis* *•Applying leads and lags* *•Schedule compression* *•Scheduling tool* ***Control Schedule:*** *•Performance reviews* *•Variance analysis* *•Project management software* *•Resource levelling* *•What-if scenario analysis* *•Adjusting leads and lags* *•Schedule compression* *•Scheduling tools*	***Several Themes*** ***Business Case:*** ***Prepare the outline Business Case*** *•Timescale* ***Plans:*** ***Identify Activities and Dependencies*** *•Making a list of activities* *•Creating work breakdown structure* *•Identify internal dependencies* *•Identify external dependencies* ***Prepare the schedule:*** ***Define activity sequence:*** *•Activity-on-node technique* *•The critical chain technique* ***Agree Control points*** ***Define Milestones:*** ***Presentation Formats for the Schedule*** *•Gantt charts* *•Critical path diagram* *•Spread sheets* *•Product checklist* ***Progress***	***Define Milestones:*** *• Time scheduling* ***Plan Procedures:*** *• Netzplantechnik* *• Effort estimation* ***Create Time Schedule*** ***Create Project Plan*** ***Activate Procedures*** ***Control Time-limits*** *• Project controlling*

Table 30: Time

The competence element “Time and Project Phase” describes the management of the schedule with defining and sequencing activities necessary to meet project´s requirements. In other competence elements like “Resources” and “Control and reports” the time aspect is elaborated (See Chapter 3.1.3). Due to IPMA`s conscious exclusion of a process model a further comparison cannot be implemented.

The time aspect is integrated in the Knowledge Area “Project Time Management” The processes of the PMBoK show a clearly structured approach for time management. In Table 30 the processes with numerous tools and techniques are shown (PMI, 2008, p.129ff.).

While the standards from PMI and DIN have an own “Time” section, in PRINCE2, the time aspect is highlighted in several Themes. In a well elaborated Business Case also a time scale of a project is taken into account. The time scale includes information about start and end of a project. This is essential to determine the period on which the cost/benefit analysis is based and the organization can expect profits from the project (Murray et al., 2009, p.26).

In the Theme “Plans” the “Identification of Activities and Dependencies” is elaborated using a clearly structured methodology shown in Table 30. Once activities and dependencies are identified the schedule can be prepared by defining the activity sequence. PRINCE2 proposes two techniques to define activity sequence and different format types for the schedule (Murray et al., 2009, p.69f.).Furthermore the theme “Progress” supports control functions of the schedule of an ongoing project (Murray et al., 2009, p.101).

DIN covers the time aspect by the Process Subdivision “Procedures and Time-limits”. The process “Define Milestones” is performed after setting up the scope and the objectives of a project. The definition of milestones is primarily important for effort estimation, carrying out a feasibility study and to sequence activities, which is described in the process “Plan Procedures”. Out of the milestones plan the time schedule is created by using the process “Create Time Schedule”.

Furthermore, in DIN 69901 the Project Plan is created in this Process Subdivision. The Project Plan is executed by using the process “Activate Procedures”. “Control Time-limits” is the process to ensure continuous monitoring and controlling of the time-limits in an ongoing project (DIN , 2009).

6.6.4 Cost

Within the cost criterion, proposed techniques and procedures, used to estimate and control the budget of a project, are compared. In Table 31, basic procedures related to this criterion are shown.

IPMA – ICB	PMI – PMBoK	OGC – PRINCE2	DIN 69901
Technical Competence: •*Cost and finance* ***Contextual Competence:*** •*Business Finance*	***Estimate Costs:*** •*Expert judgement* •*Analogous estimating* •*Parametric estimating* •*Bottom up estimating* •*Three point estimates* •*Reserve analysis* •*Cost of quality* •*Project management estimating software* •*Vendor bid analysis* ***Determine Budget:*** •*Cost aggregation* •*Reserve analysis* •*Expert judgement* •*Resource levelling* •*Historical relationships* •*Funding limit reconciliation* ***Control Costs:*** •*Earned value management* •*Forecasting* •*To complete performance index (TCPI)* •*Performance reviews* •*Variance analysis* •*Project management software*	***A Business Case includes:*** *Reasons* *Business Options* *Expected benefits* *Expected dis-benefits* *Timescale* *Major risks* *Costs* *Sum of costs derived from the Project plan* ***Proposed Techniques****:* •*Investment appraisal techniques:* •*Through- life cost* •*Net benefits* •*Return on investment (ROI)* •*Payback period* •*Discounted cash flow* •*Net present value* •*Sensitivity analysis* ***Plans:*** •*Product-based planning* ***Prepare estimates*** •*Top-down* •*Bottom-up* •*Comparative* •*Parametric* •*Single-point* •*Three-point* ***Progress***	***Estimate Efforts roughly:*** • *Resource estimate(iterative)* ***Develop Cost- and Finance Plan:*** • *Resource estimate(iterative)* ***Control Cost and financial Resources:*** • *Project controlling* ***Create Post Calculation***

Table 31: Cost

Technical and Contextual competences of the ICB cover the cost criterion (see chapter 3.1.3). IPMA focuses on the qualification of practitioners and does not provide a process model. Therefore, a detailed comparison cannot be carried out.

In the Knowledge Area “Project Cost Management”, PMI uses three processes to elaborate the cost aspect. The result of these processes is documented in a Cost Management Plan, which is also part of the Project Management Plan. In the process “Estimate Costs” an approximation of monetary resources is carried out. “Determine

Budget" contains an accumulation of estimated costs related to predefined work packages. The project budget contains all financing provided to authorize certain steps in the project. Within the process "Control Costs", the status of the project gets monitored in order to update the project budget and to manage changes related to the budget (PMI, 2008, p.179).

Even though, PRINCE2 does not use "Cost" as a theme, costs get investigated already in the Business Case. The Business Case contains among others, a summary of all costs related to the project. Costs are derived from the Project Plan which includes funding arrangements, operations- and maintenance costs. The Business Case includes an Investment Appraisal to compare value and benefits of project achievements with development-, operations- and maintenance costs (Murray et al., 2009, p.27).

In the theme "Plans", overall resource estimation within the "Product-based planning" technique is elaborated. The estimated budget is broken down in overall costs, risk budget, change budget and tolerances of estimated costs (Murray et al., 2009, p.71). In the Theme "Progress" the budget is monitored and controlled considering the predefined tolerances of costs, within the project should be carried out (Murray et al., 2009, p.101).

In the Process Subdivision "Cost and Finances", DIN provides four processes. In the process "Estimate efforts roughly" expected efforts are estimated from experienced practitioners and summarized in a project budget. In "Develop Cost- and Finance Plan", these results are documented in a Finance Plan, where financial resources are allocated to project`s requirements. This is necessary to assure liquidity during a project. The budget is controlled continuously within the process "Control Cost and financial Resources" (DIN , 2009).

An important feature of the DIN standard is the process "Create Post Calculation". On the on hand the results of the post calculation are necessary for project conclusion, on the other hand a post calculation shows up deviations from the planned costs, which may have high influence on the cost estimation of future projects (DIN , 2009, p.88).

6.6.5 Quality

The quality aspect reflects the performance of the organization regarding quality policy, objectives and responsibilities in a way that customer requirements are fulfilled. In Table 32 basic elements regarding quality are depicted.

IPMA – ICB	PMI – PMBoK	OGC – PRINCE2	DIN 69901
Technical Competence: •*Quality*	***Plan Quality:*** •*Cost-benefit analysis* •*Cost of quality* •*Control charts* •*Benchmarking* •*Design of experiments* •*Statistical sampling* •*Flowcharting* •*Proprietary quality management methodologies* •*Additional quality planning tools* ***Perform Quality Assurance:*** •*Plan quality and perform quality control tools and techniques* •*Quality audits* •*Process analysis* ***Perform Quality Control:*** •*Cause and effect diagrams* •*Control charts* •*Flowcharting* •*Histogram* •*Pareto chart* •*Run chart* •*Scatter diagram* •*Statistical sampling* •*Inspection* •*Approved change requests review*	***Quality*** ***Prepare the Quality Management Strategy*** ***Quality planning*** ***Product-based planning:*** *Project product description* *Product descriptions:* •*Quality criteria and tolerances* •*Quality Methods* *in- process methods* *appraisal methods* •*Quality responsibilities* ***Management Products:*** •*Quality Register* ***Quality control:*** ***Quality Review technique*** ***Management Products*** •*Quality and approval records* •*Acceptance records* ***Change*** ***Prepare the Configuration Management Strategy***	***Define Success Criteria:*** • *Strategy map* • *Balanced score card(BSC)* ***Plan Quality Assurance:*** ***Assure Quality:*** • *"Quality gate" – concept* ***Assure Project Experience:*** • *Learning during and from projects*

Table 32: Quality

IPMA`s approach does not allow a direct comparison of this criterion. It defines quality of a project as...*" the degree to which a set of inherent characteristics fulfills the project requirements"* (Caupin et al., 2006, p.48). In the competence element "Quality" IPMA recommends some process steps, which demonstrate how to install quality measurements during project`s life cycle.

In the Knowledge Area "Quality", PMI shows three processes where quality is planned, assured and controlled. In the process "Plan Quality", quality requirements

are identified and documented in the Quality Management Plan. Within “Perform Quality Assurance”, quality requirements are examined and compared with quality control measurements. The process “Perform Quality Control” establishes mechanisms for monitoring and controlling quality throughout the course of a project (PMI, 2008, p.189).

In PRINCE2, within the process “Initiating a Project” a “Quality Management Strategy” is elaborated. The strategy contains planning and control methodologies. “Quality” is an own Theme in PRINCE2 where basically quality is planned and controlled. To meet customer`s quality expectations, acceptance criteria are developed. Those are included in the “Project Product Description”. The “Quality Management Strategy” defines how a quality management system is applied to the project. Therefore quality methods and other Management Products are defined: In the “Product Description” quality criteria are identified. The “Quality Register” provides audit and assurance information and is continually updated (Murray et al., 2009, p.49ff.).

“Quality control is achieved by implementing monitoring and recording the quality methods and responsibilities defined in the Quality Management Strategy and Product descriptions” (Murray et al., 2009, p.54).

Furthermore, PRINCE2 offers its own “Quality Review Technique”, wherein the conformity of the product is assessed. Furthermore, the “Quality Review Technique” involves key interested parties in order to provide confirmation about product`s completion and in order to control any changes regarding the product (Murray et al., 2009, p.55). Configuration management is part of the Theme “Change”, where a “Configuration Management Strategy” is developed (Murray et al., 2009, p.91).

DIN refers to the process “Define Success Criteria” to establish quality requirements. The process “Plan Quality Assurance” investigates significant methods and instruments for quality assurance. “Assure Quality” is evolved in the control phase, where quality of project work is supervised. Within this process continuous control of the project is assured. The process “Assure Project Experience” supports continuous improvement of quality standards for further projects (DIN , 2009).

6.6.6 Organization

The organization criterion clarifies the organizational aspect of each standard. Herein is discussed how the project is lead, managed and organized. Table 33 gives an overview of the different approaches related to this criterion.

IPMA – ICB	PMI – PMBoK	OGC – PRINCE2	DIN 69901
Technical Competence: *•Project organisation* *•Teamwork* *•Resources* *•Interested Parties* ***Behavioural Competence*** ***Contextual Competence***	***Develop Human Resource Plan:*** *•Organization charts and position description* *•Networking* *•Organizational theory* ***Acquire Project Team:*** *•Pre-assignment* *•Negotiation* *•Acquisition* *•Virtual teams* ***Develop Project Team:*** *•Interpersonal skills* *•Training* *•Team building activities* *•Ground rules* *•Co-location* *•Recognition and rewards* ***Manage Project Team:*** *•Observation and conversation* *•Project performance appraisals* *•Conflict management* *•Issue log*	***Organization:*** ***Four level of management*** ***Project management team structure:*** *•Project Board* *Project Assurance* *Change Authority* *•Project Manager* *•Team Manager* *Project Support* ***Line Organisation****:* *Center of Excellence* ***Stakeholders*** ***Stakeholder analysis*** ***Stakeholder engagement*** *•Identifying stakeholders (who?)* *•Creating and analysing stakeholder profiles (what?)* *•Defining stakeholder engagement strategy (how?)* *•Planning the engagements (when?)* *•Engaging stakeholders (Do)* *•Measuring effectiveness (Results)* ***Communication Management Strategy***	***Organization:*** ***Clarify Competences:*** *•Project structuring* ***Choose PM Processes:*** ***Establish Project Core Team:*** *•Project structuring* ***Plan Project Organisation:*** *•Role clarification* *•Definition of tasks, competences and responsibilities* ***Establish Project Team:*** *•Teambuilding* ***Develop Project Team:*** *•Team development* ***Execute Kick-off*** ***Carry out a Conclusion Discussion*** ***Appreciate Achievements*** ***Close Project Organisation*** ***Resources:*** ***Create Resource Plan:*** *• Resource estimate* ***Control Resources:*** *• Project controlling* ***Recycle Resources***

Table 33: Organization

Uncommonly projects fail because of lack in planning or controlling techniques, but rather improper project organization as well as interpersonal dysfunctions leads to project breakdown (Litke, 1995, p.16).

The ICB covers the organizational aspect in all competence ranges. By developing and managing project teams, soft skills have a high importance. ICB is the only standard where “Behavioural Competence” is seen as a key element of successful project procedures and therefore, it is described in a large extent. In Table 33 some elements related to this aspect are shown, but a further comparison, due to IPMA`s different approach to PM, is not possible (see chapter 3.1.3).

The Knowledge Area “Human Resource Management” defines organizational aspects. In the PMBoK, a Project Team is composed out of the Project Manager, the Project Management Team and other project team members. The Project Management Team is responsible for PM and leadership tasks (PMI, 2008, p.215).

In the process “Develop Human Resource Plan” identification and documentation of project roles, responsibilities, required skills and reporting relationships are elaborated (PMI, 2008, p.218). The process “Acquire Project Team” assures that personal required for successful project completion is obtained (PMI, 2008, p.225).To increase team performance, the process “Develop Project Team” is established. Therein, competences, team interaction and overall team environment is improved (PMI, 2008, p.229). The process “Manage Project Team” tracks team member’s performance in order to provide feedback, to resolve issues, and to manage changes within a project (PMI, 2008, p.236).

In the Theme “Organization” the project`s structure is established. The particularity of PRINCE2 is that it defines clear accountabilities and responsibilities. To achieve such a target a four level of management system is introduced (see chapter 6.4.4). Every level has its own defined tolerances, whose have to be complied on each level. The project management team is composed out of Project Board, Project Manager and Team Manager (see chapter 3.3.2).

PRINCE2 considers also difficulties by the integration of project organisation into line organisation. Therefore, a “Center of Excellence” is recommended. It is identical to the PMO of the PMBoK.

“*Stakeholder engagement is the process of identifying and communicating effectively with those people or groups who have an interest or influence on the project`s outcome”* (Murray et al., 2009, p.41). In Table 33 a six step procedure to engage

stakeholders is shown. In the Theme “Organization” PRINCE2 refers also to the Communication Management Strategy, which facilitates engagement of stakeholders.

In the Process Subdivision “Organisation” DIN uses several processes to create a controlled environment in projects. In processes like “Clarify Competences” and “Choose PM Processes” competences get clarified and the right PM processes are chosen. These are peculiarities of DIN, evolved in the initiation phase, to adapt the project framework. After the project release the process “Establish Project Core Team” is necessary to enhance collaboration of the required staff members. In the process “Plan Project Organisation”, roles, tasks, competences and responsibilities are defined. The Project Team is established and developed within the processes “Establish Project Team” and ”Develop Project Team”. Before starting with the work of the project a kick off meeting is set up in order to enhance a common understanding of project`s objectives among all participants (“Execute Kick-off”). In the conclusion phase, essential knowledge about the project is discussed in order to gain experience for further projects (“Carry out a Conclusion Discussion”). The process “Appreciate Achievements” enhances job-satisfaction on the long run. With the process “Close Project Organisation” the Project Manager is released from any liability (DIN , 2009).

In the Process Subdivision “Resources”, within the process “Create Resource Plan” a Resource Plan is created. A Resource Plan lists up all resources necessary for the project. Resources are estimated and mapped to the course of the project. The process “Control Resources” establishes a mechanism for continuous control of the resources. It is one of the most critical success factors in projects. In the closing phase resources are released. This means, staff members are released for other jobs and excessive materials are returned or recycled. Only then, the project organisation can be closed (DIN , 2009).

6.6.7 Communication

The communication criterion compares the standards upon the proposed communication policy. A functioning communication system includes timely and appropriate generation, collection, distribution, storage, retrieval, and ultimate disposition of project information (PMI, 2008, p.243). In Table 34 basic elements related to this criterion are shown.

IPMA – ICB	PMI – PMBoK	OGC – PRINCE2	DIN 69901
Technical Competence: •*Information and documentation* •*Communication* •*Control and reports*	***Identify Stakeholders:*** •*Stakeholder analysis* •*Expert judgement* ***Plan Communications:*** •*Communication requirement analysis* •*Communication technology* •*Communication models* •*Communication methods* ***Distribute Information:*** •*Communication methods* •*Information distribution tools* ***Manage Stakeholder Expectations:*** •*Communication methods* •*Interpersonal skills* •*Management skills* ***Report Performance:*** •*Variance analysis* •*Forecasting methods* •*Communication methods* •*Reporting systems*	***Baselines for progress control:*** ***Management Products:*** •*Project Plan* •*Stage Plans* •*Exception Plans* •*Work Packages* ***Reviewing Progress:*** ***Management Products:*** •*Daily Log* •*Issue Register* •*Product Status Account* •*Quality Register* •*Risk Register* ***Progress evaluation techniques:*** •*Milestone Chart* •*S-Curve* •*Earned Value Management* ***Capturing and reporting Lessons:*** ***Management Products:*** •*Lessons Log* •*Lessons Report* ***Reporting Progress:*** ***Management Products:*** •*Checkpoint Report* •*Highlight Report* •*End Stage Report* •*End Project Report*	***Accord Approval:*** •*"Quality Gate"- concept* •*Project structuring* ***Configure Information, Communication and Reporting System*** ***Define Project marketing*** ***Accord Approval:*** •*"Quality Gate"- concept* •*Project structuring* ***Plan Information, Communication, Reporting System and Documentation*** ***Accord Approval:*** •*"Quality Gate"- concept* ***Control Information, Communication, Reporting System and Documentation*** ***Accord Acceptance*** ***Develop Final Report*** ***Archive Project Documentation***

Table 34: Communication

The “Technical Competence” range covers aspects related to communication. In the competence element “Communication” the ICB highlights that right information has to be assigned to the right parties. A Communication Plan ensures this by listing several communication procedures. In the competence element “Information and

Documentation” IPMA explains how to store project data in standardized documents, but it does not suggest a certain documentation style. To control the status of a project or the achievement of predefined objectives the competence element “Control and Reports” is introduced (Caupin et al., 2006, p.72ff.). Because of a missing process model a further comparison has not been carried out.

The PMBoK covers communicational aspects in the Knowledge Area “Project Communication Management”. In the process “Identify Stakeholders” all people and organizations involved in the project are determined. Information respecting their interests, involvement, and impact on project success are documented. In PRINCE2 and DIN, stakeholders are identified within the “Organization” aspect. In “Plan Communications” a Communication Management Plan is elaborated in order to systemize an appropriate information flow (who gets what information at what time). The process “Distribute Information” is a subset of the “Executing Process Group” and ensures distribution of information to the right parties. “Manage Stakeholder Expectations” is especially focused on stakeholder interests and addresses eventualities that may occur within a project. The process enhances the dialog with stakeholders in order to fulfill expected requirements. “Report Performance” is part of the “Monitoring and Controlling Process Group”. This process takes into consideration information about project status, progress measurements and forecasts (PMI, 2008, p.243ff.).

PRINCE2 has no communication area, but this aspect is mainly elaborated in the Theme “Progress”. Due to its concept of Management Products communication takes place in every aspect. Identification of stakeholders is elaborated in the Theme “Organization”. In the “Progress” Theme control mechanisms are defined in order to compare actual project measurements to the planned project course. To establish controls, authority with defined tolerances is delegated (see chapter 3.3.2). Also management stages enhance control mechanisms. Several Management Products support project manager in its daily control function (see chapter 6.6.1). “Reviewing Progress” is part of the process “Controlling a Stage”. The project manager regularly reviews the progress of work and updates respectively the Management Products. (Murray et al., 2009, p.107).

“Learn from Experience” is one of the seven principles of PRINCE2. Therefore, lessons are recorded and identified (“Lessons Log”). To incorporate and to study the lessons a “Lessons Report” is elaborated. Also for “Reporting Progress” several Management Products are provided. The “Checkpoint Report” is elaborated by the Team Manager and addresses the Project Manager. It contains details of progress regarding work packages. With a “Highlight Report”, the Project Manager provides progress information to the Project Board. The “End Stage Report” and the “End Project Report” are elaborated by the Project Manager towards the end of a project or stage (Murray et al., 2009, p.109).

In the Process Subdivision “Information/Communication/Documentation” the communication policy is elaborated. Within the process “Accord Approval” the project gets authorized. PMI and OGC authorize the project respectively in the Knowledge Area “Project Integration Management” and the Theme “Business Case”. In the process “Configure Information, Communication and Reporting System” Information, communication and report requirements are identified. The aim of the process “Define Project marketing” is to deliver the right information to the relevant stakeholders. The repeated process ”Accord Approval” is designed to achieve a full closure of the previous phase. In the planning phase, within the process “Plan Information, Communication, Reporting System and Documentation”, control mechanisms for the information flow are established. The process “Control Information, Communication, Reporting System and Documentation” ensures that information is available on the right time, in the right quality, on the right place in order to enhance decision making procedures. The Process “Accord Acceptance” represents again a crossover from one phase to the next. In the closing phase, a final report is created and the project documentation is archived within the processes “Develop Final Report” and “Archive Project Documentation” (DIN , 2009).

6.6.8 Risk

The risk criterion compares the standards on how risk is treated within project execution. *"Risk is an uncertain event or condition that, if it occurs, has an effect on at least one project objective"* (PMI, 2008, p.275). Since projects are innovative and unique, the risk aspect has to be cared especially. In Table 35 basic procedures related to the risk criterion are shown.

IPMA – ICB	PMI – PMBoK	OGC – PRINCE2	DIN 69901
Technical Competence: *Risk and Opportunity*	***Plan Risk Management:*** *•Planning meetings and analysis* ***Identify Risks:*** *•Documentation reviews* *•Information gathering techniques* *•Checklist analysis* *•Assumption analysis* *•Diagramming techniques* *•SWOT analysis* *•Expert judgment* ***Qualitative Risk Analysis:*** *•Risk probability and impact assessment* *•Probability and impact matrix* *•Risk data quality assessment* *•Risk categorization* *•Risk urgency assessment* ***Quantitative Risk Analysis:*** *•Data gathering and representation techniques* *•Quantitative risk analysis and modelling techniques* ***Risk Response*** *•Strategies for negative risks or threats* *•Strategies for positive risks or opportunities* *•Contingent response strategies* *•Expert judgment* ***Monitor and Control Risks:*** *•Risk assessment* *•Risk audits* *•Variance and trend analysis* *•Technical performance measurement* *•Reserve analysis* *•Status meetings*	***Define the Risk Management Strategy*** ***Identify Risks:*** *•Review lessons* *•Risk checklists* *•Risk Prompt list* *•Brainstorming* *•Risk breakdown structure* ***Assess Risks:*** ***Estimate*** *•Probability trees* *•Expected Value* *•Pareto analysis* *•Probability impact grid* ***Evaluate*** *•Risk models* *•Expected monetary value* ***Plan Risks:*** ***Risk response actions*** *•Avoid* *•Reduce* *•Fallback* *•Transfer* *•Accept* *•Share* *•Exploit* *•Enhance* *•Reject* ***Implement*** ***Communicate*** ***Business Case:*** *•Major Risks* ***Management Products:*** *•Risk Register*	***Determine Handling of Risks*** ***Analyse Project Environment and Stakeholders:*** *•Force-field analysis* *•Stakeholder Analysis* *•Environmental Analysis* ***Evaluate Feasibility:*** *•SWOT Analysis* *•Cost-utility Analysis* *•Economic Analysis* ***Analyse Risks:*** *•FMEA* *•Expert Opinion* *•ABC Analysis* ***Plan Risk Response Measures*** ***Control Risks***

Table 35: Risk

IPMA treats the risk aspect in the competence element “Risk and Opportunity”. The ICB does not provide methods or tools for specific risk treatment, but it shows possible process steps in order to identify and assess risk and, to derive appropriate response actions. Nevertheless, all competence ranges have to be considered (see chapter 3.1.3). Due to IPMA`s conscious exclusion of a process model a further comparison has not been carried out.

In the PMBoK, seven processes are used to describe the proposed risk management. The process “Plan Risk Management“ defines how risk management activities are performed and a Risk Management Plan is elaborated. Afterwards, risks whose can affect the project are identified and documented in a risk register (“Identify Risks”). In a “Qualitative Risk Analysis”, identified risks are prioritized by assessing and combining their probability of occurrence and impact (PMI, 2008, p.289). In a “Quantitative Risk Analysis” instead, the effect of identified risks on the overall project is estimated. From the results of that investigation, risk response measures can be derived in order to enhance opportunities and to reduce threats (avoid, transfer, mitigate, accept) to project`s objectives (PMI, 2008, p.301). Therefore, the process “Risk Response“ has been defined. Within the process “Monitor and Control Risks”, identified risks are tracked throughout the project, and Risk Response Plans are implemented.

PRINCE2 focuses on its own approach to risk management in the Theme “Risk”. The method is strongly related to M_o_R, another publication of OGC (see chapter 4.3). A “Risk Management Strategy” defines how risk management is embedded in PM activities. Within the “Risk Register” information about identified threats and opportunities are captured and maintained. According to M_o_R, a clear methodology regarding risk management is developed, wherein identification, assessment and evaluation of risks is considered. Furthermore, PRINCE2 highlights the communicational aspect. Threats have to be communicated continually within the project and also to external stakeholders. Due to the principle “Continued Business Justification” the risk aspect is also included in the Business Case (Murray et al., 2009, p.79ff.).

DIN uses six processes to treat the risk aspect. Before identifying, assessing and evaluating risks, a method on how to handle risks is established. It is derived from the

risk policy of the organization (“Determine Handling of Risks”). To identify all possible influences on the project, the project environment and stakeholders are analyzed within the process “Analyse Project Environment and Stakeholders”. A peculiarity of DIN is the process “Evaluate Feasibility”, which takes place in the definition phase. In this process all acquired information are compared with project objectives in order to evaluate the feasibility of the project. Within the process “Analyze Risks” these are identified, assessed and documented in a risk portfolio. To derive appropriate risk response measures the process “Plan Risk Response Measures” has been developed. “Control Risks” is the process to supervise the current risk situation (DIN , 2009).

6.6.9 Procurement

Since projects cannot be performed as a closed system, this criterion compares the standards on the established interfaces to other systems. Procurement considers all processes necessary to purchase or acquire products, services or results from outside the project organization (PMI, 2008, p.313). In Table 36 a summary is shown.

IPMA – ICB	PMI – PMBoK	OGC – PRINCE2	DIN 69901
Technical Competence: *•Procurement and contract*	***Plan Procurements:*** *•Make- or -buy analysis* *•Expert judgment* *•Contract types* ***Conduct Procurements:*** *•Bidder conferences* *•Proposal evaluation techniques* *•Independent estimates* *•Advertising* *•Internet search* *•Procurement negotiations* ***Administer Procurements:*** *•Contract change control system* *•Procurement performance reviews* *•Inspections and audits* *•Performance reporting* *•Payment systems* *•Claims administration* *•Record management system* ***Close Procurements:*** *•Procurement audits* *•Negotiated settlements* *•Records management system*	***Plans:*** *•External dependencies*	***Define Handling of Contracts*** ***Determine Content of Contracts with Customer*** ***Determine Content of Contracts with Supplier*** ***Carry out Contract with Supplier and Customer*** ***Control Additional Demand*** ***Close Contract***

Table 36: Procurement

IPMA treats this aspect within the competence element “Procurement and Contract”. Herein, it highlights the responsibility of purchasers to get best value from their spending. Also the project manager is appointed and his responsibility regarding contracts is highlighted. The project managers competence consists also in formalising and managing contracts agreements with third parties (Caupin et al., 2006, p.68). Nevertheless, all competence ranges have to be considered by performing procurements.

The PMBoK refers to procurements in the Knowledge Area “Procurement”. All processes, shown in Table 36 involve contracts that are legal documents between a seller and a buyer. (PMI, 2008, p.315). In the process “Plan Procurements” projects needs, which can be met best by acquiring products, services or results from outside the project, are identified. In “Conduct Procurements” the best seller, who meets the previously defined selection criteria, is identified. “Administer Procurements” is the process to managing procurement relationships, monitoring contract performance and making changes or corrections to contracts (PMI, 2008, p.335). When all procurements are executed and all work or deliverables are accepted, the procurement can be closed (PMI, 2008, p.341).

Procurement is outside the scope of PRINCE2. In the Theme “Plans”, it refers to external dependencies when creating the time schedule and the budget for a project (Murray et al., 2009, p.67).

In the Process Subdivision “Contracts and Additional Demand”, DIN elaborates the procurement aspect. DIN emphasizes on formalising and conducting contracts to meet customer requirements. To ensure a systematic handling of all contracts, in the process “Define Handling of Contracts”, competences and responsibilities are clarified. In the processes “Determine Content of Contracts with Client” and “Determine Content of Contracts with Supplier” the content of a contract is elaborated and specified. Afterwards, the contract is carried, involving the respective parties. Commonly, changes occur and the acquired services do not comply with those planned. To manage such difficulties, within the process “Control Additional Demand”, contracts are monitored continuously. When the contract agreements were carried out successfully, the contract can be closed (DIN , 2009).

6.7 Certification

Three of the compared standards offer a certification scheme for practitioners. Entry requirements, exam procedures, validity and core competences were already discussed in the relevant chapters (see chapters 3.1.5, 3.2.5 and 3.3.5). In this chapter, the different certification levels are compared to each other regarding the acquired qualification. Table 37 lists up the certification schemes, compared to the certification levels of IPMA.

IPMA – ICB	PMI – PMBoK	OGC – PRINCE2
Certified Projects Director (IPMA Level A)	Program Management Professional (PgMP)	
Certified Senior Project Manager (IPMA Level B)		
Certified Project Manager (IPMA Level C)	Project Management Professional (PMP)	Practitioner
Certified Project Management Associate (IPMA Level D)	Certified Associate in Project Management (CAPM)	Foundation
	PMI Scheduling Professional (PMI-SP) PMI Risk Management Professional (PMI-RMP) PMI Agile Certified Practitioner (PMI-ACP)	

Table 37: Comparison of the Certification Schemes

Level A from IPMA is identical to PMI`s PgMP certification. Therein, Program Managers are certified in order to be able to manage multiple projects. It can be seen that PRINCE2 does not offer an equivalent certification level. A reason therefore might be the incompleteness of the methodology:

“It is not intended (or possible) for PRINCE2 to cover every aspect of PM. There are three broad topic categories which are deliberately considered outside the scope of PRINCE2: specialist aspects, detailed techniques and Leadership capability” (Murray et al., 2009, p.6f.).

Regarding single projects, the Level B of the IPMA certification scheme is the most comprehensive achievable certificate. In this level the competence “Managing” is assessed. The complexity of projects, among different entry requirements, is the

decisive criterion to differentiate between Level C and Level B of IPMA`s certification scheme. In the other standards an equivalent certification level is not provided.

The Level C of IPMA`s certification scheme is identical to the PRINCE2 Practitioner exam and PMI`s PMP, although, different assessment procedures are suggested.

IPMA`s Level D complies with the PRINCE2 Foundation exam and PMI`s CAPM. Furthermore, PMI offers a variety of specified certifications for agile project management, project risk management and project scheduling.

In a personnel certification scheme, skills are examined and evaluated. IPMA and PMI follow a two stage method:

- First, the candidate has to pass an entrance examination, where, among others, formal competences are examined. When entry requirements are met, the candidate is admitted to a performance test. On the one hand formal competence is examined by confirmations of employment, on the other hand the candidate hast to apply his knowledge to specific situations. To certificate these requirements, IPMA uses assessment workshops and interviews. PMI examines formal competence within the audit process (Gessler, 2009, p.14ff.). Such an entrance examination does not take place in the Foundation exam of PRINCE2.
- The following performance test evaluates knowledge and capability necessary to manage projects. A performance test is carried out in each certification scheme, but different certification tools are used (see chapters 3.1.5, 3.2.5 and 3.3.5).

7 Future Perspectives

In times of globalization, organizations are increasingly forced to open up themselves to their purchasing and sales markets. Earlier, projects were mainly carried out internally. Nowadays, organizations have to link their projects more and more with external partners.

According to a study of the Deutsche Bank Research, in the year 2020, 15 % of overall value creation in Germany is delivered by project economy. In the year 2007 its contribution was only 2%. This effect is mainly caused due to increasing globalization, by stronger concentration of organizations to their core competences and by shifting PM throughout the overall value chain (Steeger, 2008, p.3).

Thereby the complexity of projects rises and the importance of standards will rise. The more complex the organizational structure is, the more reasonable is the introduction of an international PM standard. Standards enhance communication between parties involved and support them to synchronize their activities during the course of a project. Also despite continuous alternating project partners standardization of processes has a high importance (Wagner, 2009, p.1).

As diverse the challenges of project work are, as diverse are also its problem solving approaches. Due to the different direction of PM standards and therefore, different approaches in some areas of PM, also economic damage can arise. Not harmonized, heterogeneous PM systems lead to additional costs for synchronisation of the activities. Furthermore, the development of new solutions in PM (processes, methods and tools), the adaption of these solutions to systems of internal or external project partners and the necessary education of employees can increase organizational costs enormously (Wagner & Waschek, 2009, p.30).

The urgent need of consistent approaches in PM can be constantly seen by the collaboration of international partners in large and complex projects.

To overcome many differences in PM standardization, efforts are made to unify PM standards and to create an international standard. On the one hand, the Global Alliance for Project Performance Standards (GAPPS) benchmarks actual PM standards to an own developed process model. This alliance of associations,

government or industry provides the global PM community with information regarding PM.

On the other hand, an international standard is in development. ISO 21500 is expected to be published in August 2012 (Wagner & Waschek, 2009, p.30). This international standard will not replace the existing PM standards, but it will have a high influence on further arrangement and configuration of PM standards. Therefore, a lot of countries and associations participate on the creation of this standard. While IPMA is directly involved as a supervisor, PMI is involved by national representatives. The effort of all parties will contribute to a more uniform understanding regarding PM on an international level. The process model of ISO 21500 is seen as central element of the standard and is mainly based on the approaches of DIN 69901-2 and the PMBoK (Wagner, 2009, p.7).

8 Conclusion and Outlook

The comparison of the analyzed standards has shown the different approaches to PM. While PMBoK is considered as a comprehensive reference book which informs practitioners about methodologies, tools and techniques, PRINCE2 supports practitioners with concrete recommendations of action. Like PMBoK, also DIN 69901 describes PM processes, but not as comprehensive as the PMBoK. In the ICB the approach is totally different and competences of project managers are highlighted.

This makes a comparison and evaluation of each standard quite difficult. Each of them shows strength and weaknesses. In Figure 23, four spider diagrams are depicted. Each of them shows the different performance characteristics of each standard. It summarizes different peculiarities of the criteria matrix, introduced in chapter 5. Nine representative criteria were chosen to demonstrate the different approaches to PM in a clearly arranged way:

“Completeness” evaluates the coverage of all PM aspects. “Certification” reviews the evaluation schemes of the standards. In “Process model” the procedural methods in PM are assessed. The “Compatibility” criterion marks the effort to integrate the standard in existing PM systems or corporate organizations. “Tailoring” evaluates respectively measures to adapt standards to projects requirements. “Level of detail” marks the standards on how detailed certain PM processes have been considered. The “Level of abstraction” criterion reviews PM processes by its practicability. “Roles and Organization” evaluates the recommended project organization and its roles. “Product orientation” evaluates the focus on projects outcome and the continuous business case justification of each standard.

The diagrams show that each standard follows different key aspects and shows different characteristics. Each standard want to keep its peculiarities and a central unification may not be desired. It shows also that PM is a relatively young discipline and standardization in PM has still some way to go before uniform procedures can be guaranteed.

The scaling ranges from number one to number five, where five represents a strong effect on a chosen PM field and one represents a low effect.

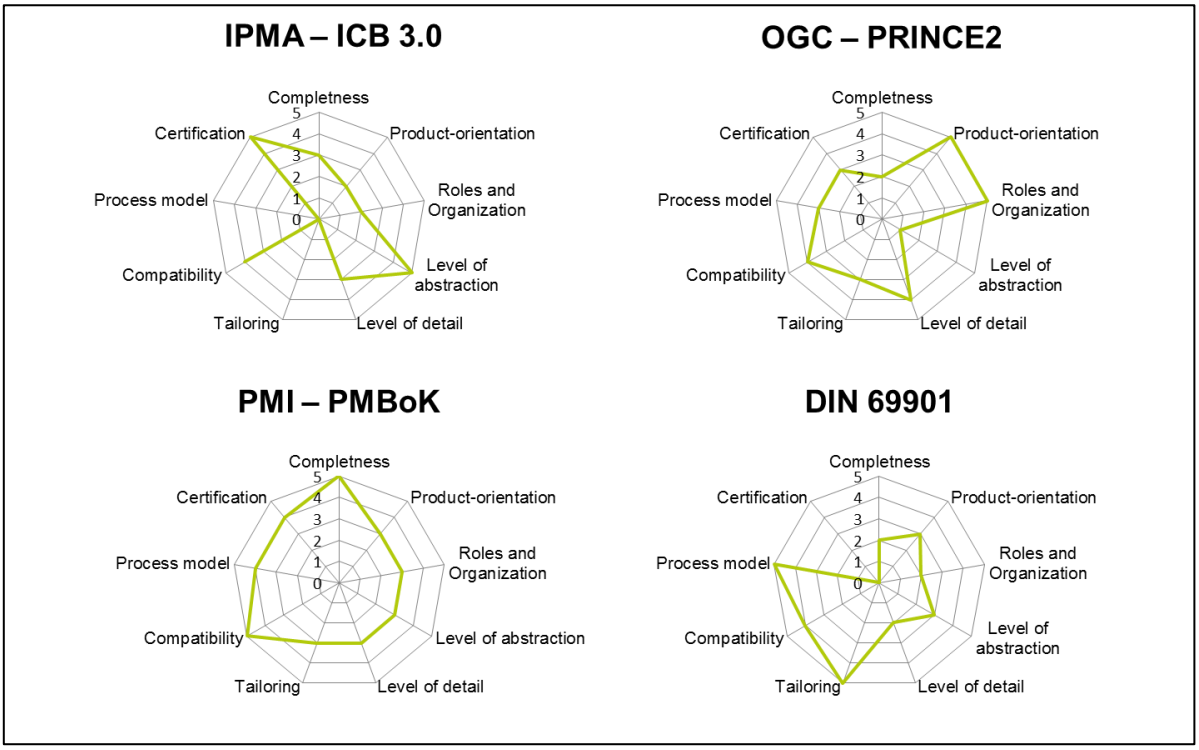

Figure 23: Performance Characteristics

Afterwards, the diagrams are explained by the strength and weaknesses of each standard:

IPMA`s certification scheme establishes the basis for the whole standard and is applied to the entire competence approach. Therefore, it is very strongly marked. The ICB shows also a high level of abstraction and the comparison to other process oriented approaches was only partially carried out. Besides technical and contextual competences, the ICB focuses also on interpersonal skills, which are a crucial success factors in PM. The other standards mention the importance of “soft skills”, but do not consider them in an appropriate extent.

PMI shows a comprehensive “Best Practice Toolbox” and lists up numerous methods and tools for PM. In Figure 23, the PMBoK shows a well-rounded shape, because it covers nearly all aspects of PM. Due to PMI`s market leader position and the recognition of ANSI regarding PM, the PMBoK shows up a high degree of compatibility.

PRINCE2 does not claim to be complete and important elements of PM are missing. But it represents a methodology with a clear structured distribution of roles and responsibilities. This allows a clear and detailed description of processes. Furthermore, PRINCE2 is strongly focused on its products. The principle “Continued Business Justification” and the own method “Product based Planning” are applied throughout a PRINCE2 project.

DIN 69901 provides a strongly marked process model, not comprehensive as the process model of the PMBoK, but with its graphical representation of PM processes, the standard represents the most clearly arranged process model. Furthermore, DIN specifies more processes than PMI. While PMI emphasizes planning activities with numerous processes, in DIN 69901, processes are uniformly distributed. Due to DIN`s modular design, the adaption of the process model is simplified.

The thesis gives an overview on PM standards and points out major differences of them. The comparison is limited to the four universal PM standards of PMI, OGC, IPMA and DIN. Therefore, it allows conclusions only for these analyzed standards. The developed criteria matrix can be easily transferred to other standards, especially to ISO 21500. The publication of ISO 21500, which is created by many national and international associations, is seen as an “umbrella” PM standard. Therefore, especially this standard will influence further efforts in standardization of PM.

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Appendix: Tools and Methods

PMI

Acquisition:	Due to a lack of in-house staff, the required service or product is brought in.
Advertising:	Technique to expand the list of sellers.
Alternatives analysis:	Searching for alternative methods to accomplish project`s objectives (e.g. levels of resource capability, different machines, different tools, make-or-buy).
Alternatives identification:	Method for generating different approaches to execute the work of a project.
Analogous estimating:	Method where parameters like duration, budget, size, weight and complexity from a previous project are investigated to determine parameters for future projects.
Applying leads and lags:	Determination of leads and lags of activities. A Lead allows an acceleration of the successor activity and a lag directs a delay of the successor activity.
Assumption analysis:	Risk identification is based on assumptions. This method examines the validity of these assumptions concerning the project.
Benchmarking:	Systematic method to compare actual project data with past comparable project data.
Bidder conferences:	Meetings between buyer and sellers in order to ensure common understanding of procurements.
Bottom up estimating:	Estimation technique, where the work within the activity is detailed and resource needs are estimated.

Cause and effect diagrams:	Illustration of various factors concerning the project, inter-linked to potential problems and effects.
Change control meetings:	Change requests are elaborated and documented by a Change Control Board.
Change requests review:	A method to review change requests and to control the implementation of approved changes.
Checklist analysis:	Development of risk identification checklists.
Claims administration:	Claims are documented, processed, monitored and managed throughout the contract life-cycle.
Co-location:	Placing many or all of the most active team members in the same place to enhance their performance.
Communication methods:	Methods to share information among project stakeholders. Basically, these methods are classified into three groups: “Interactive Communication” for multidirectional exchange, “Push Communication” to inform specific recipients and “Pull Communication” used for very large volumes (e.g. intranet).
Communication models:	A model, where the information flow is depicted.
Communication analysis:	Determination of communication requirements for each stakeholder.
Communication technology:	Techniques used to transfer information between stakeholders.
Conflict management:	Management to solve conflicts between team members.
Contingent response:	Risk response strategy, which is executed only under certain conditions.
Contract change control:	Definition of processes to modify the contract (e.g. documentation, tracking systems)

Contract types:	With a contract the risk between buyer and seller is shared. Contracts can be categorized in fixed-price contracts, cost-reimbursable contracts and time and material contracts.
Control charts:	A control chart enhances monitoring output variables like schedule or cost variances due to installed specification limits.
Cost aggregation:	Overall cost estimations and work package costs are cumulated according the WBS until resulting in the total cost of the project.
Cost of quality:	The sum of costs for preventing nonconformance to product`s requirement and costs for failing to meet product`s requirement.
Cost-benefit analysis:	A comparison of costs to meet quality criteria and the expected benefit.
Critical chain method (CCM):	The critical chain is represented by the resource-constrained activities. It is a technique to modify project schedule.
Critical path method (CPM)	Calculation of early start and finish dates, and late start finish dates for all activities in order to indicate time periods within the activity could be scheduled. A critical path is characterized by zero total float.
Decomposition:	A method to subdivide a project. It follows basically four steps: Identifying and analyzing the deliverables, structuring and organizing the WBS, decomposing the WBS, and verifying if that degree of decomposition is sufficient for project execution.
Dependency determination:	Determination of mandatory-, discretionary- and external dependencies.

Design of Experiments (DOE):	Statistical method for identifying which factors may influence specific variables of a product or process.
Diagramming techniques:	Cause and effect diagrams, system or process flow chart, influence diagrams
Documentation reviews:	A structured review on project documentation.
Earned value management:	Performance measurement where the integrated predefined project baseline is compared with actual performance data
Facilitated workshops:	Key-cross functional stakeholders are brought together to define product requirements.
Flowcharting:	A graphical representation of a process showing the relationships among process steps.
Focus groups:	A method to bring together prequalified stakeholders and experts to discuss expectations about project`s result.
Forecasting:	Methodology to forecast the costs for completing a project. Within a project, this method is used, when the Budget at Completion (BAC) is exceeded and an Estimate at Completion (EAC) has to be forecasted.
Forecasting methods:	Techniques to predict future project performance based on actual data (e.g. time series method, causal method, judgmental methods).
Funding limit reconciliation:	A method to place funding limits within a schedule. It is used, when a variance between funding constraints and planned expenses date constraints have to be placed in the schedule.
Ground rules:	Rules are established to reflect clear expectations regarding acceptable behavior in a project team.

Group creativity techniques:	Techniques to create ideas within a group (e.g. brainstorming, nominal group technique, delphi technique, Idea/mind mapping, affinity diagram).
Group decision making:	Establishment of rules regarding decision making (e.g. unanimity, majority, plurality, dictatorship)
Histogram:	Vertical bar chart to show how often a particular variable state occurred.
Historical relationships:	Method, where form historical project characteristics a mathematical model is developed to predict total project costs.
Independent estimates:	Estimation of procurement costs for benchmarking the proposed product price from the suppliers.
Information distribution tools:	Tools and techniques to support sharing of information (e.g. hard-copy document distribution, electronic communication, electronic tools for project management).
Information gathering:	Technique to gather information (e.g. brainstorming, delphi technique, interviewing, root cause analysis).
Inspection:	Activities to measure, examine, and verify whether work and deliverables meet product acceptance criteria.
Interviews:	An approach to discover information from the stakeholders.
Issue log:	A document to monitor issues arising during a project and to establish appropriate control mechanisms.
Make-or-buy analysis:	Management technique to decide whether work is performed by the project team or is purchased from outside.
Negotiated settlements:	When a negotiated settlement cannot be achieved, alternative dispute resolutions are explored.

Networking:	Interaction between others
Observation / Conversation:	Monitoring work and attitudes of the project team members to document applied processes
Organization description:	Documentation of team member`s roles and responsibilities
Organizational theory:	Provides information on how people, teams, and organizational units behave.
Parametric estimating:	Statistical relationship between historical data and other variables to estimate activity parameters like cost, budget or activity duration.
Pareto chart:	Specific histogram, which is ordered by the frequency of occurrence.
Payment systems:	Payments are made and documented in accordance to the contract.
Performance reporting:	Information about seller`s effectiveness in achieving contract goals.
Performance reviews:	Method to measure, compare and analyze schedule performance (e.g. variance analysis, trend analysis, earned value performance)
Planning meetings /analysis:	Meetings to develop the risk management plan
Pre- assignment:	Project team members are selected in advance, because the project depends on expertise of the selected persons.
Precedence diagraming:	A method to depict activities. Activities are shown as rectangles and show the logical relationship that exists between them.
Probability and impact matrix:	A method to classify risks regarding probability of occurrence and impact of the risk.

Process analysis:	Techniques to analyze processes for further process improvement.
Procurement audits:	A structured review of the procurement process
Procurement performance:	A structured review of the seller regarding scope, quality, cost and time.
Product Analysis:	Translation of high level product description into tangible deliverables.
PM estimating software:	Software like statistical tools, simulation or computerized spreadsheets to support cost estimation procedures.
PM information system:	System to support sharing of information like scheduling software tools, configuration management systems or information collection and distribution systems.
PM software:	Software to support PM in planning, organizing, managing and estimating resources.
Performance appraisals:	Evaluation of performance (e.g. re-clarification of roles and responsibilities, constructive feedback, detection of unknown issues, developing of training plans and determination of specific goals).
Proposal evaluation:	Techniques to review complex procurements based on previously defined criteria.
Proprietary quality:	Methodologies like Six Sigma, Lean Six Sigma, and Quality Function Deployment (QFD)….
Prototypes:	A working model of the expected product to obtain early feedback from customers.
Published estimating data:	Updated production rates and resource costs are published to support the estimation of resources required.

Quality audits:	A structured independent review to check project activities compliance with organizational policies.
Quality planning tools:	Brainstorming, nominal group technique, affinity diagrams, force field analysis, matrix diagrams, prioritization matrices.
Quantitative risk analysis:	Methodology to analyze the effect of identified risks on the project, supported by e.g., sensitivity analysis, expected monetary value analysis or modeling and simulation.
Questionnaires and surveys:	Questions designed to quickly accumulate information from a wide number of respondents.
Recognition and rewards:	Recognizing and awarding appropriate behavior of staff members to increase their motivation.
Record management system:	A system to manage and document contract and procurement management.
Reporting systems:	Tools for capturing, storing and distributing information to stakeholders considering cost, progress and performance of the project
Reserve Analysis:	Analysis to determine the amount of contingency reserves like e.g. time reserves, buffer or budget
Resource leveling:	A technique which is used to change a schedule created with the CPM used to allocate critical resources
Risk audits:	Examination and documentation of risk responses and overall risk management processes
Risk categorization:	Grouping of risks regarding critical aspects like sources of risks, area of project affected or the project phase.
Risk data quality assessment:	Evaluation of the degree to which data about risks are useful for risk management.

Risk probability and impact:	Method to assess risk probability (likelihood that the risk may occur) and risk impact (potential effect on project when the risk occurs).
Risk reassessment:	Identification of new risks, reassessment of current risks and closing of risks that are outdated
Risk urgency assessment:	Method to determine urgency of risks
Rolling wave planning:	Progressive elaboration planning, where the work to be accomplished in the near term is planned in detail and future work is planned at higher level of the WBS
Run chart:	A chart to show history and pattern of variation. Over time trends can be derived from the run chart.
Scatter diagram:	The diagram shows the relationship between two variables
Schedule compression	Methodologies to shorten project schedule. There are two types of compression: “Crashing” is used to obtain greatest amount of compression with the least incremental cost (e.g. additional resources, overtime). “Fast tracking” is the parallelization of normally sequential project phases
Schedule network analysis:	Technique to generate the schedule. It comprises the critical path method (CPM), the critical chain method (CCM), resource leveling and the what-if scenario analysis
Schedule network templates:	Standardized template to support the creation of networks of project activities.
Scheduling tool:	Tool to support scheduling process
Stakeholder analysis:	Quantitative and qualitative information gathering to determine whose interests are taken into account.

Statistical sampling:	A method where only some products are inspected.
Status meetings:	Periodic status meetings for risk management
Strategies for negative risks:	Avoid, transfer, mitigate, and accept.
Strategies for positive risks:	Exploit, share, enhance and accept.
Team building activities:	Activities to improve interpersonal relationships
Technical performance:	Measurement technique, where technical accomplishments are compared to the Project Management Plan`s schedule of technical achievements.
Templates:	Standard activities are listed in order to support a further definition of current activities.
Three point estimates:	A method to improve the accuracy of activity duration considering risk and uncertainty. Durations are grouped into three ranges: Most likely; Optimistic and Pessimistic.
TCPI:	The to-complete performance index (TCPI) is a calculated projection of cost performance that must be achieved on actual work to meet the defined management goal.
Training:	Activities to enhance competences of project team members.
Variance analysis:	Project performance measurement to control variation from the original scope baseline.
Vendor bid analysis:	Cost estimating based on bids of vendors
Virtual teams:	Groups of people with a shared goal who fulfill their roles with little or no time spent meeting face to face.
What-if scenario analysis:	A method to identify alternative activities when different scenarios (e.g. delaying, extending durations and external factors) are happening

DIN

ABC analysis:	A method where objects are grouped into three categories (A-B-C) and ordered by frequency of occurrence. The method can be used in several disciplines.
Balanced Score Card (BSC):	Concept of measuring, documenting and controlling activities within a project considering strategic objectives of the organization.
Cost-utility analysis:	A method to evaluate comparable alternatives
Economic analysis:	A method to analyze benefit and profit of a project
Effort estimation:	Method to forecast which resources to what context are necessary to implement a project. (E.g. expert estimate, delphi-method, three-point-estimates, assessment meetings, project comparison)
Environmental analysis:	A method to identify all parties involved and to set measures for critical parties
FMEA:	Failure Mode and Effects Analysis (FMEA) is used to analyze failures. All possible failures are identified, assessed and response measures are derived.
Force-field-analysis:	A method to analyze a situation regarding driving and retaining factors
Learning during projects:	Documentation of experiences of a project
Network technique:	A methodology to describe and depict timely dependencies of activities.
Objectives description:	A description of objectives enhances the first project evaluation.
Project controlling:	Methodologies to monitor and control a project (e.g. earned value analysis (EVA), degree of completion, target/actual comparison, milestone trend analysis)

Earned Value Analysis (EVA): To calculate the EVA, planned data, actual data and remaining effort have to be available. Forecasts on overall costs and date of completion can be derived.

Degree of Completion: Determination of the degree of completion on a reference date.

Target/actual comparison: The planned target value is compared with the actual value in order to provide information about the status of a project.

Milestone trend analysis: A periodical record, analysis and forecast of expected milestone dates.

Project structuring: A method to show all tasks of a project in order to support project planning and control functions. Basically, there are two types of project structuring: the decomposition method and the composition method.

Quality Gate-concept: Quality-gates are points in the course of a project where on the basis of predefined criteria decisions for further progression are made.

Role clarification: Definition of stakeholders

Stakeholder analysis: Technique to identify, prioritize and understand stakeholders.

Strategy map: The method is used to document primary goals of the project.

SWOT-analysis: Analysis of strengths, weaknesses, opportunities and threats of the project

Team building: Composition of groups to achieve a common goal

Team development: To form an effective team, a team development process has to be performed.

Time scheduling:	Techniques to determine start and finish date of project`s activities.

PRINCE2

Activity-on-node technique:	A technique to sequence identified activities. It is used to schedule dependent activities within a plan.
Center of Excellence:	Central standard unit, which defines standards and provides training courses to the project staff.
Estimation techniques:	Techniques to identify type of resources and effort required (e.g. Top-down estimating, Bottom-up estimating, comparative estimating, parametric estimating, Single-point estimating, Three-point estimating)
Investment appraisal:	Techniques to compare the development of maintenance and operation costs with the benefits of the project within a certain period (e.g. through- life cost, net benefits, return on investment (ROI), payback period, discounted cash flow, net present value, sensitivity analysis).
Issue and Change Control:	A technique to deal with change requests, which follows these steps: capture, examine, propose, decide, implement.
MoSCoW:	A technique to prioritize issues and rate change requests: must have, should have, could have, and won’t have
Product-based planning:	Iterative planning method, composed out of the following steps: write the project product description, create the product breakdown structure, write the product descriptions, create the product flow diagram.

Progress evaluation:	Techniques to evaluate the progression of a project (e.g. milestone chart, s-curve, earned value management).
Quality review technique:	A quality technique to assess conformity of a product, to involve key interested parties, to obtain confirmation about completeness of a product and to create a baseline for change control.
Risk estimation techniques:	Techniques to estimate risks (e.g. probability trees, expected value, pareto analysis, probability impact grid).
Risk evaluation techniques:	Techniques to evaluate risks (e.g. risk models, expected monetary value)."
Risk Identification techniques	Techniques to identify risks (e.g. review lessons, risk checklists, risk prompt list, brainstorming, risk breakdown structure).
Stakeholder engagement:	A six step procedure to engage the right stakeholders. The six steps are: identifying stakeholders (who?), creating and analyzing stakeholder profiles (what?), defining stakeholder engagement strategy (how?), planning the engagements (when?), engaging stakeholders (do), measuring effectiveness (results).
The critical chain technique	Scheduling method which considers also the resources required.