Towards a theory for defining a project management multidisciplinary kernel: An approach based on Abstract Level Progress Health Attributes

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Put a smile on your face to every situation you face, to apologize you will be late. You don't want to realize with grief, you are as the cookie thief...

Agradecimientos

Son muchas las personas que han contribuido a que este trabajo sea posible. El primero de ellos, Dios, quien siempre ha estado allí en todos los momentos cuando pensé que no sería capaz. Nunca se alejó de mi lado y siempre permaneció apoyándome.

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Abstract

Project management is a discipline for gathering knowledge, capabilities, tools, and techniques in order to control the environment where projects run. Project management bodies of knowledge (BOKs) and standards are defined for codifying the project management theory. However, BOKs and standards are discipline-dependent, so they fail in covering all dimensions project-driven disciplines involve. Problems associated with dimension coverage rely on codifying a generalized project management theory to be applied along project-driven disciplines. Thus, codifying a project management multidisciplinary theory is considered a challenging task. Some authors claim a holistic view towards project management allows us for identifying general codifying patterns of a multidisciplinary theory. Accordingly, in this M.Sc. Thesis we propose some constructs for defining a project management multidisciplinary theory. We aim to identify a common structure among project management BOKs and standards. We define such a structure as a kernel for covering a project management multidisciplinary theory. Particularly, we focus on introducing into project management discipline an approach based on Abstract Level Progress Health Attributes—such approach has its origins in Semat (Software Engineering Method and Theory), an initiative for defining a theory for software engineering. By introducing such approach, we allow practitioners for tracking project health, so they can identify and control project dimensions requiring special attention when running a project. So, project success likelihood can be incremented. Furthermore, we allow for covering all dimensions project-driven disciplines involve, so we can connect project-driven disciplines by using a multidisciplinary kernel. Finally, we present an analytic approach for validating the kernel by comparing it to other project management BOKs and standards, so we can demonstrate the multidisciplinary kernel covers all dimensions project management discipline involves. Furthermore, we introduce a way for representing project management practices based on the kernel defined in this M.Sc. Thesis.

Abstract Level Progress Health Attributes, Multidisciplinary kernel, Project Management, Project Management BOKs, Project Management Standards, Project Management Theory, Semat

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1 Introduction

In PMI (Project Management Institute) a project is defined as *"a temporary endeavor undertaken to create a unique product or service."* Some organizations recognize projects as proper ways to organize work and create new products or services [1]. Aiming to improve the way projects are managed, project management organizations define rules, tools, and techniques. Such elements represent the project management theory. Consequently, such a theory is codified into project bodies of knowledge (BOKs) and standards defined by project management organizations [2, 3].

Project management organizations such as PMI, OGC (Office of Government Commerce), SCRUMstudy™, and Semat (Software Engineering Method and Theory) provide BOKs and standards in order to codify and define the main terms related to specific disciplines. Such BOKs and standards are considered to be consistent among them, despite they use different approaches for managing projects [3].

According to Smyth and Morris [4], bodies of knowledge as PMBOK are empirically built, *i.e.*, case studies are driven in order to compile results and build generalizations allowing for understanding project management. So, such bodies of knowledge depend on the discipline and conditions where case studies are driven, so when they are applied outside the discipline where they are codified, they fail in covering all dimensions project-driven disciplines involve. So, a discipline-dependent vision is assigned to project management. Consequently, codifying a project management multidisciplinary theory is considered a challenging task [3].

Smyth and Morris [4] consider the focus on specific-discipline dimensions—as most representative project management BOKs and standards do—hardens the identification of codifying patterns belonging to a project management multidisciplinary theory. Instead, a holistic view towards project management can allow us for identifying such patterns.

Accordingly, in this M.Sc. Thesis we propose some concepts for defining a project management multidisciplinary theory. To this end, we compare most representative project management BOKs and standards from different disciplines—such as PMBOK, PRINCE2, SBOK, and Semat—and represent their structure by using pre-conceptual schemas [5]. As a result, we identify a common structure among them. We define such a structure as a kernel—*the project management quintessence kernel*—for covering a project management multidisciplinary theory.

The *project management quintessence kernel* is based on Abstract Level Progress Health Attributes (Alphas)—such approach has its origins in Semat [6], an initiative for defining a theory for software engineering. Alphas are project dimensions practitioners should care

about when running a project. They are used to describe the things practitioners should manage in order to control the environment where projects run. Alphas are explained by using states. Such states allow for tracking project health and progress. So, practitioners can identify and manage project dimensions requiring special attention when running a project [6]. In this way, project success likelihood can be incremented. Furthermore, alphas are progressed by performing activities contained by activity spaces. Activity spaces represents the things practitioners should do when running a project. They should be interpreted as macro-activities.

Particularly, in this M.Sc. Thesis we introduce a set of alphas and activity spaces related to project management. Also, we define a way to instantiate particular dimensions of project driven disciplines. So, we allow for covering all dimensions project-driven disciplines involve by using the *quintessence kernel*. Finally, we propose an analytic approach for validating the kernel by comparing it to other project management BOKs and standards. We demonstrate the set of alphas defined in this M.Sc. Thesis allows for covering all dimensions defined by most representative project management BOKs and standards. Also, we demonstrate we can cover all dimensions project-driven disciplines involve by testing the way to instantiate project management dimensions of specific disciplines. To this end, we represent three strategic planning practices by using the *quintessence kernel*

This M.Sc. Thesis is structured as follows: in Chapter 2 we describe the structure of several project management BOKs and standards. Also, we describe the main symbols of the pre-conceptual schemas. In Chapter 3 we present challenges related to codifying a project management multidisciplinary theory. In Chapter 4 we compare BOKs and standards from several disciplines and represent their structure by using pre-conceptual schemas. In this way, we identify a common structure among them. Accordingly, we introduce the *project management quintessence kernel*. In Chapter 5, we validate the multidisciplinary kernel by comparing it to other project management standards and BOKs. Finally, we discuss some conclusions and future work.

2 Theoretical framework

2.1. Project Management Body of Knowledge (PMBOK)

PMBOK [1] is a body of knowledge codified by the PMI. In order to codify project management knowledge, a set of tools, techniques, and processes practitioners should follow when running a project are defined.

PMBOK comprises process groups, knowledge areas, and processes. Process groups include processes performed across project life cycle. Knowledge areas are categorical ways of grouping processes. Also, they are considered specialized dimensions practitioners should manage adequately, so project success likelihood is incremented [1]. In Sections 2.1.1 and 2.1.2, we present PMBOK process groups and knowledge areas.

2.1.1. Process groups

A project is defined as *"a temporary endeavor undertaken to create a unique product or service."* [1] Accordingly, projects can be addressed by performing a set of interrelated actions and processes for creating a unique product or service—*i.e.*, by performing processes.

Projects comprise two types of processes: project management processes and product-oriented processes [1]. Project management processes are those aiming to managing and monitoring the environment where projects run. Product-oriented processes are specifically oriented to describe the way the product or service should be created. Product-oriented processes should vary according to the application area, while project management processes should remain unchanged.

PMBOK [1] is just focused on defining project management processes. Consequently, they define a set processes practitioners should follow when running a project. According to the project management nature and interactions among processes, they group project management processes into five process groups—*i.e.*, initiating, planning, executing, monitoring & controlling, and closing [1].

2.1.2. Knowledge areas

Knowledge areas are categorical ways of grouping processes. Also, they are considered specialized dimensions practitioners should manage adequately, so the project success likelihood can be incremented. Knowledge areas represent dimensions for measuring projects—*i.e.*, project integration management, project scope management, project schedule management, project cost management, project quality management, project resource management, project communications management, project risk management, project procurement, and project stakeholder management [1].

2.2. PRINCE2

PRINCE2 is a structured project management method codified by the OGC [7]. PRINCE2 comprises a static structure and a dynamic structure; static structure is similar to the structure defined in other project management standards, *i.e.*, a structure comprising processes, activities and project management dimensions practitioners should address when running a project, so PRINCE2 can be considered as a project management standard too. Dynamic structure comprises the principles practitioners should apply when running a project. They serve as the foundation for the PRINCE2 method. Also, they represent behavior practitioners should adopt when running a project under the PRINCE2 method [7]. Due to the scope of this M.Sc. Thesis, we focus on the static structure PRINCE2 provides.
As a matter of fact, PRINCE2 and PMBOK are similarly structured, since they define similar constructs for addressing project management—*e.g.*, PRINCE2 themes are constructs similar to PMBOK knowledge areas; PRINCE2 processes are constructs are similar to PMBOK process groups; PRINCE2 activities are constructs similar to PMBOK processes.
In Section 2.2.1 and 2.2.2 we present PRINCE2 themes and processes.

2.2.1. Themes

PRINCE2 themes are defined as *"aspects of project management that must be addressed continually."* [7] They represent the project dimensions practitioners should manage adequately when running a project, so project success likelihood is incremented—*i.e.*, business case, organization, quality, plans, risk, change, and progress [7].

2.2.2. Processes

PRINCE2 processes are defined as *"a structured set of activities designed to accomplish a specific objective."* [7]—*i.e.*, starting up a project, directing a project, initiating a project,

controlling a stage, managing product delivery, managing stage boundary, and closing a project [7].

2.3. Scrum Body of Knowledge (SBOK)

SBOK is a body of knowledge codified by the SCRUMstudy™ as a set of guidelines for implementing Scrum. Scrum was conceived as a framework for developing software. Similar to PRINCE2, SBOK comprises a static structure and a dynamic structure. The static structure includes aspects, phases, and processes for managing projects by using Scrum. The dynamic structure provides principles practitioners should follow when running a project by using Scrum [8]. Due to the scope of this M.Sc. Thesis, we focus on the static structure SBOK provides.
As a matter of fact, SBOK, PRINCE2, and PMBOK are similarly structured, since they define similar constructs for addressing project management—*e.g.*, SBOK aspects are constructs similar to PRINCE2 themes and PMBOK knowledge areas; SBOK phases are constructs similar to PRINCE2 processes and PMBOK process groups; SBOK processes are constructs similar to PRINCE2 activities and PMBOK processes.
In Section 2.3.1 and 2.3.2 we present SBOK aspects and phases.

2.3.1. Aspects

SBOK aspects are dimensions practitioners should address and manage in a project, so project success likelihood is incremented—*i.e.*, organization, business justification, quality, change, and risk.

2.3.2. Phases

SBOK phases are categorical ways of grouping processes. They provide description for processes. Also, they associate inputs and outputs from them—*i.e.*, initiate, plan and estimate, implement, review and retrospect, and release.

2.4. Semat

Semat is promoting a theory for software engineering aiming to improve the way software engineering teams track project health and progress [6]. To this end, Semat has codified a set of patterns known as the Essence kernel and a formal language—be advised Semat patterns are different from patterns addressed in this M.Sc. Thesis, since Semat patterns are descriptions of structures in a practice while patterns addressed in this M.Sc. Thesis are

abstractions of constructs allowing for defining a structure for a multidisciplinary project management kernel.

Semat Essence kernel is based on defining universal elements covering all software engineering endeavors, *i.e.*, elements we always work with when running software engineering projects. Due to the universal nature of patterns, Semat Essence kernel is agnostic to software engineering methods and practices [6].

Semat Essence kernel is classified by using the following areas of concern: client, solution, and endeavor. Such areas of concern are specialized into different dimensions of software engineering endeavors. Semat Essence kernel comprises alphas, activity spaces, and competencies. Alphas are universal dimensions in all software engineering endeavors. They represent software engineering project dimensions. They allow for tracking health and progress of projects via alpha states; activity spaces represent *"the things to do"* in a software engineering endeavors. *"They provide descriptions of the challenges a team faces when developing, maintaining, and supporting software systems;"* competencies represent the abilities, capabilities, and skills required for performing the work of software engineering endeavors [6].

As a matter of fact, Semat, SBOK, PRINCE2, and PMBOK are similarly structured, since they define similar constructs for addressing project management—*e.g.*, Semat alphas are constructs similar to SBOK aspects, PRINCE2 themes, and PMBOK knowledge areas; Semat activity spaces are constructs similar to SBOK phases, PRINCE2 processes, and PMBOK process groups.

In Section 2.4.1, 2.4.2, and 2.4.3 we present, respectively, alphas, activity spaces, and competencies as codified by Semat.

Furthermore, Semat language is based on defining a graphical syntax allowing for software engineering method and practice representation. Consequently, in Section 2.4.4 we present such a language.

2.4.1. Essence kernel alphas

Alphas are universal dimensions practitioners always work with in all software engineering endeavors. They represent project dimensions practitioners should care about when running a project. Furthermore, they can be used to describe the things practitioners should manage in order to control the environment where projects run.

Essence kernel alphas have states. Likewise, alpha states have checklists. Such checklists define criteria for guiding teams to successfully achieve alpha states. So, they can be interpreted as general guidelines of the things a team should do when running a software engineering endeavor. By establishing the state an alpha is in, Essence kernel allows for tracking health and progress of any software engineering endeavor at any time.

In Figure **2-1** we present Essence kernel alphas and their relationships.

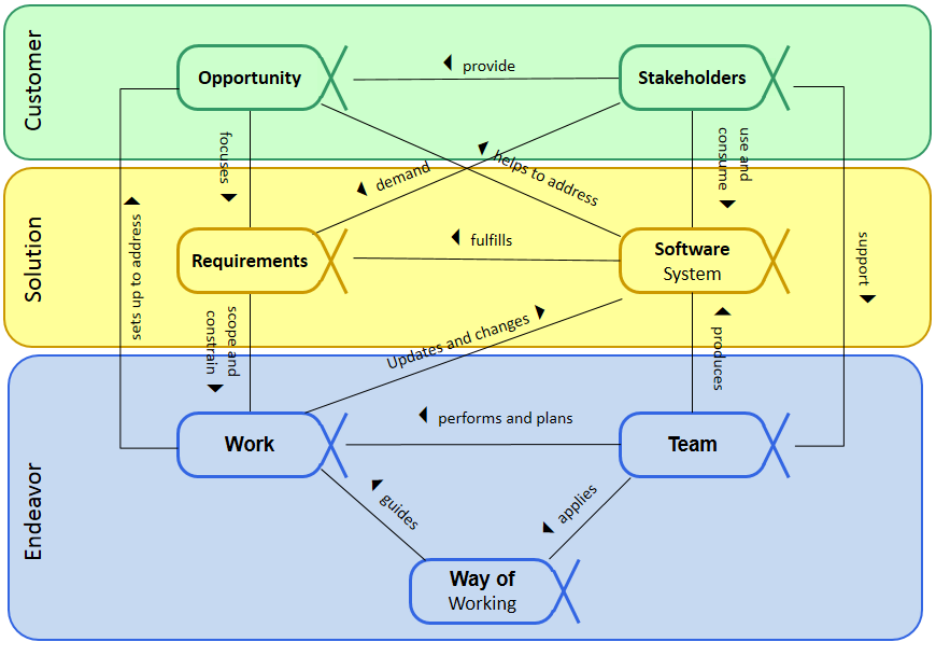

Figure 2-1: Essence kernel alphas and their relationships. [6]

2.4.2. Essence kernel activity spaces

Activity spaces represent the things practitioners should do when running a software engineering endeavor. They are described as elements providing *"descriptions of the challenges a team faces when developing, maintaining, and supporting software systems."* [6]

Activity spaces should be interpreted as macro-activities comprising activities project team should define in order to achieve the description provided by activity spaces.

In Figure **2-2** we present Essence kernel activity spaces.

2.4.3. Competencies

Competencies represent the abilities, capabilities, and skills required for performing the work of a software engineering endeavor. In Figure **2-3** we present Essence kernel competencies.

A set of competencies for software engineering are defined in Semat, but Durango *et al* [9] state such competences are insufficient for describing software engineering practitioners abilities, capabilities, and skills required for performing the work of a software engineering endeavor. Consequently, they introduce seven new competencies to Essence kernel—*i.e.,* communication, service orientation, systemic thinking, knowledge management, change management, collaborative work, and achievement orientation. In Figure **2-4** Durango *et al* competencies are presented.

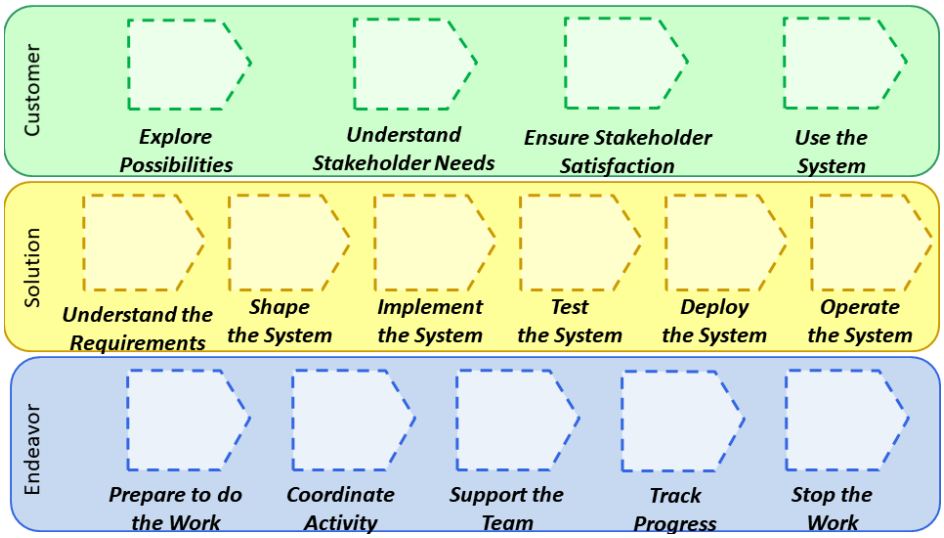

Figure 2-2: Essence kernel activity spaces. [6]

Figure 2-3: Essence kernel competencies. [6]

2.4.4. Semat language

In Figure **2-5** Semat language elements are presented. They are described as follows:

- Practice: Is a systematic approach for performing a set of activities. It helps to describe how software engineering endeavor activities should be performed.
- Alpha: Represents the things practitioners always work with in all software engineering endeavors.
- Activity space: Represents the things practitioners should do when running a software engineering endeavor. It is described as an element providing *"descriptions of the challenges a team faces when developing, maintaining, and supporting software systems."*
- Competency: Represents the abilities, capabilities, and skills required for performing the work of a software engineering endeavor.

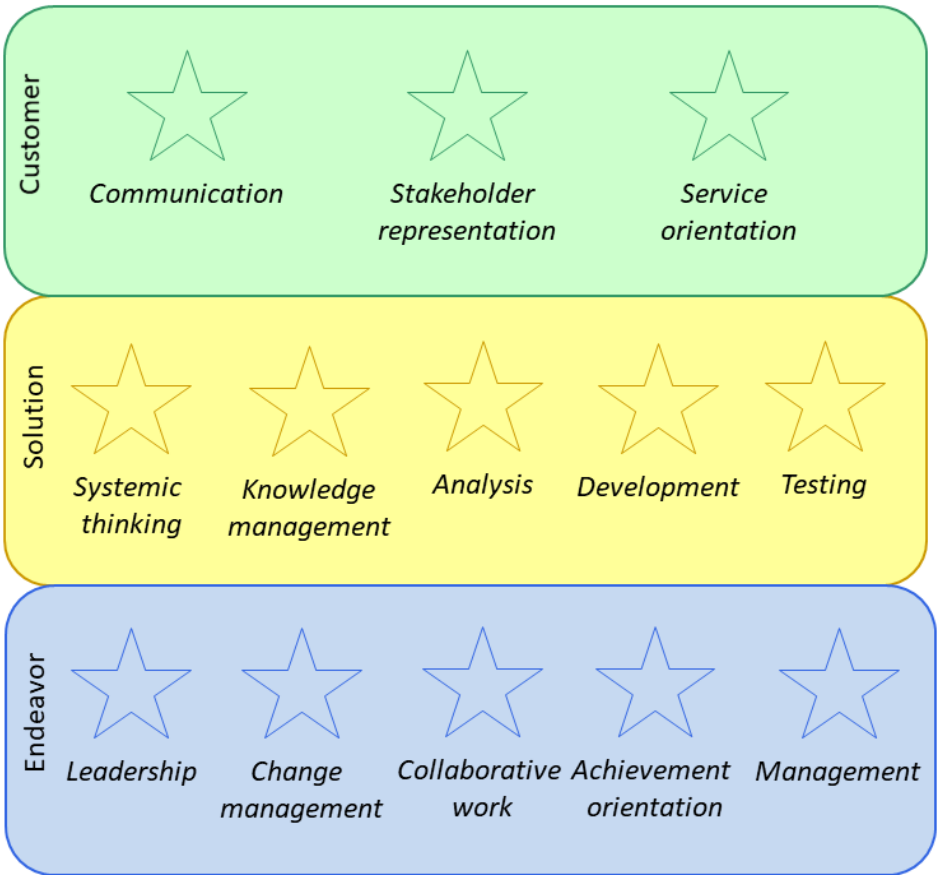

Figure 2-4: Durango *et al* competencies proposal. [9]

- Work product: Is an activity result. Furthermore, it helps to provide evidence for alphas states—*e.g.*, documents or a piece of software.
- Pattern: Is a description of a structure in a practice—*e.g.*, roles, phases and milestones.

2.5. Pre-conceptual schemas

Pre-conceptual schemas are knowledge representations based on formal logic and natural language [5]. To this end, set of elements is defined in pre-conceptual schemas. In Figure **2-6** we present the main symbols of pre-conceptual schemas.

- Concept. Nouns and noun phrases.
- Structural relationship. Verbs "be" and "have".
- Dynamic relationship. Verbs designating actions.

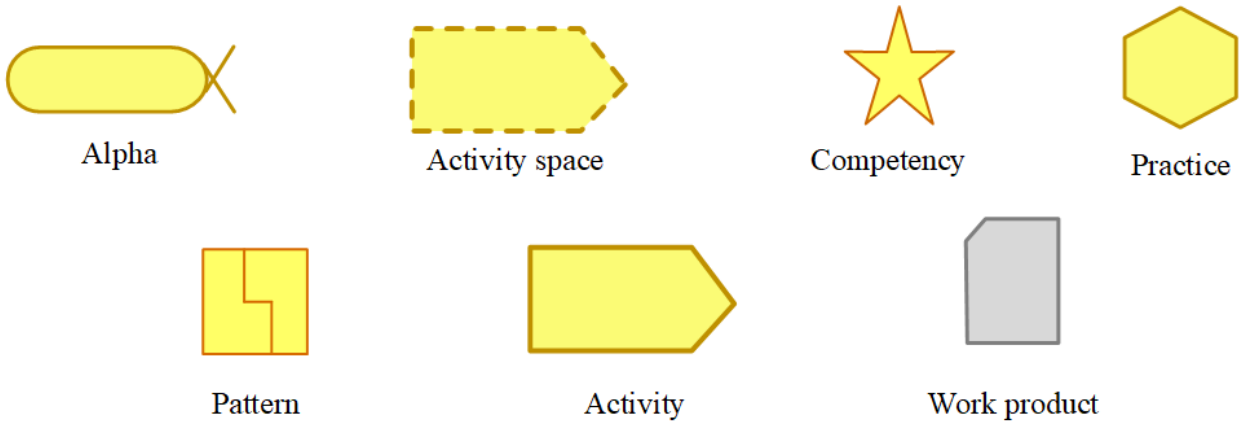

Figure 2-5: Essence kernel language elements. [6]

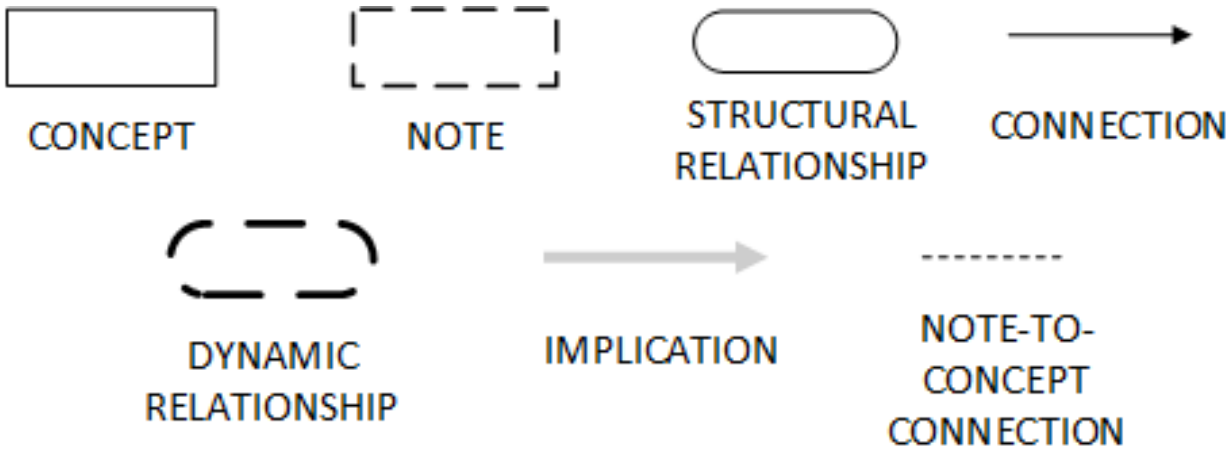

Figure 2-6: Main symbols of pre-conceptual schemas. [5]

- Note. Possible values of a concept.
- Connection. An arrow for binding concepts.
- Implication. Cause-effect relationships between dynamic relationships.
- Note-To-Concept Connection. Dotted line for binding notes to concepts.

3 Background

According to PMI [1], processes performed throughout the project execution can be framed in two categories: project management processes and product-oriented processes. The former are intended to provide the way practitioners should manage the environment where projects run while the latter are intended to describe the way the product or service resulting from the project should be created. Accordingly, two type of project management BOKs and standards are: general-purpose BOKs and standards—based on defining just project management processes—and discipline-specific BOKs and standards—based on defining both type of processes.

PMBOK and PRINCE2 can be framed as general-purpose BOKs and standards. Consequently, they can be applied along several project-driven disciplines. However, when they are applied in such disciplines, they fail to cover all dimensions such disciplines involve, since they exclude contextual dimensions provided by product-oriented processes. On the other hand, discipline-specific BOKs and standards are codified in order to cover contextual dimensions excluded from general-purpose BOKs and standards—*e.g* BOKs and standards such as Semat and SBOK can be framed as discipline-specific BOKs and standards, since both type of processes are codified in them.

Despite discipline-specific BOKs and standards help to solve problems related to general-purpose BOKs and standards, authors such as Smyth and Morris [4] consider such BOKs and standards are empirically built, *i.e.*, case studies are driven in order to compile results and build generalizations allowing for understanding project management. Accordingly, a discipline-dependent vision is assigned. So, they should be applied inside the discipline where they are codified, since they just cover project management dimensions related to such discipline.

Simonette and Magalhães [10] evidence the aforementioned problems. They compare PMBOK and Semat in order to analyze coverage of process groups into Semat. They conclude 11 % of all PMBOK project management processes can be mapped in the customer area of concern; 15 % in the solution are of concern; 74 % in the endeavor area of concern. As expected, most PMBOK process groups are mapped in the endeavor area of concern, since they include descriptions for project management processes performed in software engineering projects, which are the same nature of processes defined in PMBOK—*i.e.* project management processes. However, product-oriented defined in both customer and solution areas of concern are uncovered. Such situation is known as the multidisciplinary gap among project management BOKs and standards.

Similar to the problems described by Simonette and Magalhães [10], Zapata and Henao [12] and Santiago and Morales [13] evidence problems related to the multidisciplinary gap among project management BOKs and standards. They compare Semat and PMBOK in order to analyze coverage of knowledge areas into Semat. As a result, they conclude some dimensions should be introduced in both standards in order to reduce multidisciplinary gap. In Figures **3-1** to **3-4** dimensions proposed by Zapata and Henao [12] and Santiago and Morales [13] allowing for reducing multidisciplinary gap among Semat and PMBOK are presented.

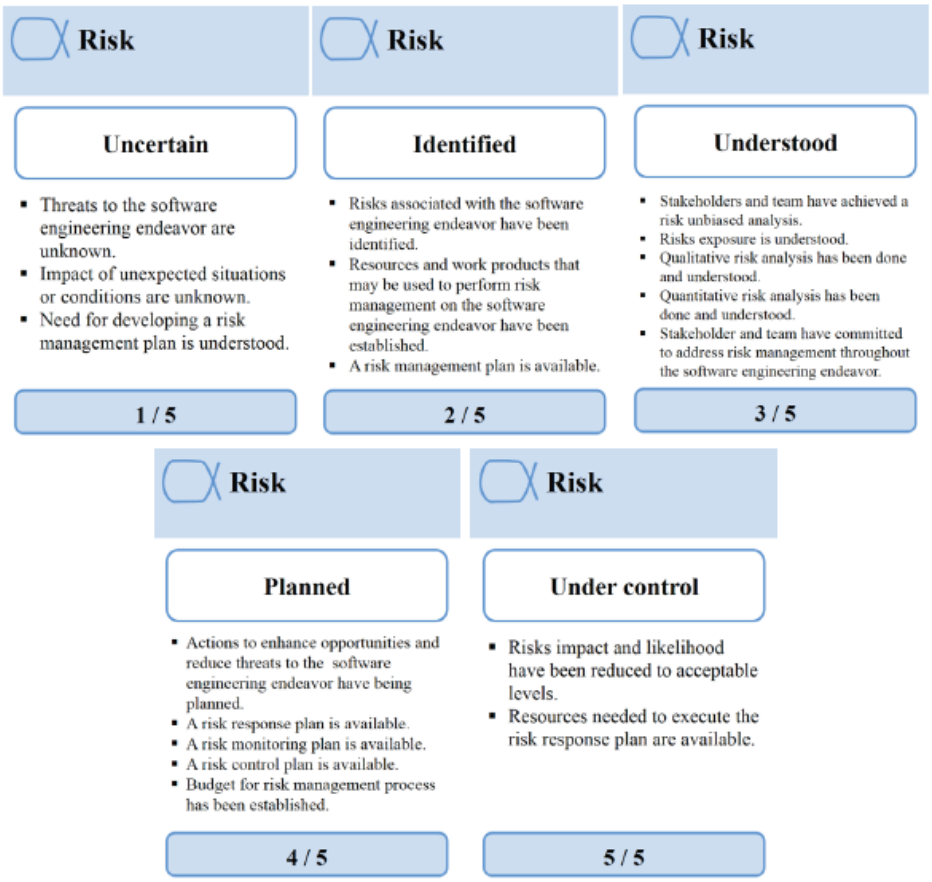

Figure 3-1: Risk dimension. [12]

Despite they solve some problems related to the multidisciplinary gap among BOKs and standards, Smyth and Morris [4] consider the focus on specific-discipline dimensions hardens the identification of codifying patterns belonging to a project management multidisciplinary theory. Instead, a holistic view towards project management can allow us for identifying such patterns in order to define such a theory. However, according to Crawford [14], the biggest challenge is determining at what point such theory becomes *"so generalized that is of limited value, and at what point it is so specific that it is no longer generalizable."*
Problems associated with identification of a common structure among project management BOKs and standards are related to terminology unification problems, *i.e.*, a construct can

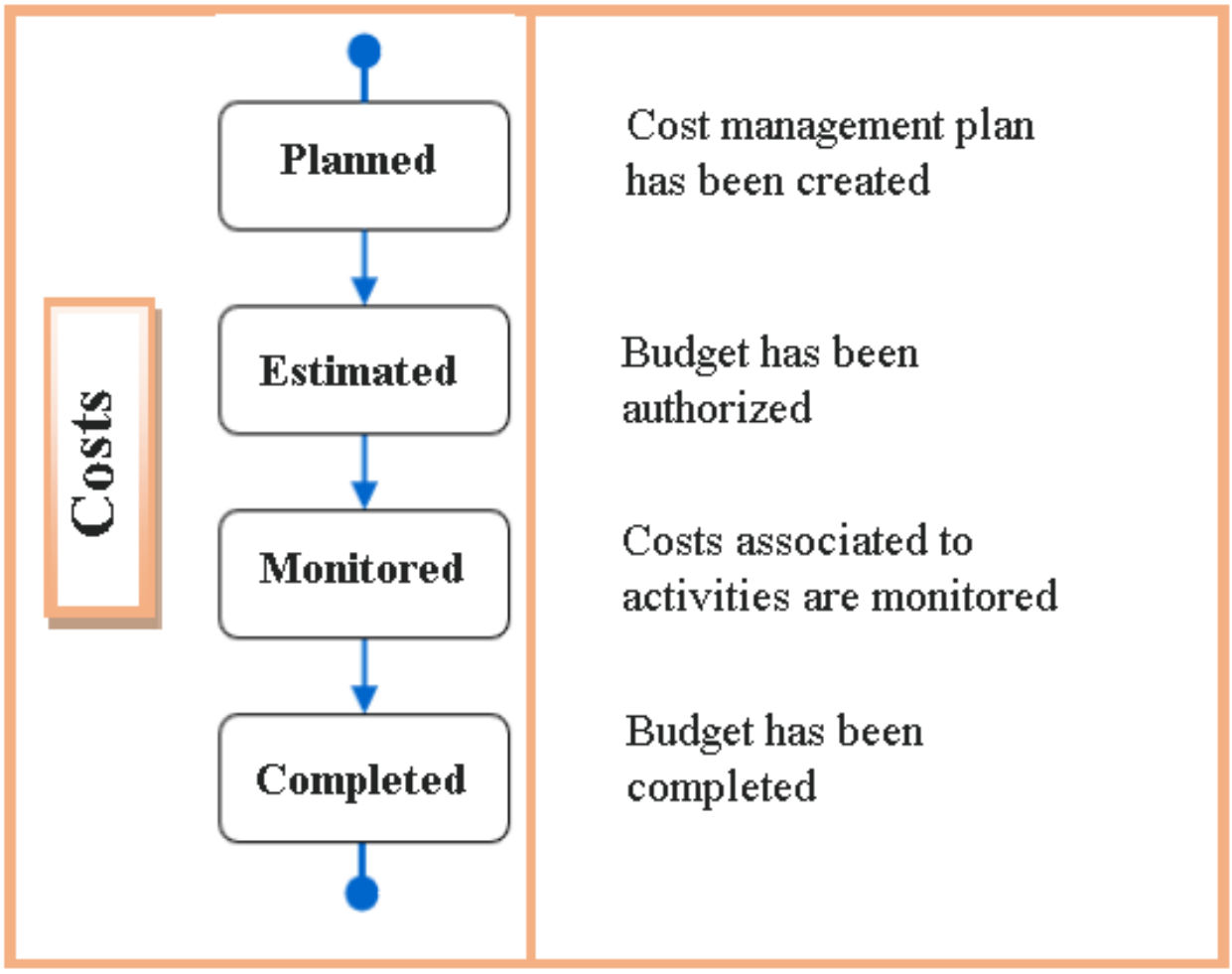

Figure 3-2: Cost dimension. Translated from [13]

be present in several BOKs and standards with different names—*e.g.*, PMBOK knowledge area construct is similar to PRINCE theme construct, Semat alpha construct, and SBOK aspect construct. However, due to absence of a theory allowing for unifying terminology in project management, such constructs are treated as different. Such problem can be solved by unifying project management terminology. So, a set of finite constructs can be identified. By identifying such a set of constructs, we allow for defining a common structure among project management BOKs and standards[4].

The set of universal constructs comprising a common structure among project management BOKs and standards should help to cover all aspects included in most known BOKs and standards. Furthermore, they should be defined in a way allowing for solving problems related to general-purpose and discipline-specific BOKs and standards. So, they should allow for covering all project-driven disciplines.

Identification of universals is challenging, since the way project management is addressed in each one of the project management BOKs and standards vary due to the elements and

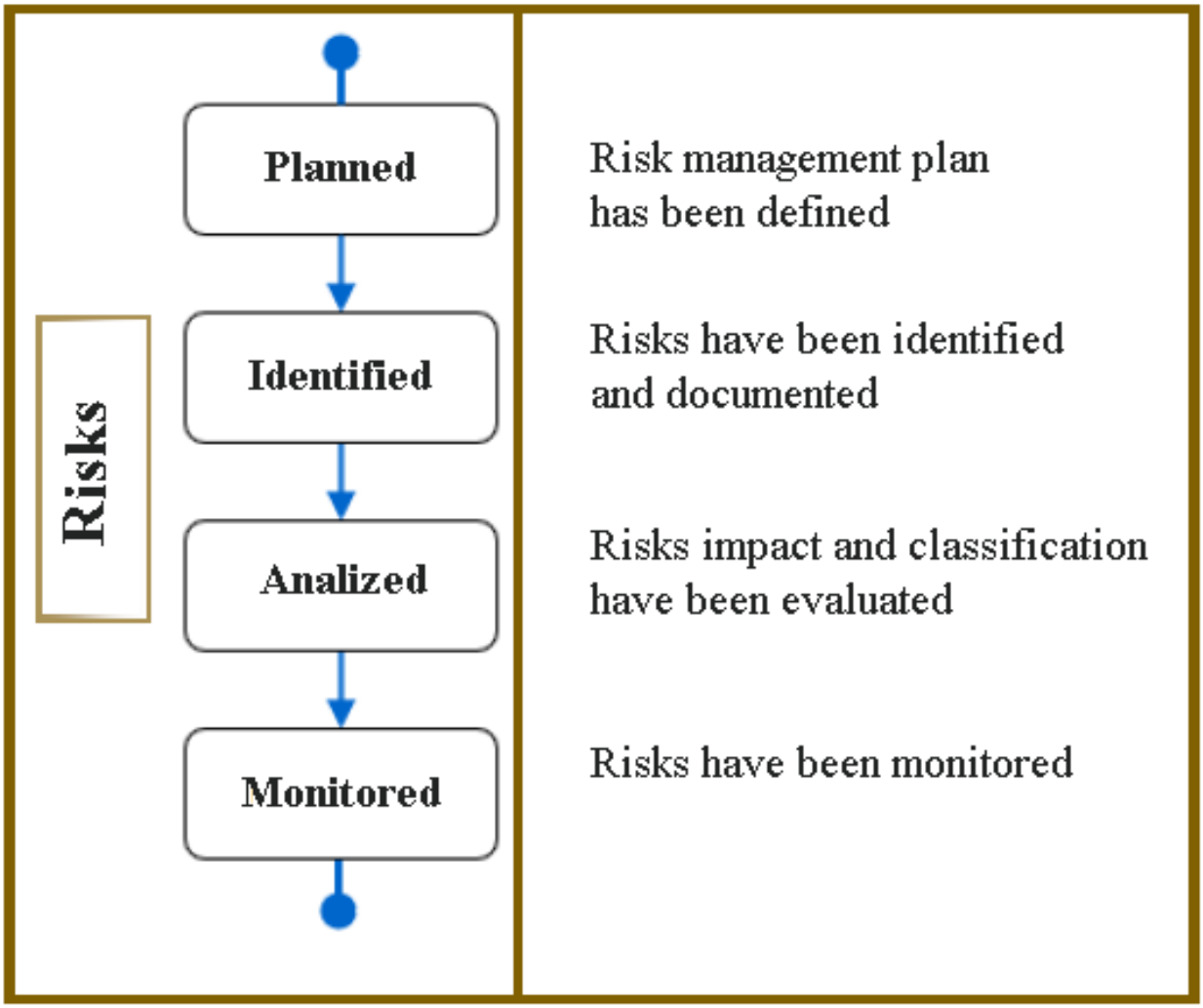

Figure 3-3: Risk dimension. Translated from [13]

the way such elements are defined—*e.g.*, in PMBOK, scope knowledge area is defined for defining and controlling what should be included in the project [1]. However, such dimension is covered by the PRINCE2 business case theme, the SBOK business justification aspect, and the Semat opportunity alpha. As a result of their name, they seem different dimensions, but each one of them address the same project management dimension.

According with problems stated above, in this M.Sc. Thesis we propose some concepts for defining a project management multidisciplinary theory. We aim to identify a common structure among project management BOKs and standards—*i.e.*, codifying patterns—allowing for defining a project management multidisciplinary theory. Furthermore, we identify a set of universal elements covering all project-driven disciplines. Finally, we define a pattern for instantiating particular dimensions of project driven disciplines, so multidisciplinary gap among BOKs and standards can be bridged.

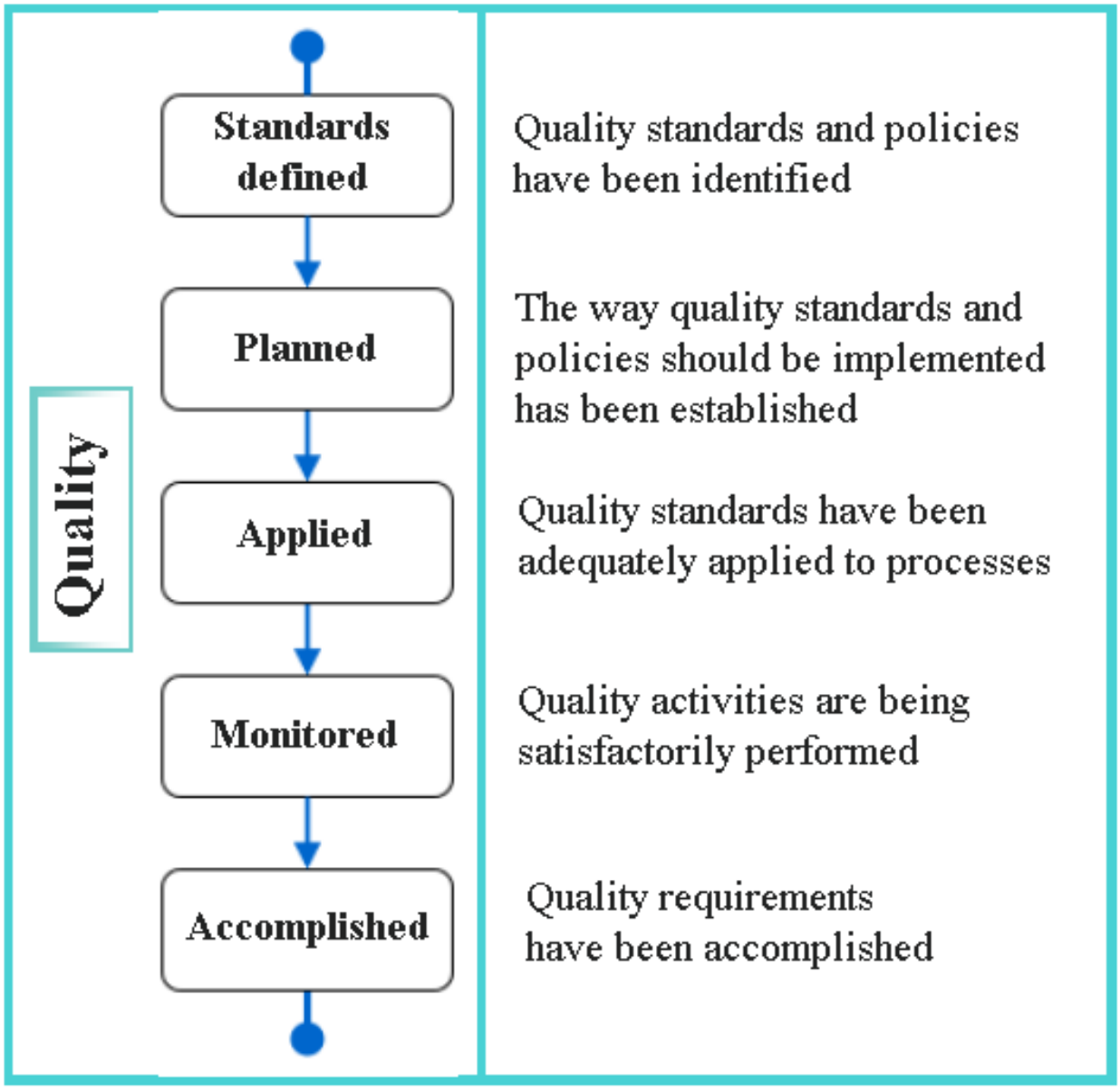

Figure 3-4: Quality dimension. Translated from [13]

4 Solution

4.1. Project management quintessence kernel

As we previously mentioned, one of the problems on defining a multidisciplinary project management theory is related to the identification of a common structure among project management BOKs and standards. Consequently, we generalize project management constructs—defined in each one of BOKs and standards addressed in this M.Sc. Thesis—into a set of universal patterns allowing for covering constructs addressed in project management BOKs and standards. To this end, we compare most representative project management BOKs and standards from different disciplines—such as PMBOK, PRINCE2, SBOK, and Semat—and represent their structure by using pre-conceptual schemas. Such patterns allows for defining a multidisciplinary project management structure we name as *the project management quintessence kernel*.

In Figures **4-1**, **4-2**, **4-3**, and **4-4** PMBOK, PRINCE2, SBOK, and Semat structures are represented.

Along such representations, three codifying patterns can be identified—*i.e.,* the dimensionality pattern, the process-definition pattern, and the process-grouping pattern. They are generalizations of constructs defined in project management BOKs and standards addressed in this Thesis. Consequently, they allow for describing structure among such BOKs and standards. The dimensionality pattern allows for defining the project management dimensions each standard addresses. PMBOK knowledge area construct, PRINCE2 theme construct, SBOK aspect construct, and Semat alpha construct are instances of this pattern; the process-definition pattern allows for defining the set of actions for creating a product or service. PMBOK process construct, PRINCE2 activity construct, and SBOK process construct are instances of this pattern—as matter of fact, Semat does not have a construct associated to this pattern due to its method-and-practice agnostic nature. The process-grouping pattern allows for grouping—in a categorical way—actions for creating a product or service. PMBOK process group construct, PRINCE2 process construct, SBOK phase construct, and Semat activity space construct are instances of this pattern.

Even though the aforementioned patterns allow for defining a common structure among project management BOKs and standards, their instantiation resembles a discipline-dependent vision, since they are generalizations of BOKs and standards with such a problem. Accordingly, we remove discipline-dependent vision assigned by such patterns by defining an additional pattern known as the sub-element pattern. Such pattern is based on the Semat

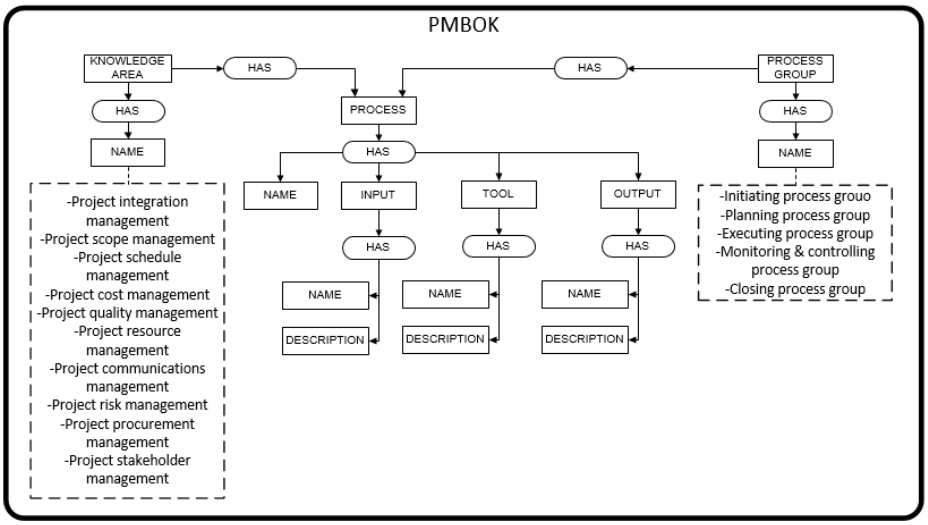

Figure 4-1: PMBOK structure. The authors based on [1]

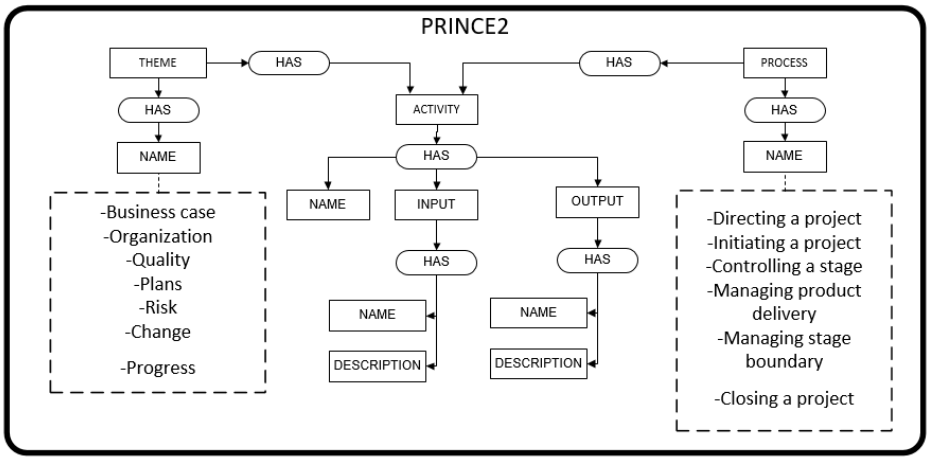

Figure 4-2: PRINCE2 structure. The authors based on [7]

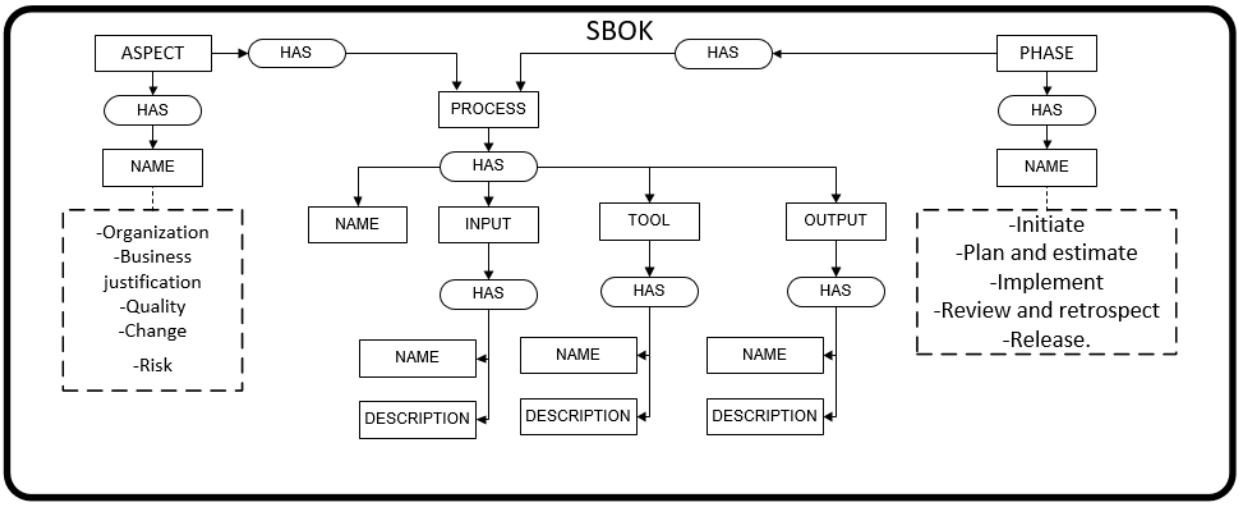

Figure 4-3: SBOK structure. The authors based on [8]

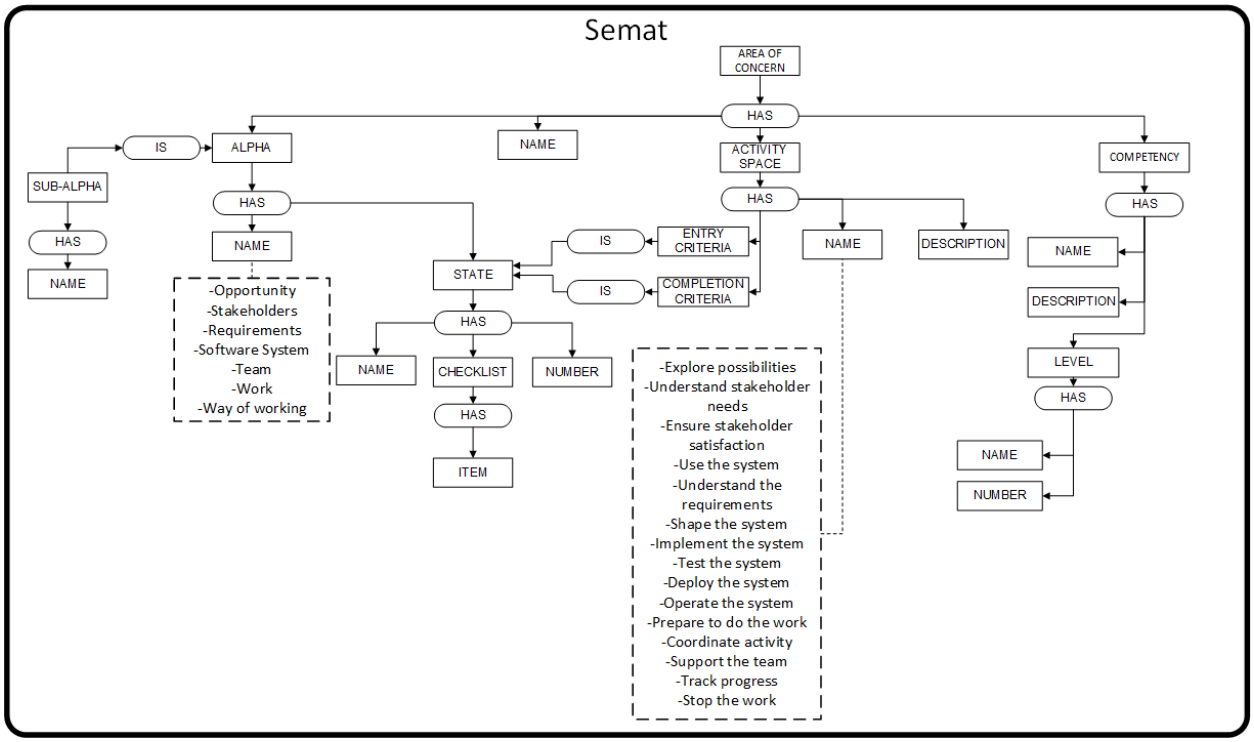

Figure 4-4: Semat structure. The authors based on [6]

sub-alpha construct.

Semat is based on a philosophy of defining universal elements allowing for covering all software engineering projects. As a result, project management dimensions are addressed in Semat via alphas. They are intended to represent the full set of project management dimensions necessary for managing software engineering projects. However, due to specific needs of some software engineering projects, additional dimensions are sometimes needed for tracking progress and health, even though they are still undefined in the Semat Essence kernel. In order to solve such problem in Semat the sub-alpha construct is defined [6].

Abstraction of Semat philosophy to project management discipline allows for defining a project management multidisciplinary theory. Consequently, a project management multidisciplinary theory based on such philosophy should include a set universal elements allowing for covering all project management disciplines. Furthermore, a mechanism allowing for introducing dimensions and processes from specific disciplines should be provided. So, we bridge the multidisciplinary gap among project management BOKs and standards. Particularly, in this M.Sc. Thesis, such a mechanism is represented by the sub-element pattern.

In Figure **4-5**, we present the way defined patterns allow for generalizing constructs in project management BOKs and standards addressed in this M.Sc. Thesis—be advised instantiation of such patterns in the *quintessence kernel* are named similar to Semat constructs, since we decide following its philosophy. The dimensionality pattern is instantiated by the alpha construct, the process grouping pattern is instantiated by the activity space construct, and the sub-element pattern is instantiated by the sub-alpha and the sub-activity space constructs. In contrast to Semat Essence kernel, we define an additional construct known as the sub-activity space, due to the lack of a mechanism for introducing undefined grouping processes in the Semat Essence kernel. The process definition pattern is outside of the quintessence kernel, since it introduces a discipline-dependent vision to the kernel. However, it can be instantiated by using the sub-element pattern.

In Figure **4-6** we propose an structure based on pre-conceptual schemas for the *quintessence kernel*.

Another problem to be solved in defining a multidisciplinary project management theory is the terminological unification of constructs defined in project management BOKs and standards. Consequently, in Table **4-1** we solve terminology unification problems by defining the *Quintessence kernel* constructs—and their equivalences in BOKs and standards addressed in this M.Sc. Thesis where applicable.

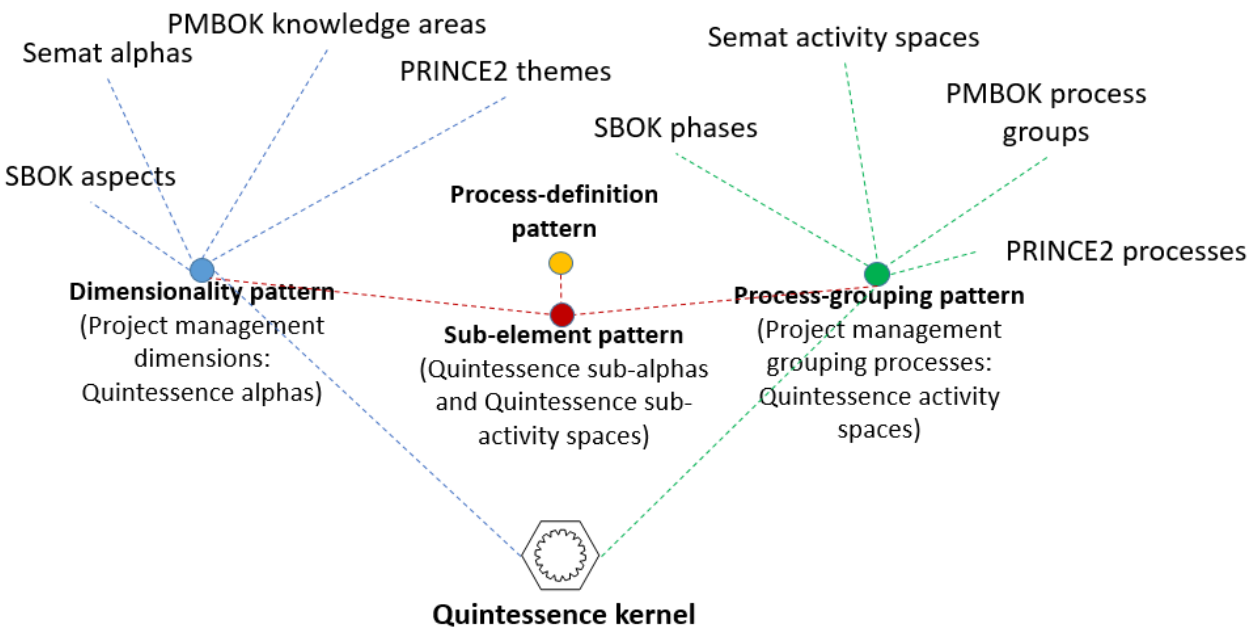

Figure 4-5: Project management quintessence kernel generalization of project management BOKs and standards. The authors

Table 4-1: Project management quintessence constructs. The authors

Construct	Definition	Equivalences
Area of concern	Areas of concern are categorical ways of grouping multidisciplinary project management Essence kernel elements	Semat area of concern
Alpha	Alpha stands for Abstract Level Progress & Health Attribute. Alphas are universal dimensions practitioners should care about when running a project. They describe the things we always work with	PMBOK Knowledge area PRINCE2 Theme SBOK Aspect Semat alpha

Table 4-1: Project management quintessence constructs. The authors

Construct	Definition	Equivalences
Activity space	Activity spaces should be interpreted as macro-activities comprising activities practitioners should always perform in order to create a product or service. Activity spaces are categorical ways of grouping product-oriented processes. They describe the challenges practitioners face when running a project	PMBOK Process group PRINCE2 Process SBOK Phase Semat activity space
Competency	Competencies represent the abilities, capabilities, and skills required for performing the work of a project	Semat competency
Sub-alpha	Sub-alphas are sub-ordinate alphas. They should be used for instantiating dimensions of specific project driven disciplines	Semat sub-alpha
Sub-activity space	Sub-activity spaces are sub-ordinate activity spaces. They should be used for instantiating ways of grouping project management processes from specific project driven disciplines	Some of the Semat current activity spaces—*i.e.,* use the system
State	States comprise checklists. Such states provide description of the project health and progress at a specific moment	Semat alpha states

Table 4-1: Project management quintessence constructs. The authors

Construct	Definition	Equivalences
Checklist	Checklists comprise items. Such checklists define criteria for guiding team to successfully achieve alpha states. They are general guidelines of the things a team should do when running a project	Semat checklists
Entry criteria	Entry criteria are activity space restrictions. Activity spaces should be started when one or more of their entry criteria are fulfilled. They are expressed in terms of alpha states	Semat entry criteria
Completion criteria	Completion criteria allows for establishing when an activity space is completed. They are expressed in terms of alpha states	Semat completion criteria
Level	Competency levels define a level of how competent a team member is regarding the abilities defined in the respective competency	Semat competency level

4.2. Project management quintessence kernel alphas

The *project management quintessence kernel* allows for defining a set of universal elements to all project-driven disciplines. So, a multidisciplinary project management theory can be codified. To this end, in this Section we introduce a set alphas universal to all project-driven disciplines. We allow for covering all dimensions project-driven disciplines involve by introducing project management alphas. Furthermore, we group such alphas in a categorical way by using Semat areas of concern.

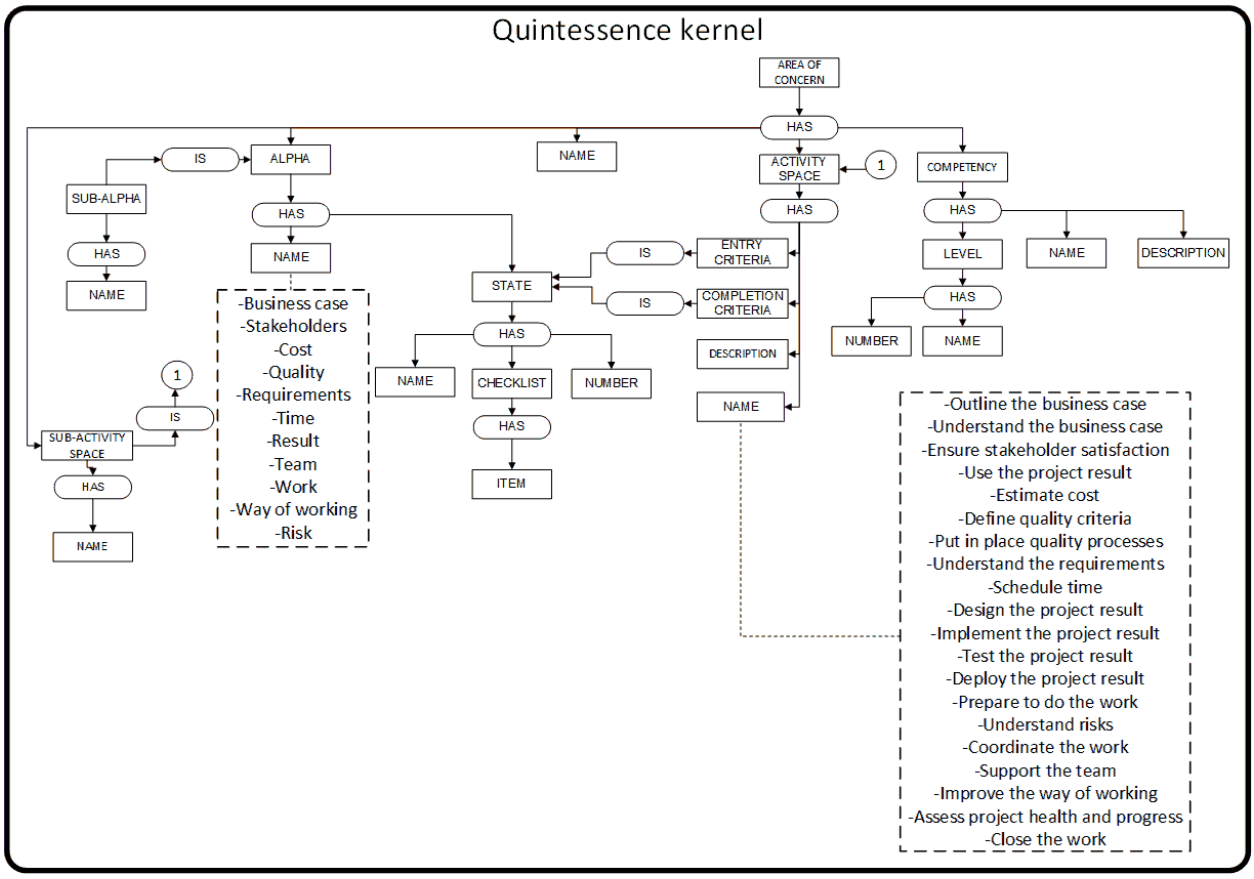

Figure 4-6: Project management quintessence kernel structure. The authors

Since Semat areas of concern are extensible to all project-driven disciplines, we group project management alphas universal to all project driven disciplines by using them—*i.e.,* by using the customer, solution, and endeavor areas of concern. The customer area of concern comprises everything related to defining business case scope and stakeholders engagement and satisfaction; the solution area of concern comprises everything related to assuring project result quality, estimating and controlling project cost and time, and assuring project result meets stakeholder requirements; the endeavor area of concern comprises everything related to managing the team, setting their way of working, and controlling project work and risks associated with it. Areas of concern are distinguished with different color codes in order to facilitate their identification along Quintessence kernel elements. In Fig **4-7** we present color codes associated with them.

We compare most representative project management BOKs and standards aiming to identify a set alphas universal to all project management disciplines. Furthermore, we analyzed Zapata and Henao [12] and Santiago and Morales [13] work in order to unify project dimensions they propose with our proposal. Consequently, we identify a set of eleven alphas. Such alphas and their states are presented in Figures **4-8** to **4-18**. Alpha states should comprise

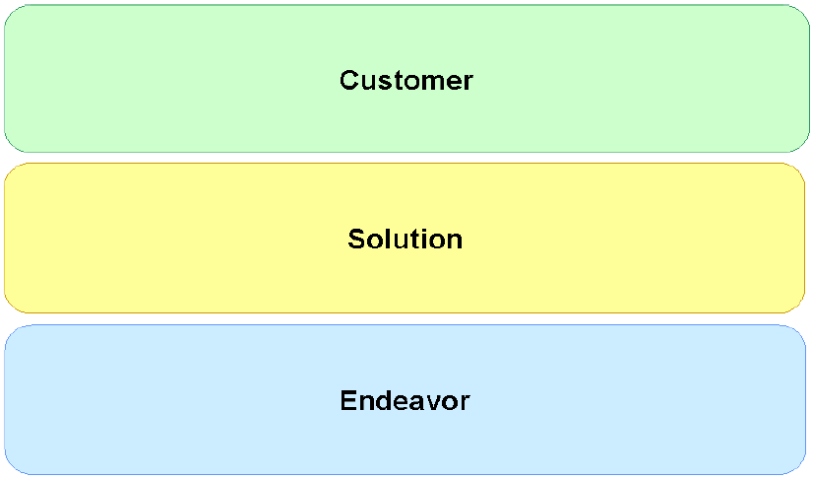

Figure 4-7: Quintessence areas of concern. [6]

checklists providing guidance on the things team should do when running a project. However, due to the scope of this M.Sc. Thesis, we just define project management alphas and their states.

The *business case* alpha go through five states—*i.e.,* identified, benefit established, approved, maintained, and addressed. Business case *identified* state describes when a reason for starting a project has been identified; business case *benefit established* state allows for establishing the impact the project result will have on stakeholders; business case *approved* state allows stakeholders for evaluating whether is worth executing the project in spite of risks associated to its execution; business case *maintained* state allows for updating business case according to cost, risk, and benefits information resulting from the project execution; business case *addressed* state allows for collecting baseline measures and it helps to describe the moment when the business case has been addressed. In Figure **4-8** business case alpha and its states are presented.

The *stakeholders* alpha go through five states—*i.e.,* recognized, represented, involved, satisfied for deployment, and satisfied in use. Stakeholders *recognized* state allows for identifying project stakeholders; stakeholders *represented* state allows for agreeing on mechanisms for involving stakeholders on project execution and it allows for appointing stakeholder representatives; stakeholders *involved* state allows for putting in place mechanisms involving stakeholder representatives in project execution, so they should be actively performing their work and fulfilling their responsibilities; stakeholders *satisfied* for deployment state allows for defining stakeholders quality criteria satisfying them for deploying the project result; stakeholders *satisfied in use* state allows for deploying project result and meeting stakeholder minimal expectations. In Figure **4-9** stakeholders alpha and its states are presented.

The *cost* alpha go through five states—*i.e.,* resource identified, estimated, approved, monitored, and calculated. Cost *resource identified* state allows for identifying resources needed for planning and performing project activities; cost *estimated* state allows for estimating

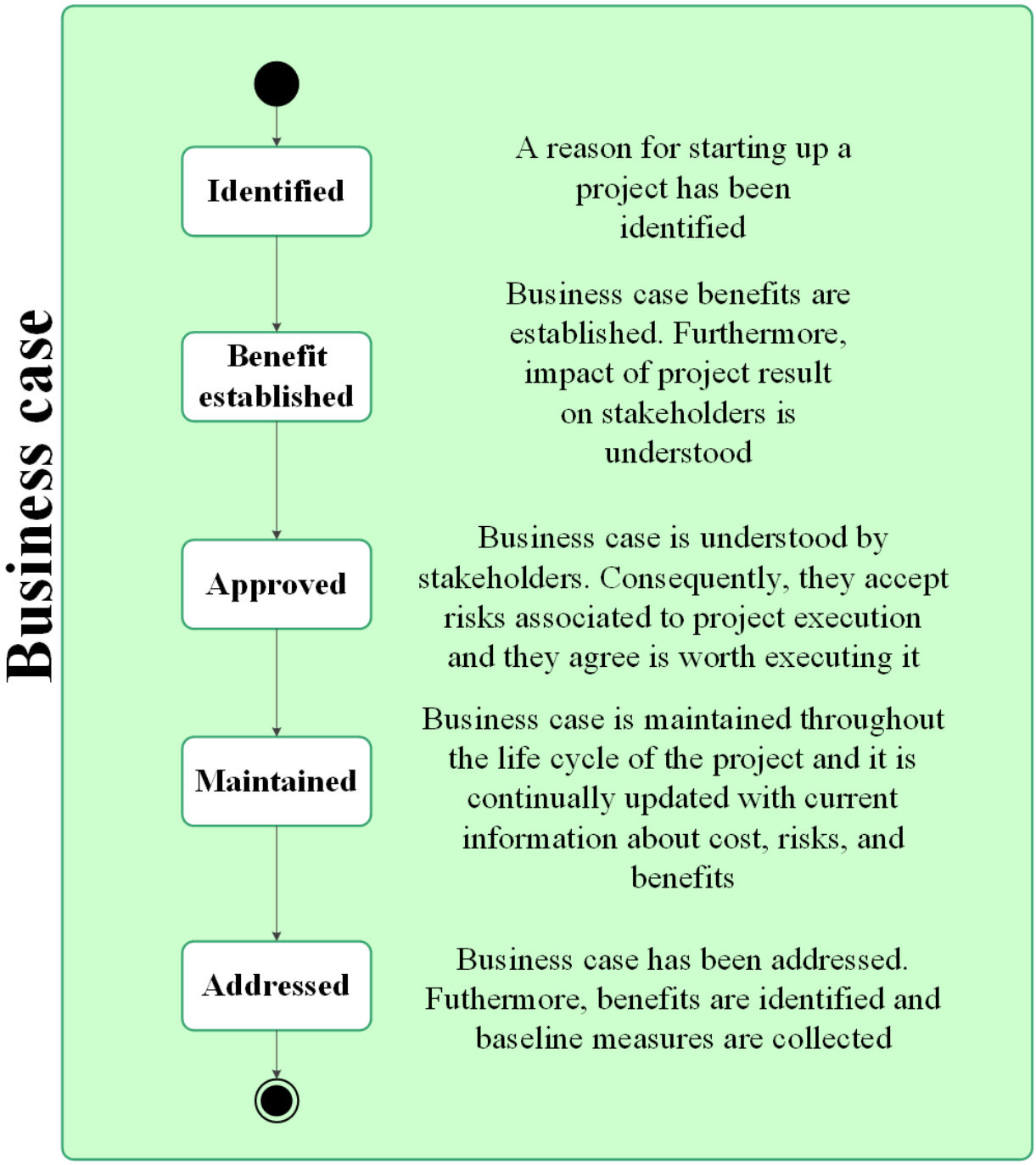

Figure 4-8: Business case alpha. The authors

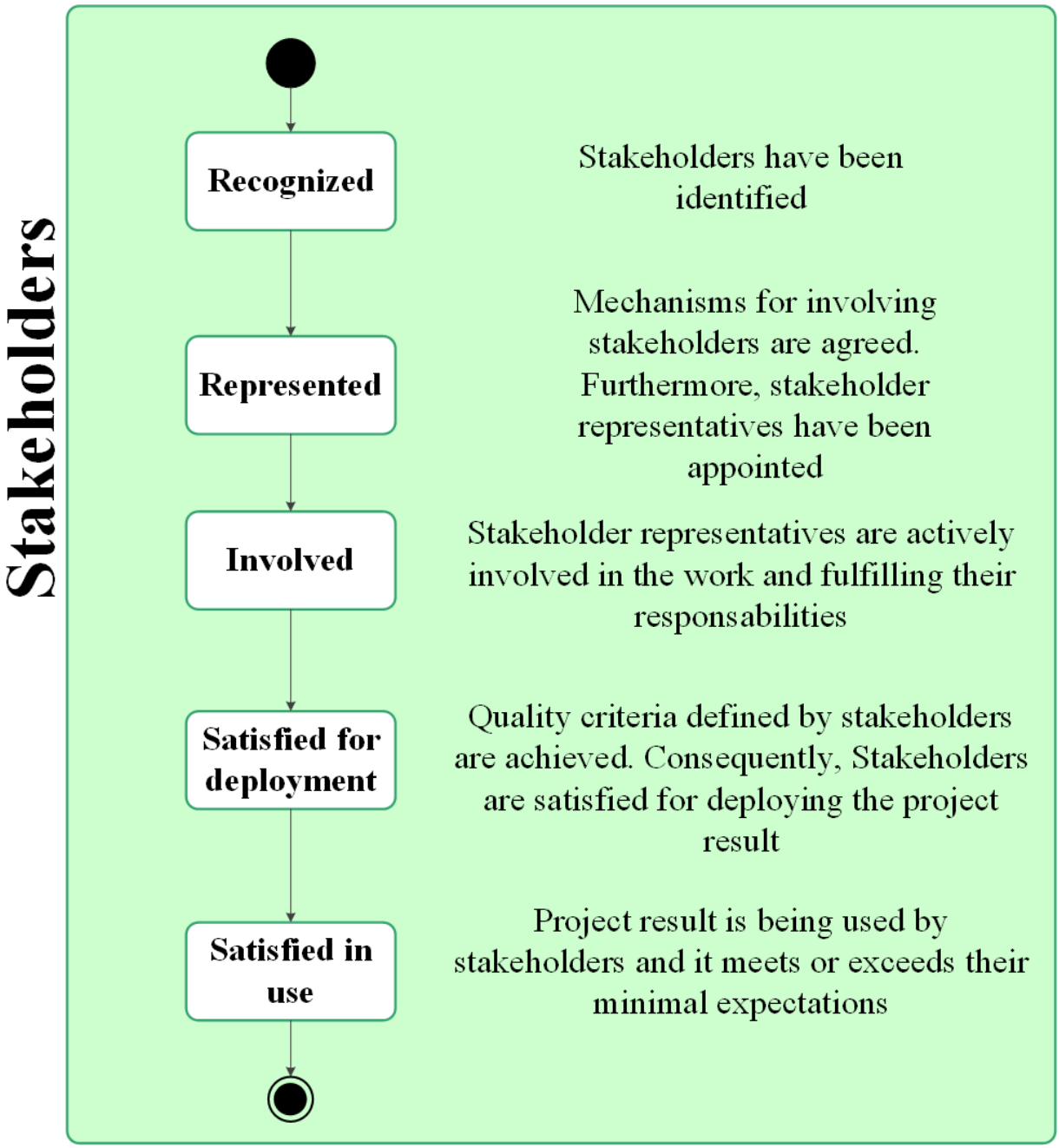

Figure 4-9: Stakeholder alpha. The authors

cost of resources needed for planning and performing project activities; cost *approved* state allows for getting project cost approval by getting stakeholders on agreement on project resources estimation and it allows for modifying project cost according to stakeholder needs; cost *monitored* state allows for monitoring project cost performance and detecting variance on it resulting from the project execution; cost *calculated* state allows for calculating project cost. Furthermore, it allows for documenting changes affecting project cost. In Figure **4-10** cost alpha and its states are presented.

The *quality* alpha go through five states—*i.e.,* criteria defined, assured, processes in place, monitored, and achieved. Quality *criteria defined* state allows for defining quality criteria and quality standards to be followed in the project; quality *assured* state allows for assuring quality requirements are adequate for project nature; quality *processes in place* state allows for putting in place quality processes for measuring quality criteria defined by stakeholders, so quality measurement can be started; quality *monitored* state allows for monitoring performance of project quality measures; quality *achieved* state allows for achieving quality criteria defined by stakeholders. In Figure **4-11** quality alpha and its states are presented.

The *requirements* alpha go through six states—*i.e.,* conceived, bounded, coherent, acceptable, addressed, and fulfilled. Requirements *conceived* stated allows for identifying stakeholders funding the project and project purpose; requirements *bounded* state allows for agreeing on what is expected from the project; requirements *coherent* state allows for coherently describing essentials features expected from project result; requirements *acceptable* state allows for getting acceptance from stakeholders on requirements description; requirements *addressed* state allows for addressing enough requirements satisfying the business case, so stakeholders are satisfied for deployment; requirements *fulfilled* state allows for fully addressing project requirements. So, the project result can be operated. In Figure **4-12** requirements alpha and its states are presented.

The *time* alpha go through five states—*i.e.,* estimated, scheduled, approved, monitored, and determined. Time *estimated* state allows for identifying project activities and resources, and it allows for estimating how long the project will take; time *scheduled* state allows for sequencing project activities according to time estimation and time constraints; time *approved* state allows for getting approval from stakeholders on project schedule; time *monitored* state allows for monitoring project time performance and detecting variance in project time resulting from the project execution; time *determined* state allows for calculating how long the project took and it allows for documenting changes affecting project time estimations. In Figure **4-13** time alpha and its states are presented.

The *result* alpha describes result expected from the project. Since all projects are executed in order to produce a result, we generalize result from all project-driven disciplines with this alpha. Project result associated to specific disciplines—*e.g.,* the software system for software engineering—should be instantiated as sub-alphas of the result alpha. So, we allow for solving multidisciplinary gap among BOKs and standards by allowing instantiation of project management dimensions from specific project-driven disciplines. As a result, we allow

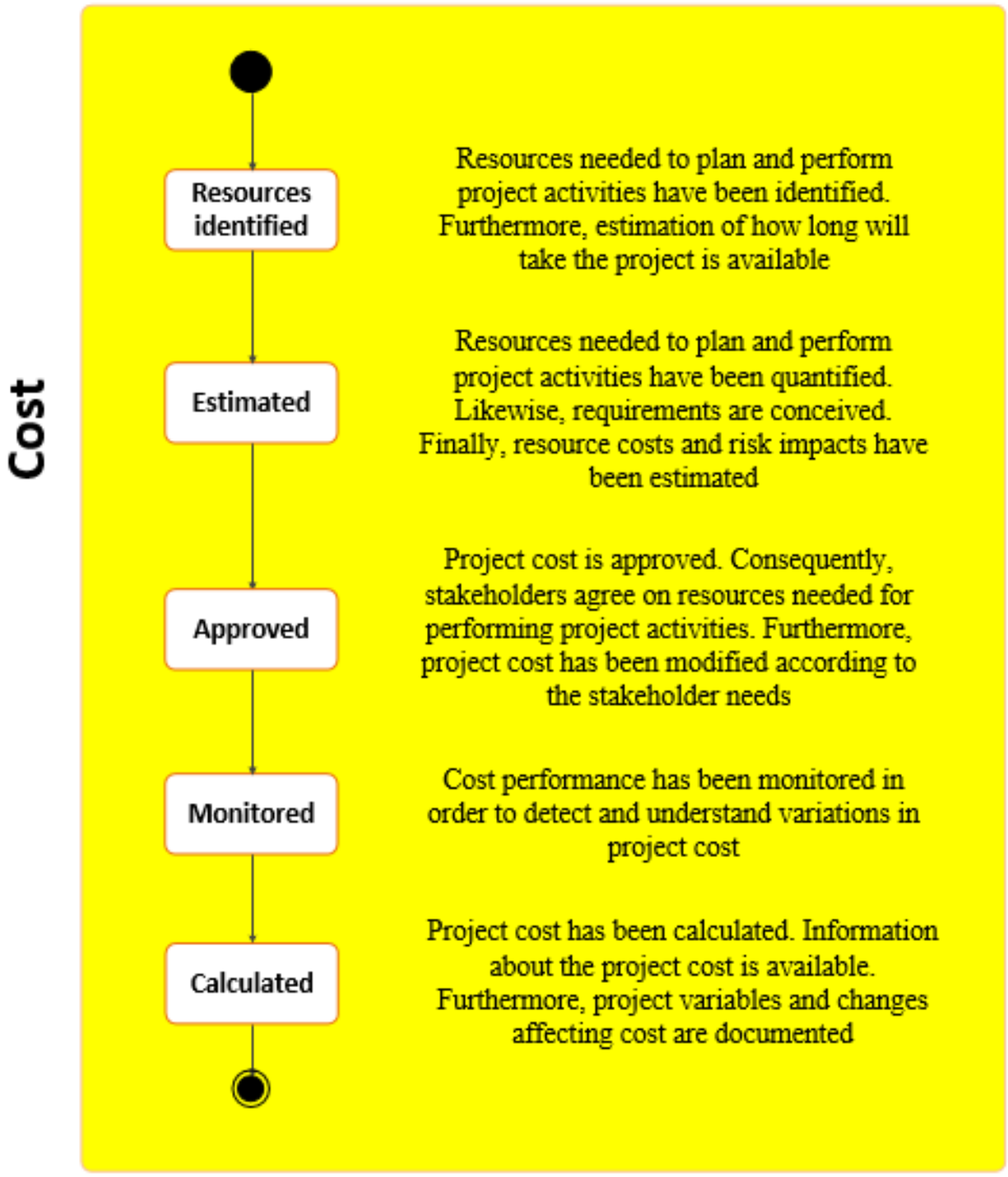

Figure 4-10: Cost alpha. The authors

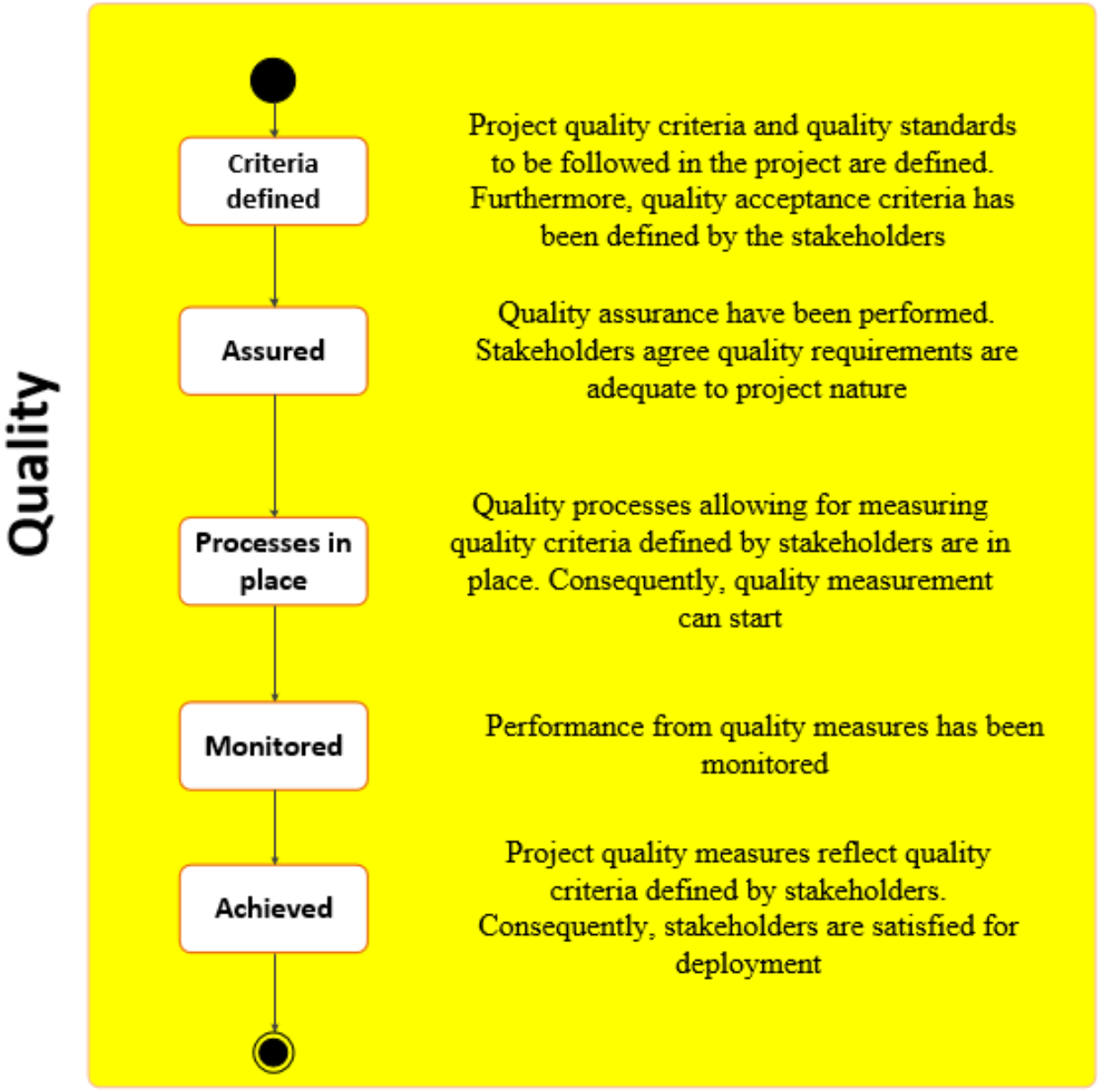

Figure 4-11: Quality alpha. The authors

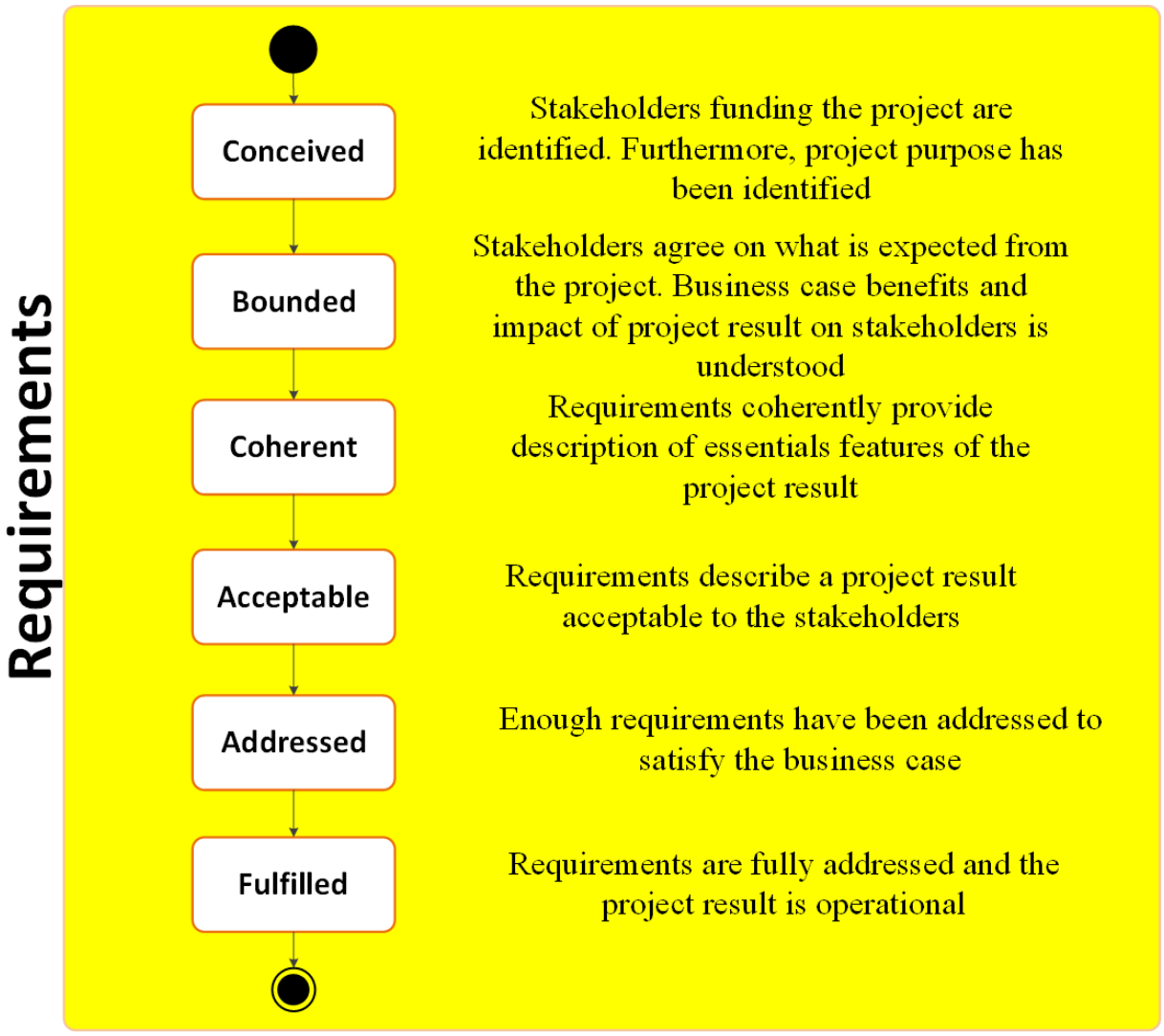

Figure 4-12: Requirements alpha. The authors

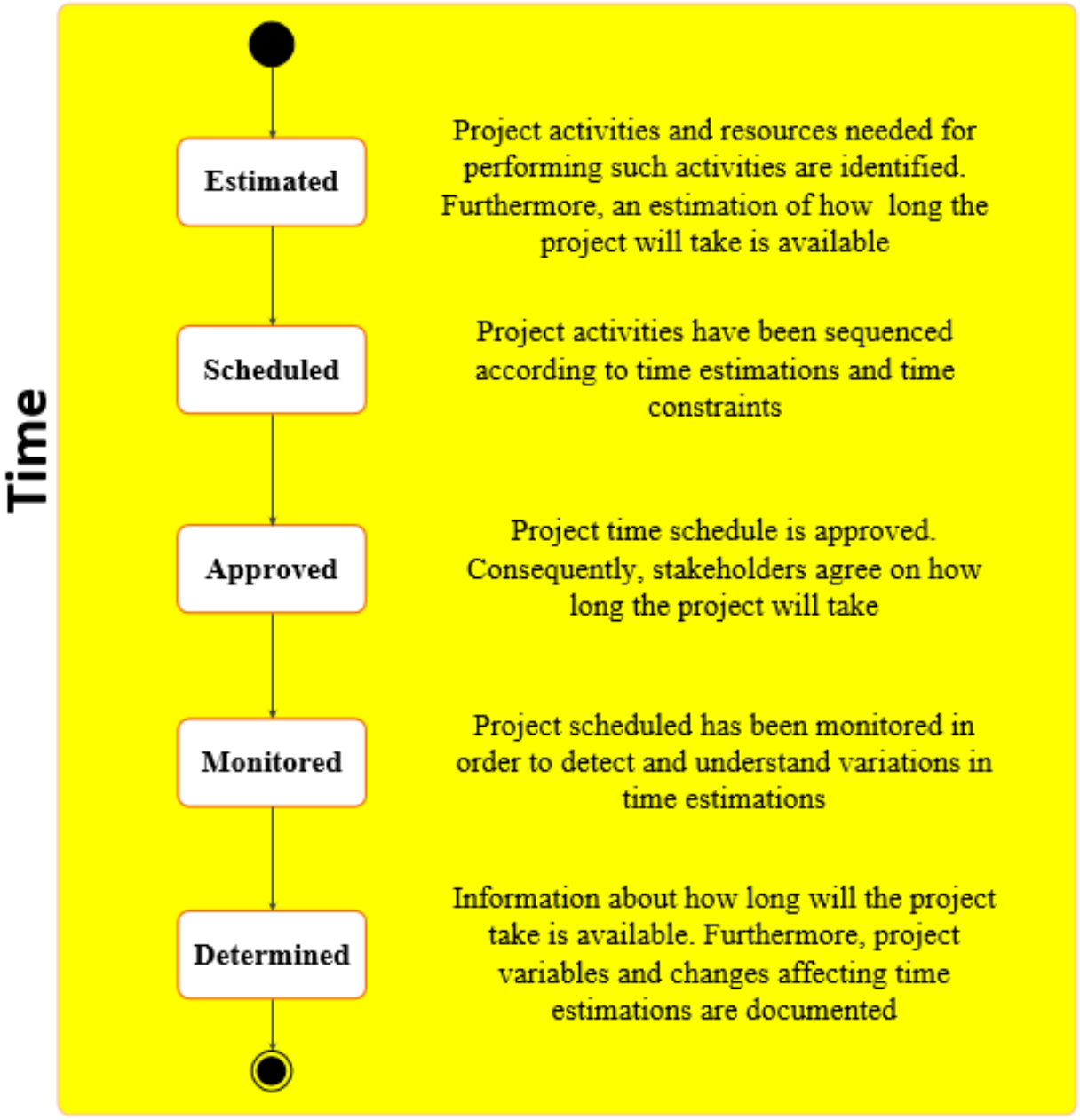

Figure 4-13: Time alpha. The authors

for covering all project management dimensions. The result alpha go through five states—*i.e.,* designed, approved, implemented, tested, and operational. Result *designed* state allows for designing project result according to stakeholder requirements, quality criteria, and project restrictions; result *approved* state allows for getting approval from stakeholders of project result design; result *implemented* state allows for implementing project result. So, the result is coherent with stakeholders requirements; result *tested* state allows for achieving quality criteria by testing the result and fixing all problems identified in tests; result *operational* state allows for making the project result operational, so it can be used by stakeholders. In Figure **4-14** result alpha and its states are presented.

The *team* alpha go through five states—*i.e.,* seeded, formed, collaborating, performing, and mission accomplished. Team *seeded* state allows for providing a mission to the team and it allows for identifying team member roles needed for executing the project; team *formed* allows for populating the team; team *collaborating* state allows for getting team members working as one unit; team *performing* state allows for getting team members working effectively and efficiently; team *mission accomplished* allows for accomplishing team mission. In Figure **4-15** team alpha and its states are presented.

The *work* alpha go through five states—*i.e.,* planned, prepared, started, under control, and closed. Work *planned* state allows for breaking down work into actionable items with clear definitions of done and it allows for scheduling work according to the project time; work *prepared* state allows for acquiring all project resources; work *started* state allows team members for accepting and progressing assigned tasks; work *under control* state allows for controlling all work; work *closed* state allows for completing project closure activities, so the work can be officially closed. In Figure **4-16** work alpha and its states are presented.

The *way of working* alpha go through five states—*i.e.,* principles established, in place, in use, working well, and lessons learned. Way-of-working *principles established* state allows for selecting practices and tools serving as a foundation to the way of working; way-of-working *in place* state allows for getting understanding from the team and stakeholders on the way the work should be progressed; way-of-working *in use* state allows team members and stakeholders for using the way of working for completing their tasks; way-of-working *working well* state allows for controlling the way of working, so the team and stakeholders are working well and accomplishing their tasks; way-of-working *lessons learned* state allows for documenting lessons learned along the project, so the way of working can be improved for future projects. In Figure **4-17** way of working alpha and its states are presented.

The *risk* alpha go through five states—*i.e.,* identified, understood, planned, under control, and addressed. Risks *identified* state allows for identifying project risks and it allows for identifying resources and work products to be used for performing risk management; risks *understood* state allows for performing qualitative and quantitative analysis to project risks, so stakeholders understand risk exposure and the likelihood of its occurrence; risks *planned* state allows for planning actions in order to reduce threats, minimizing risk occurrence likelihood, and establishing how risks should be monitored and controlled; risks *under control*

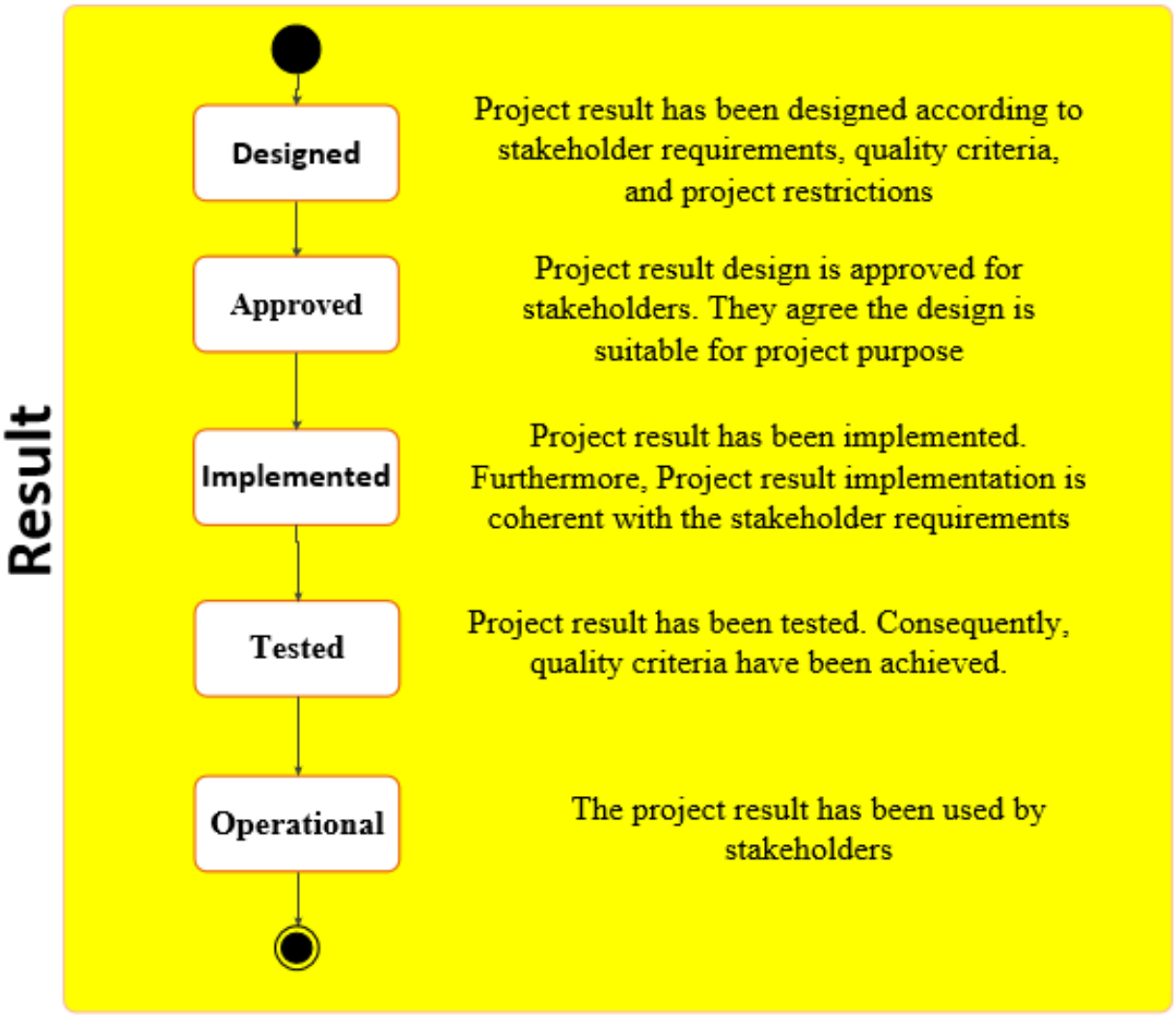

Figure 4-14: Result alpha. The authors

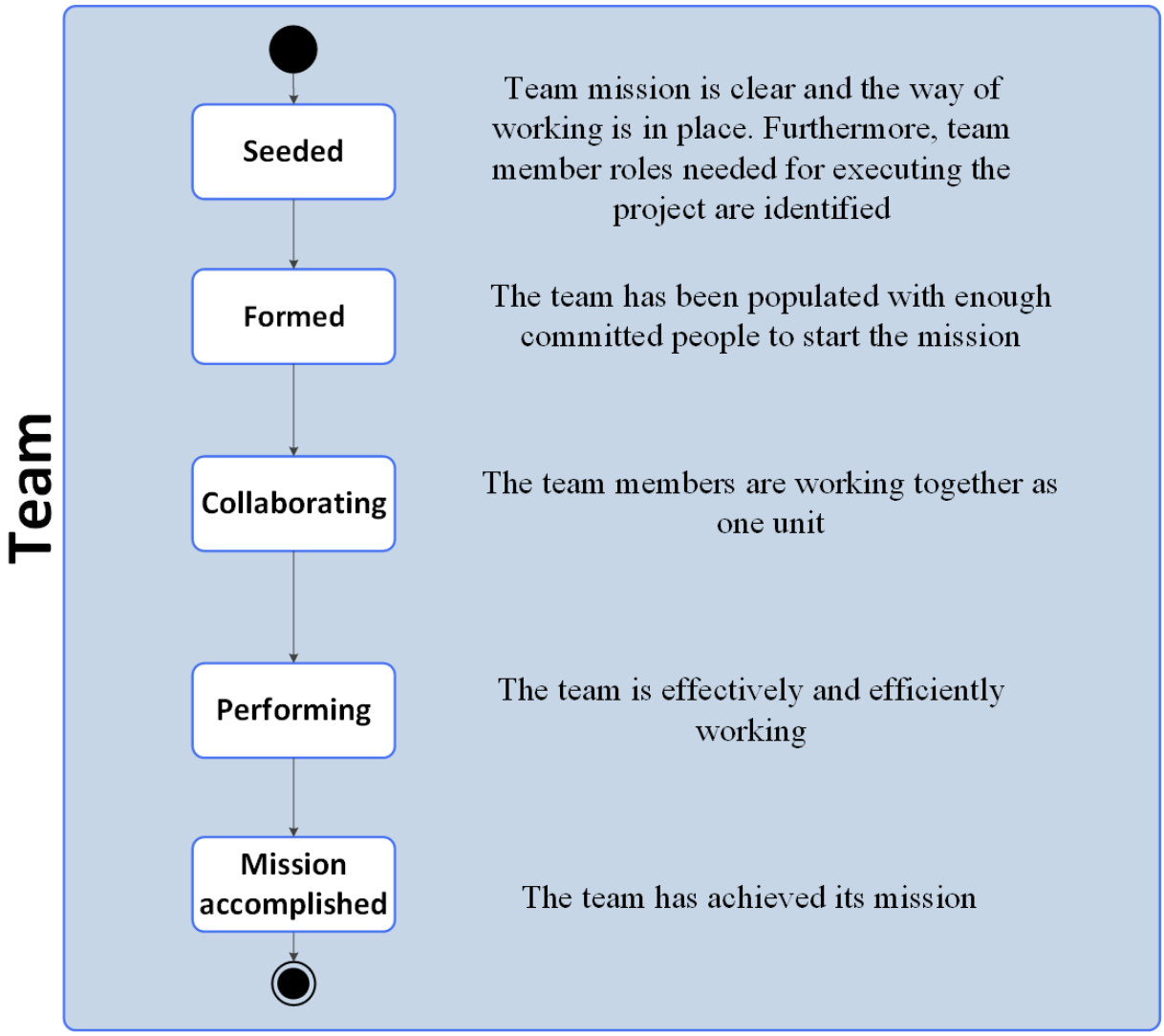

Figure 4-15: Team alpha. The authors

state allows for monitoring risks occurrence likelihood and performing preventive actions in order to avoid materialization of other risks; risks *addressed* state allows for successfully minimizing risk impact of materialized risks impacting project execution. In Figure **4-18** risk alpha and its states are presented.

4.3. Project management quintessence kernel activity spaces

In this Section we introduce a set activity spaces universal to all project-driven disciplines. We allow for covering all processes/activities project-driven disciplines involve by introducing project management activity spaces. We group such activity spaces into a categorical way by using Semat areas of concern.
We compare most representative project management BOKs and standards aiming to identify a set activity spaces universal to all project management disciplines. Consequently, we identify a set of twenty activity spaces. Such activity spaces are presented in Figure **4-19**.
Project management activity spaces help to describe activities practitioner should always perform in order to create a project result. Consequently, they are described as follows:

- *Outline the business case* activity space helps to describe activities for: starting up a project and identifying project stakeholders

- *Understand the business case* activity space helps to describe activities for: establishing the impact the project result will have on stakeholders and agreeing on mechanisms for involving stakeholders on project execution. Furthermore, it allows for appointing stakeholder representatives.

- *Ensure stakeholder satisfaction* activity space helps to describe activities for: achieving approval from stakeholders on whether is worth executing the project in spite of risks associated to its execution; updating business case according to cost, risk and benefits information resulting from project execution; putting in place mechanisms involving stakeholder representatives in project execution.

- *Use the project result* activity space helps to describe activities for: defining stakeholder quality criteria for satisfying them when deploying the project result; successfully addressing the business case; deploying project result; meeting stakeholder minimal expectations.

- *Estimate cost* activity space helps to describe activities for: identifying resources needed for planning and performing project activities; estimating cost associated to such resources and activities; getting stakeholder approval to project cost estimation.

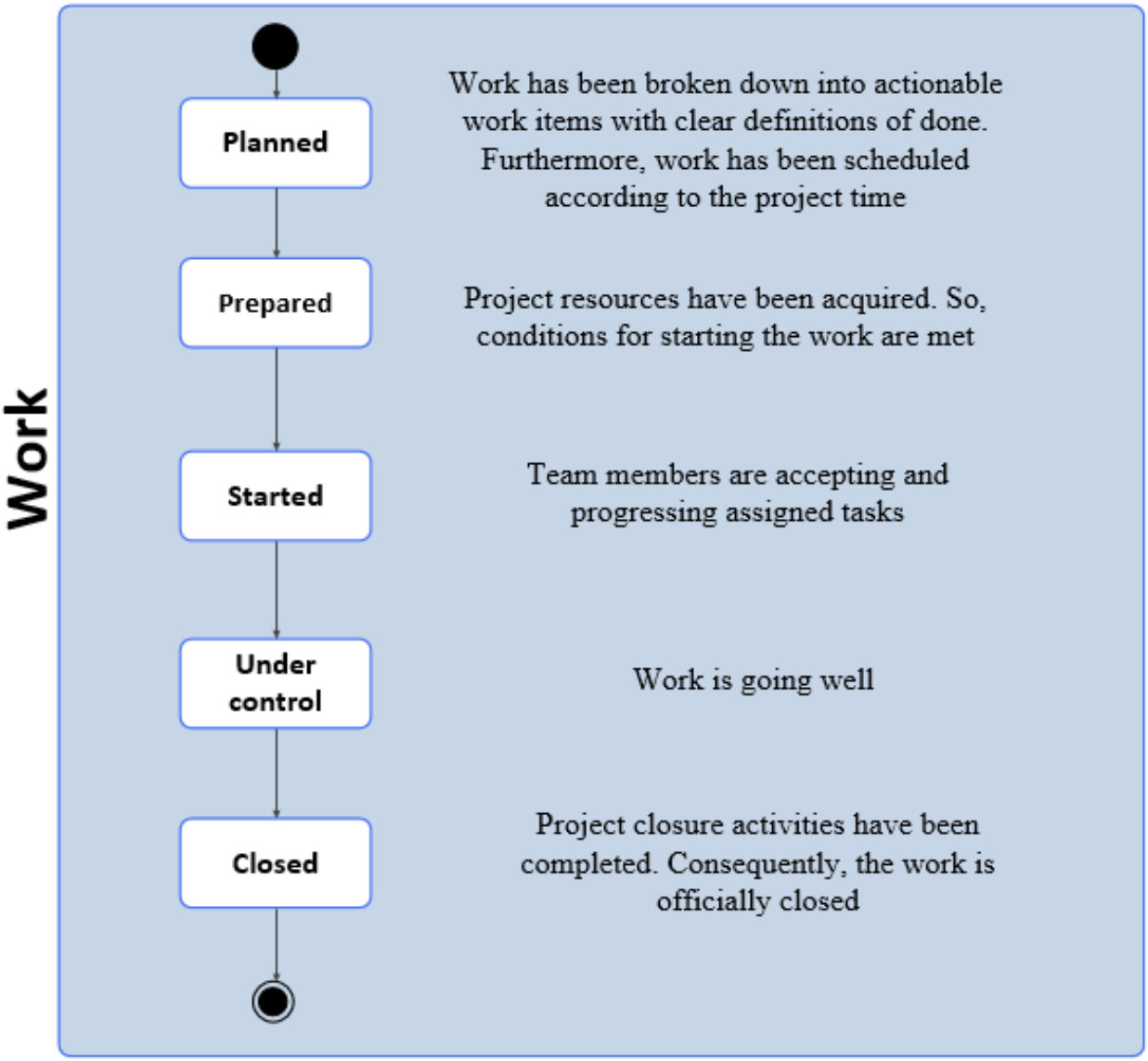

Figure 4-16: Work alpha. The authors

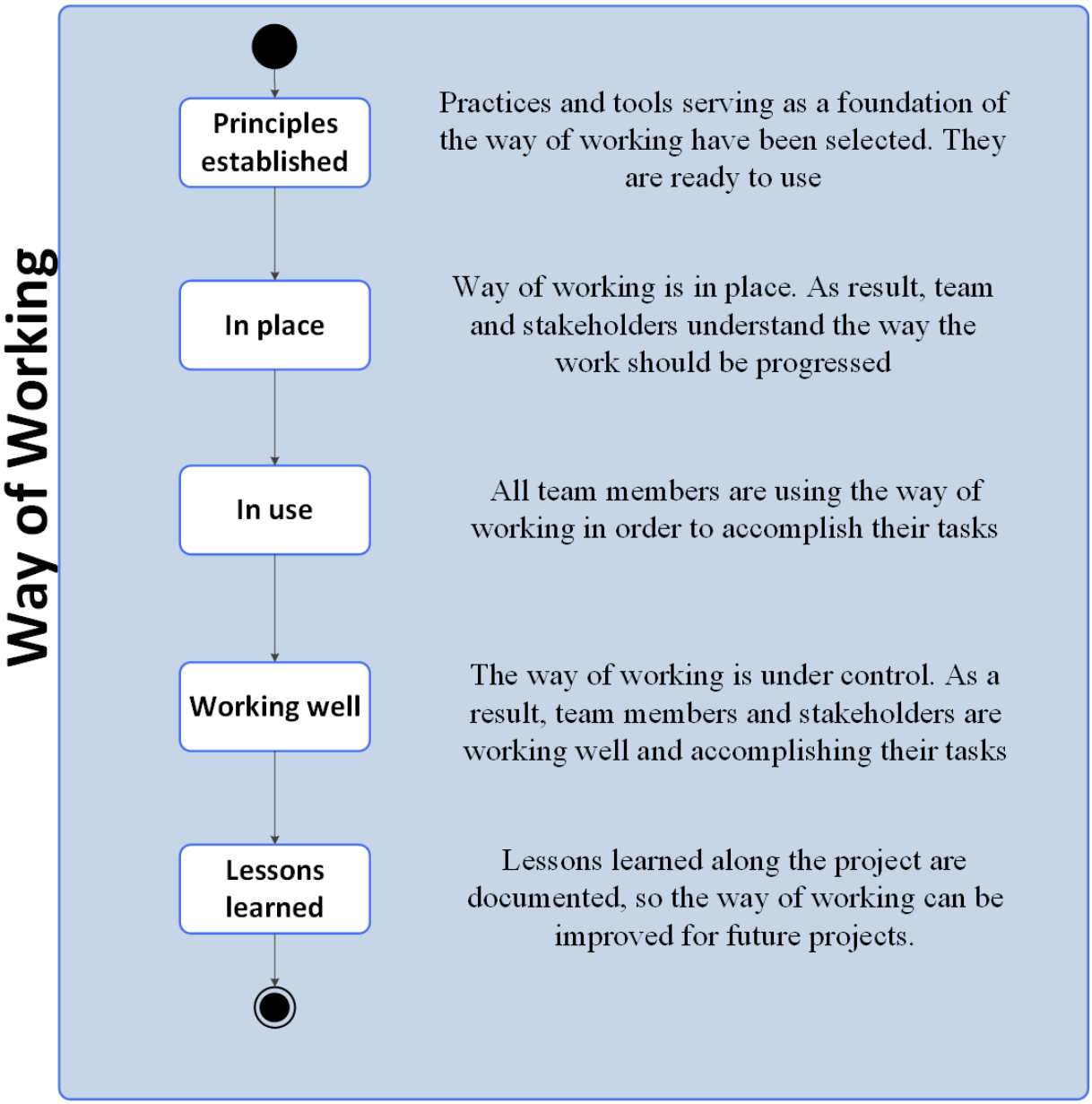

Figure 4-17: Way of working alpha. The authors

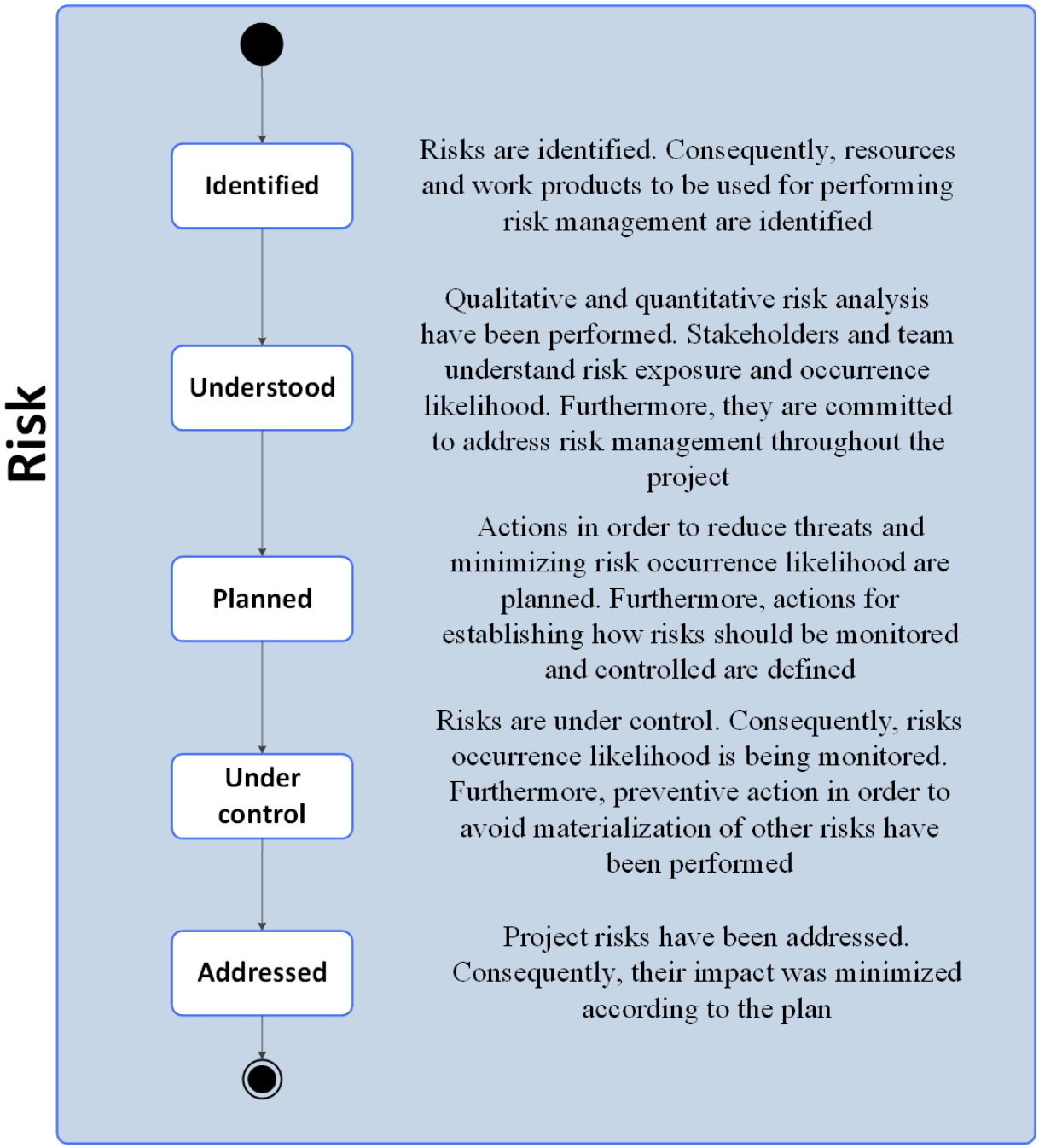

Figure 4-18: Risk alpha. The authors

- *Define quality criteria* activity space helps to describe activities for: defining quality criteria and quality standards to be followed in the project.
- *Put in place quality processes* activity space helps to describe activities for: assuring quality requirements are adequate to the project nature and putting in place quality processes for measuring quality criteria defined by stakeholders.
- *Understand the requirements* activity space helps to describe activities for: identifying stakeholders funding the project and project purpose; agreeing on what is expected from the project; coherently describing essential features expected from project result.
- *Schedule time* activity space helps to describe activities for: identifying project activities and resources; estimating how long the project will take; sequencing project activities according to time estimation and time constraints.
- *Design the project result* activity space helps to describe activities for: achieving stakeholder approval on requirements description; designing project result according to stakeholder requirements, quality criteria, and project restrictions; achieving stakeholder approval on project result design.
- *Implement the project result* activity space helps to describe activities for: implementing project result.
- *Test the project result* activity space helps to describe activities for: monitoring performance of project quality measures; fully addressing project requirements; achieving quality criteria by testing the result and fixing all problems identified in tests.
- *Deploy the project result* activity space helps to describe activities for: making the project result operational.
- *Prepare to do the work* activity space helps to describe activities for: providing a mission to the team; identifying team member roles needed for executing the project; breaking down work into actionable items with clear definition of done; selecting practices and tools serving as a foundation to the way of working; getting team and stakeholders understanding on the way the work should be progressed; identifying project risks.
- *Understand risks* activity space helps to describe activities for: qualitative and quantitative analyzing project risks, so stakeholders understand risk exposure and the likelihood of its occurrence; identifying resources and work products to be used for performing risk management; planning actions in order to reduce threats and minimizing risk occurrence likelihood; establishing how risks should be monitored and controlled.
- *Coordinate the work* activity space helps to describe activities for: accepting and progressing tasks; using the way of working to accomplish tasks.

- *Support the team* activity space helps to describe activities for: getting team members working as one unit.
- *Improve the way of working* activity space helps to describe activities for: controlling the way of working, so team members and stakeholders are working well and accomplishing their tasks; documenting lessons learned along the project, so the way of working can be improved for future projects.
- *Assess project health and progress* activity space helps to describe activities for: monitoring project cost performance and detecting variations on it resulting from the project execution; calculating project cost; monitoring project time performance and detecting variations in project time resulting from the project execution; calculating how long will the project take; getting team members working; controlling all work; monitoring risk occurrence likelihood and performing preventive actions in order to avoid materialization of other risks.
- *Close the work* activity space helps to describe activities for: accomplishing team mission; successfully minimizing risk impact of materialized risks impacting project execution; completing project closure activities.

In Figure **4-20** we establish how alpha states should progress by completing activity spaces.

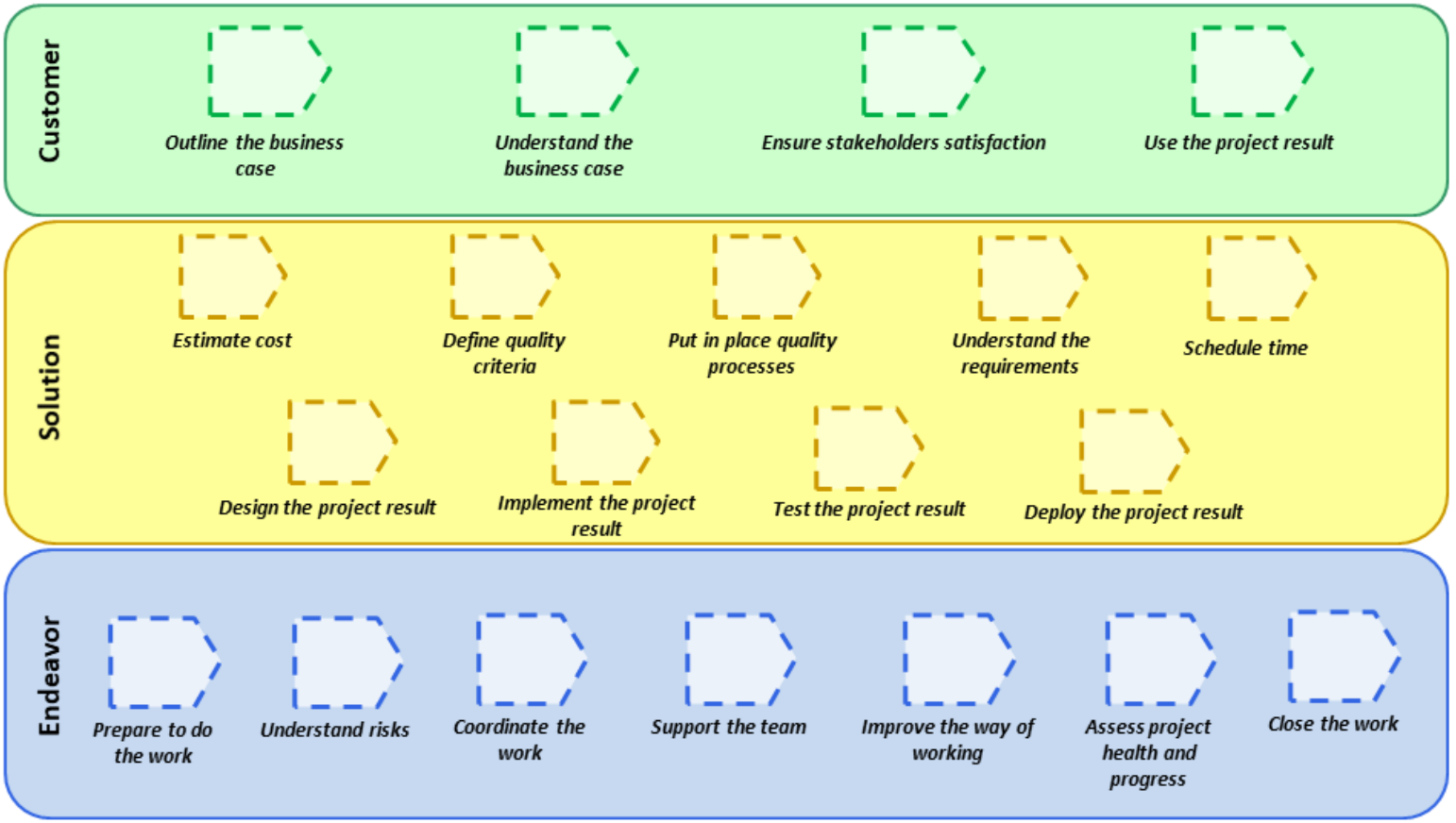

Figure 4-19: Project management quintessence kernel activity spaces. The authors

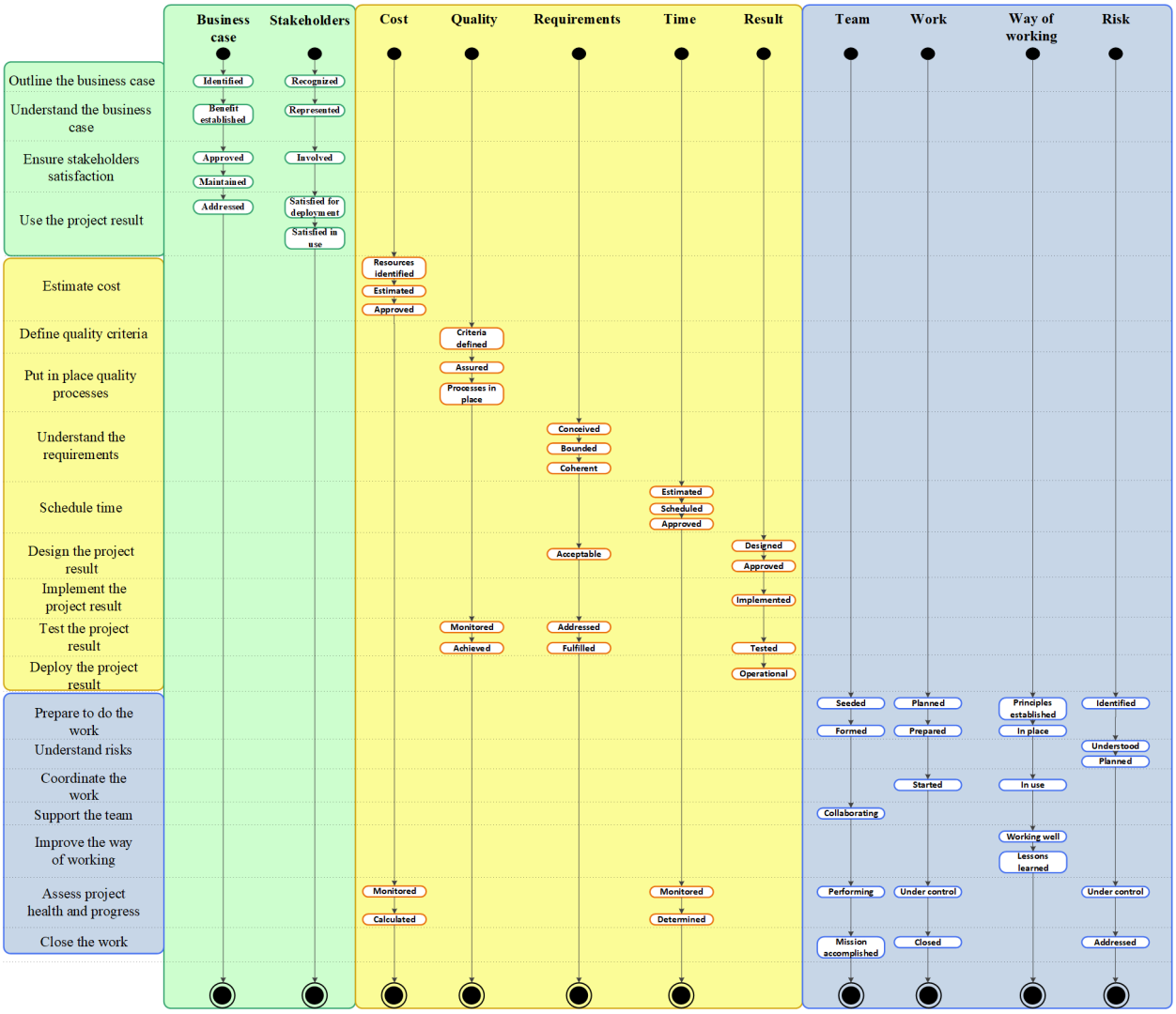

Figure 4-20: Relationship among activity spaces and alphas. The authors

5 Validation

5.1. Quintessence alphas coverage

In this Section we compare PMBOK, PRINCE2, SBOK, and Semat dimensionality-pattern instances to Quintessence alphas defined in Section 4.2. So, we demonstrate the set of alphas defined in Section 4.2 allows for covering all PMBOK, PRINCE2, SBOK, and Semat dimensionality-pattern instances. Consequently, in Tables **5-1** to **5-4** we discuss how PMBOK, PRINCE2, SBOK, and Semat dimensionality-pattern instances dimensions are covered by the set of alphas defined in Section 4.2.

Table 5-1: PMBOK dimension coverage. The authors

Project management dimension	**Business case**	**Stakeholders**	**Cost**	**Quality**	**Requirements**	**Time**	**Result**	**Team**	**Work**	**Way of working**	**Risk**
Project integration management	X	X	X	X	X	X	X	X	X	X	X
Project scope management	X				X						
Project schedule management						X					
Project cost management			X								
Project quality management				X							
Project human resource management								X			
Project communications management		X						X	X		
Project risk management											X
Project procurement management									X		
Project stakeholder management		X									

Table 5-2: PRINCE2 dimension coverage. The authors

Project management dimension	**Business case**	**Stakeholders**	**Cost**	**Quality**	**Requirements**	**Time**	**Result**	**Team**	**Work**	**Way of working**	**Risk**
Business case	X										
Organization		X						X		X	
Quality				X							
Plans									X		
Risk											X
Change	X	X	X	X	X	X	X	X	X	X	X
Progress	X										

Table 5-3: SBOK dimension coverage. The authors

Project management dimension	**Business case**	**Stakeholders**	**Cost**	**Quality**	**Requirements**	**Time**	**Result**	**Team**	**Work**	**Way of working**	**Risk**
Organization		X						X		X	
Business justification	X								X		
Quality				X							
Change					X	X					
Risk											X

Table 5-4: Semat dimension coverage. The authors

Project management dimension	Business case	Stakeholders	Cost	Quality	Requirements	Time	Result	Team	Work	Way of working	Risk
Opportunity	X										X
Stakeholders		X									
Requirements					X						
Software system							X				
Team								X			
Work									X		
Way of working										X	

5.2. Quintessence activity spaces coverage

In this Section we compare PMBOK, PRINCE2, SBOK, and Semat process-grouping-pattern instances to Quintessence activity spaces defined in Section 4.3. So, we demonstrate the set of activity spaces defined in Section 4.3 allows for covering all process-grouping pattern instances defined by most representative project management BOKs and standards. Consequently, in Figures **5-1**, **5-3**, **5-4**, **5-5**, **5-6**, and **5-7** we discuss how PMBOK, PRINCE2, SBOK, and Semat process-grouping pattern instances are covered by the set of alphas defined in Section 4.3.

5.3. Project management practice representation

In this Section three strategic planning practices are represented by using the Semat language, the *project management quintessence kernel* defined in section 4.1, and Durango *et al* [9] work. In this way, we test the way to instantiate project management dimensions from specific disciplines, so we demonstrate constructs defined in this M.Sc. Thesis allows for defining a multidisciplinary project management theory.
Sinek *et al.* [15] has codified a communication pattern—known as the golden circle—present in the way people and organizations communicate. In Figure **5-2** we present the golden circle as codified by Sinek.

Process-grouping-pattern instance	Initiating processes group	Planning process group	Executing process group	Monitoring & controlling process group	Closing process group
Outline the business case	x				
Understand the business case		x			
Ensure stakeholders satisfaction			x		
Use the project result				x	x
Estimate cost	x	x			
Define quality criteria	x	x			
Put in place quality processes		x			
Understand the requirements	x	x			
Schedule time	x	x			
Design the project result	x	x			
Implement the project result			x		
Test the project result				x	
Deploy the project result					x
Prepare to do the work	x				
Understand risks	x	x			
Coordinate the work			x		
Support the team			x	x	
Improve the way of working			x	x	
Assess project health and progress			x	x	
Close the work					x

Figure 5-1: PMBOK process-grouping-pattern instances coverage. The authors

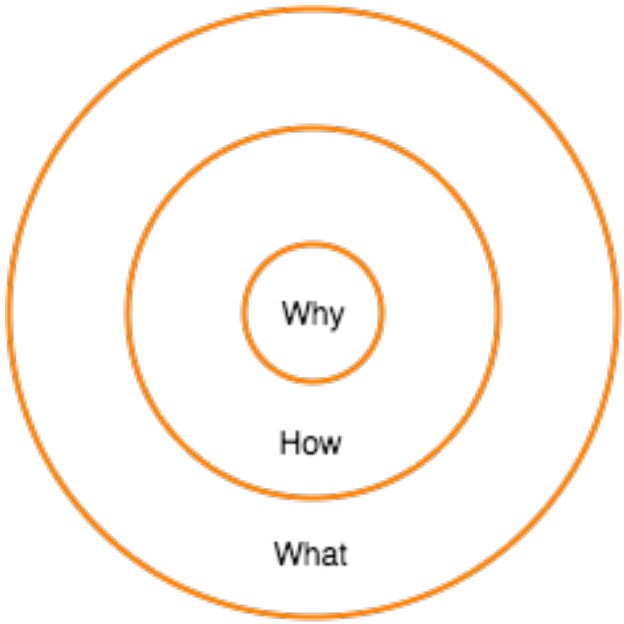

Figure 5-2: The golden circle. [15]

Process-grouping-pattern instance	Directing a project	Initiating a project	Controlling a stage	Managing product delivery	Managing stage bondary	Closing a project
Outline the business case	x				x	
Understand the business case		x				
Ensure stakeholders satisfaction		x	x		x	
Use the project result				x		x
Estimate cost	x	x				
Define quality criteria	x	x				
Put in place quality processes		x				
Understand the requirements	x	x	x		x	
Schedule time	x	x				
Design the project result	x	x	x		x	
Implement the project result		x				
Test the project result			x			
Deploy the project result				x		x
Prepare to do the work	x	x				
Understand risks	x	x				
Coordinate the work			x		x	
Support the team			x		x	
Improve the way of working			x		x	
Assess project health and progress			x			
Close the work						x

Figure 5-3: PRINCE2 process-grouping-pattern instances coverage. The authors

Process-grouping-pattern instance	Initiate	Plan and estimate	Implement	Review and retrospect	Release
Outline the business case	x				
Understand the business case	x	x			
Ensure stakeholders satisfaction				x	
Use the project result					x
Estimate cost	x	x			
Define quality criteria	x	x			
Put in place quality processes		x			
Understand the requirements	x	x			
Schedule time	x	x			
Design the project result	x	x			
Implement the project result			x		
Test the project result			x	x	
Deploy the project result					x
Prepare to do the work	x	x			
Understand risks	x	x			
Coordinate the work					
Support the team				x	
Improve the way of working				x	
Assess project health and progress				x	
Close the work					

Figure 5-4: SBOK process-grouping-pattern instances coverage. The authors

Process-grouping-pattern instance	Explore possibilities	Understand stakeholder needs	Ensure stakeholder satisfaction	Use the system
Outline the business case	x			
Understand the business case		x		
Ensure stakeholders satisfaction			x	
Use the project result				x
Estimate cost	x	x		
Define quality criteria	x	x		
Put in place quality processes				
Understand the requirements	x	x		
Schedule time	x	x		
Design the project result				
Implement the project result			x	
Test the project result			x	
Deploy the project result				
Prepare to do the work				
Understand risks	x			
Coordinate the work				
Support the team				
Improve the way of working				
Assess project health and progress				
Close the work				

Figure 5-5: Semat process-grouping-pattern instances coverage - Customer area of concern. The authors

Process-grouping-pattern instance	Understand the requirements	Shape the system	Implement the system	Test the system	Deploy the system	Operate the system
Outline the business case	x					
Understand the business case	x					
Ensure stakeholders satisfaction						
Use the project result						x
Estimate cost						
Define quality criteria	x					
Put in place quality processes						
Understand the requirements	x					
Schedule time						
Design the project result		x				
Implement the project result			x			
Test the project result				x		
Deploy the project result					x	
Prepare to do the work						
Understand risks						
Coordinate the work						
Support the team						
Improve the way of working						
Assess project health and progress						
Close the work						

Figure 5-6: Semat process-grouping-pattern instances coverage - Solution area of concern. The authors

Process-grouping-pattern instance	Understand the requirements	Shape the system	Implement the system	Test the system	Deploy the system	Operate the system
Outline the business case	x					
Understand the business case	x					
Ensure stakeholders satisfaction						
Use the project result						x
Estimate cost						
Define quality criteria	x					
Put in place quality processes						
Understand the requirements	x					
Schedule time						
Design the project result		x				
Implement the project result			x			
Test the project result				x		
Deploy the project result					x	
Prepare to do the work						
Understand risks						
Coordinate the work						
Support the team						
Improve the way of working						
Assess project health and progress						
Close the work						

Figure 5-7: Semat process-grouping-pattern instances coverage - Endeavor area of concern. The authors

The *what* level represents the things people and organizations do; the *how* level represents the differentiating factor among people and organizations; the *why* level represents people and organizations purpose, cause, or believe. Sinek [14] states most people and organizations know what they do, some of them know how they do it, but few of them know why they do it. Consequently, most people and organizations communicate from the outside in of the golden circle—*i.e.,* from the clearest level to the fuzziest level. However, he states most innovative people and organizations communicate from the inside out of circle—*e.g.,* an outside in marketing message would say *"We make great computers. They are beautifully designed, simple to use, and user-friendly. Buy one."* while an inside out marketing message would say *"We believe in challenging the status quo. We believe in thinking differently. Consequently, the way we challenge the status quo is by making our products beautifully designed, simple to use and user-friendly. And we happen to make great computers"* [15].

Sinek [15] claims people and organizations which communicate from the inside out inspire other people to take action, so by applying such a pattern to project strategic planning it is possible to inspire people to work in pursue of a cause or believe. As a result, an environment allowing people for innovating is created. Consequently, Sinek *et al.* [15] have define a method known as *find your why.*

We identify practices codified by Sinek *et al.* [16] and we represent them by using the Semat language and the quintessence kernel defined in Section 4.1. To this end, we instantiate one sub-alpha and three sub-activity spaces. *Find your way* practices are represented in Figures **5-8** to **5-12**.

Why-discovery process takes place in a session where team members gather for finding an organization or project why. No matter the way the session is handled, it is possible to identify three things team members always perform—*i.e.,* run the why-discovery process,

draft a why statement, and agree upon the why statement. Furthermore, we can identify a dimension team members always care about—*i.e.,*the why. Consequently, we represent such things as three activity spaces and one alpha.

Storytelling-based context setting practice is focused on setting the session context. To this end, a senior leader explains the session purpose; then the facilitator should tell a story where the golden circle application is clear, invite people to answer the context prompt—*i.e., ïf you think back to the time when you join the organization, what inspired you most? what inspire you to keep coming back?"*—, so interaction among the group is generated. Such activity helps the group to prepare for what will follow, explain the golden circle foundations, and explain session remainder [15].

Flip-board-based why discovery practice is focused on discovering the why by generating a set of interactions among team members by using a flip board. To this end, the session group is divided into three teams. Then, team members gather and share stories, themes, and impacts they have identified by following the three conversation phase. The first conversation is based on telling specific stories when each one of team members has felt most proud to work for the organization. Then, such stories are written on a flip board and shared with the whole group in order to identify most relevant stories. The second conversation is based on identifying team members contribution on each of the stories. To this end, team members write on a flip board themes—verbs or actions phrases—identified as contributions. Then, such themes are gather along the group and shared in order to identify most relevant themes. The third conversation is based on identifying impacts on people caused by contributions made by team members on second conversation. Then, such impacts are written on a flip board and shared with the whole group. Furthermore, such impacts should be summarized by the facilitator, so every impact is related to a story.

Flip-board-based why drafting practice is focused on drafting the why statement by summarizing stories, themes, and impacts identified earlier. Such a why statement should follow a well-established structure. To this end, facilitator explains how to write a why statement. Next, each team writes a why statement in order to present it to the whole group. Finally, the whole group agree on a why statement by discussing possible candidates.

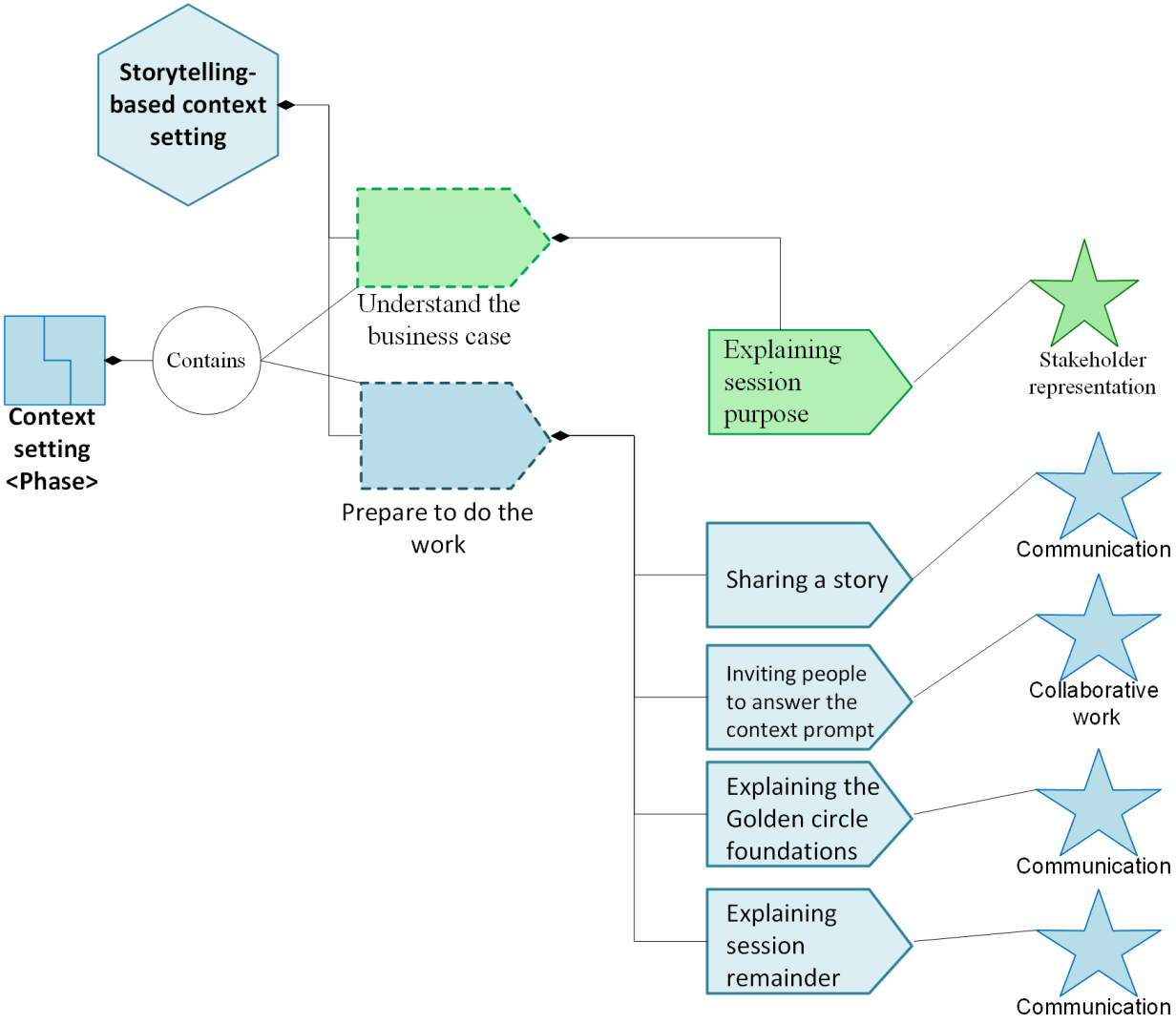

Figure 5-8: Storytelling-based context setting (1). The authors based on [16]

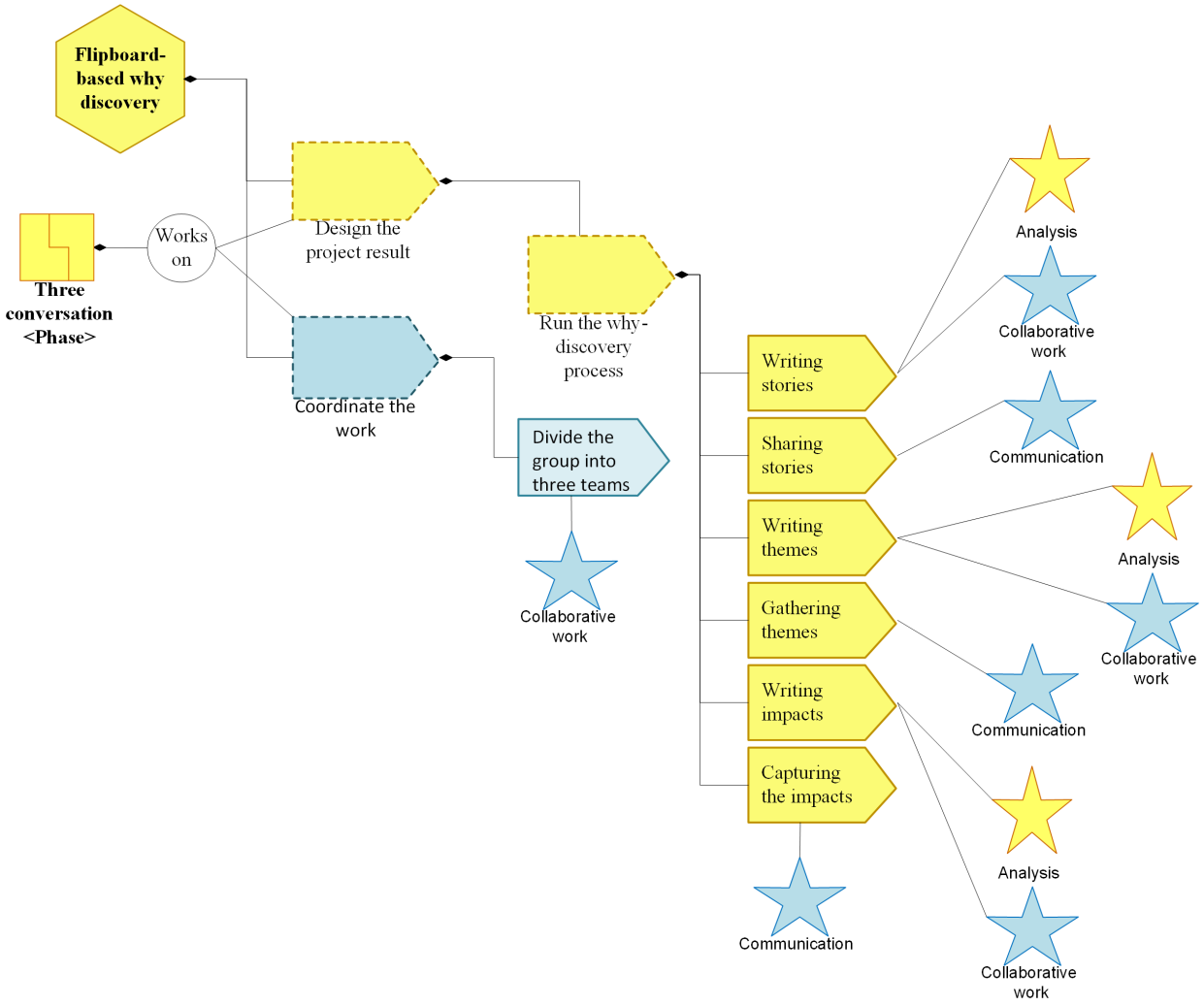

Figure 5-9: Flip-board-based why discovery (1). The authors based on [16]

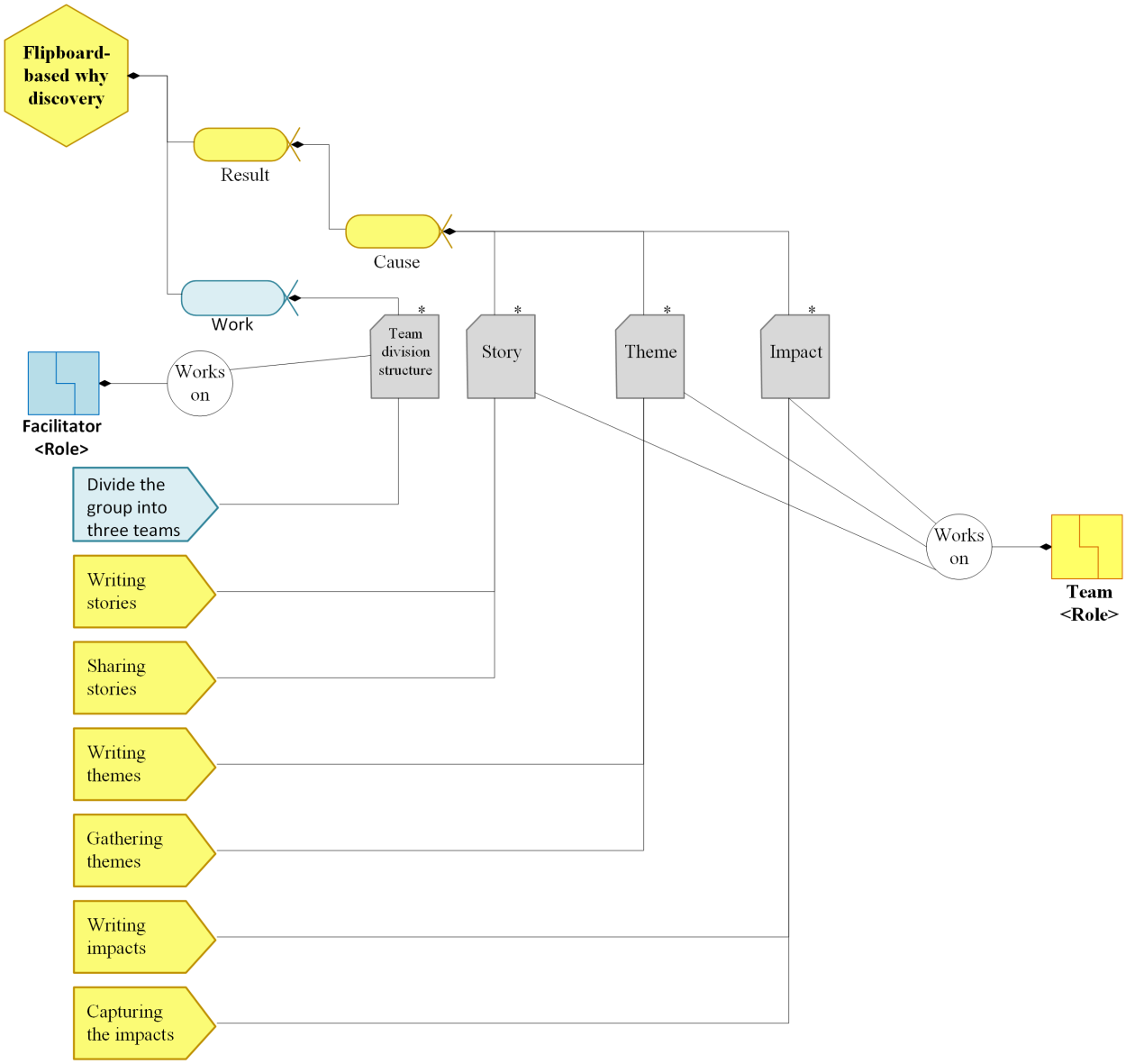

Figure 5-10: Flip-board-based why discovery (2). The authors based on [16]

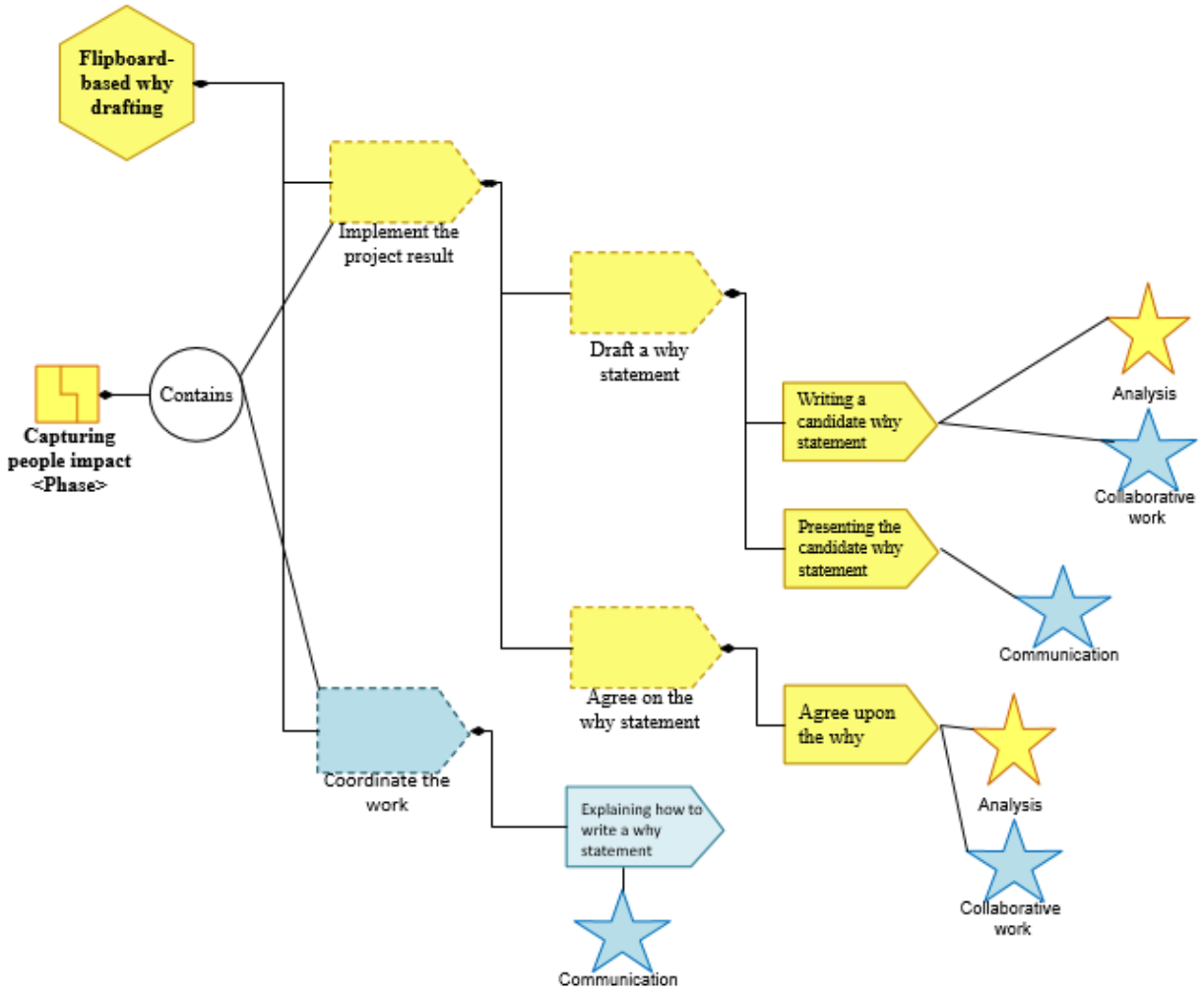

Figure 5-11: Flip-board-based why drafting (1). The authors based on [16]

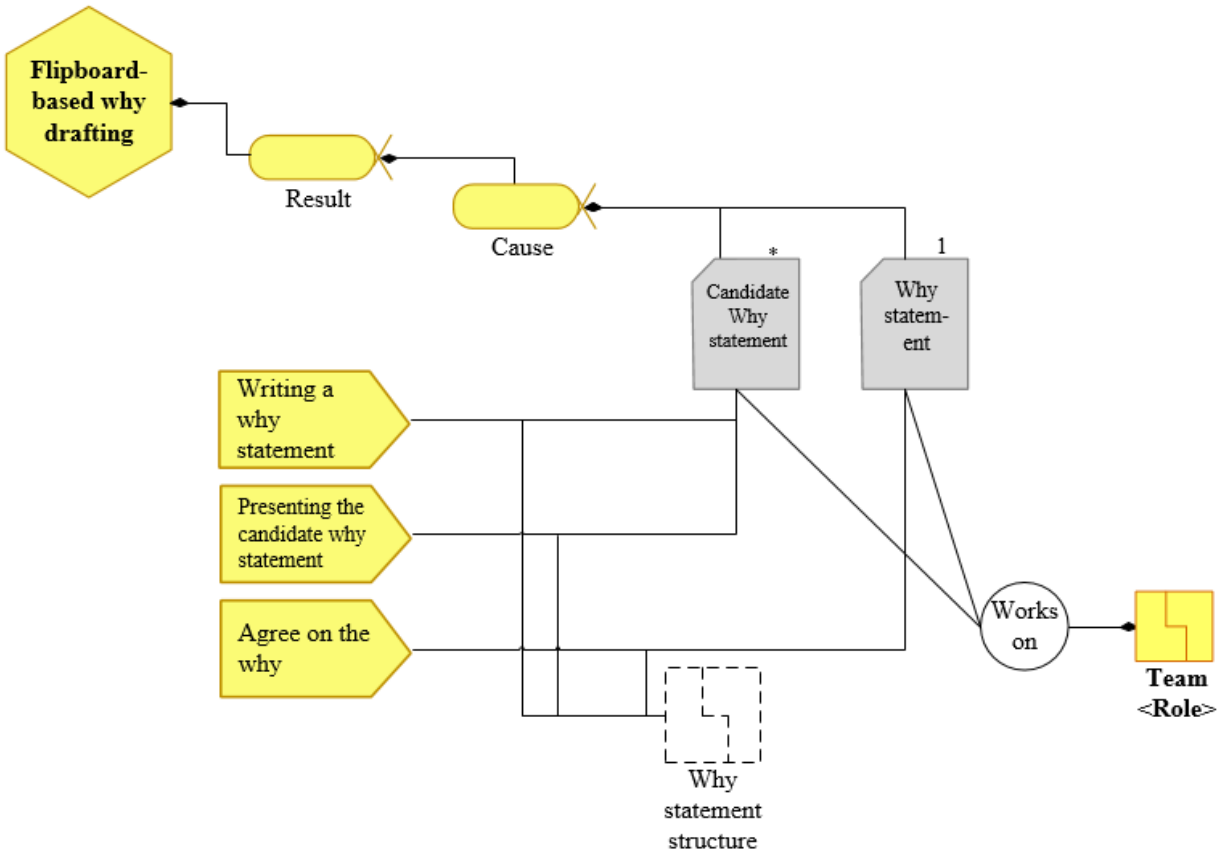

Figure 5-12: Flip-board-based why drafting (2). The authors based on [16]

6 Conclusions and future work

6.1. Conclusions

In this M.Sc. thesis we identified three codifying patterns by representing PMBOK, PRINCE2, SBOK, and Semat structures. To this end we used pre-conceptual schemas. Furthermore, we solved discipline-dependent vision introduced by such patterns by defining the sub-element pattern. As a result, we codified a kernel for a multidisciplinary project management theory and we named it the *project management quintessence kernel*. Such a kernel comprises alphas, activity spaces, and competencies. We defined a set of alphas and activity spaces by comparing PMBOK, PRINCE2, SBOK, and Semat. Competency definition is out of the scope of this M.Sc. Thesis, so we adopt Semat Essence kernel competencies and competencies proposed by Durango *et al* [9].
Furthermore, we compared PMBOK, PRINCE2, BOK, and Semat dimensionality-pattern instances to Quintessence alphas, and PMBOK, PRINCE2, BOK, and Semat process-grouping-pattern instances to Quintessence activity spaces, so we demonstrate the set of alphas and activity spaces defined in this M.Sc. Thesis allows for covering all project-driven disciplines. Finally, we represented three strategic planning practices by using the Semat language, the *project management quintessence kernel*, and Durango *et al* [9] work.

6.2. Future work

As future work, we propose the following lines of research:

- Instantiating the Quintessence kernel in specific project-driven disciplines.
- Complementing Semat Essence kernel by using the Quintessence kernel—*i.e.,* adding missing alphas and activity spaces.
- Studying relationship among the alphas time, cost, scope, and quality, since they appear to be universal alphas to all project management dimensions—*i.e.,* every alpha can be measured in terms of time, cost, and scope alphas.

Furthermore, we consider this M.Sc. Thesis is aligned with Callaos [17] work on meta-engineering. Such work is based on identifying *what is common to different kinds of engineering activities*. Consequently, we consider is worth exploring his work as a foundation for a multidisciplinary project management theory.

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