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RETHINKING THE ROLE OF CLASSIFICATION IN PROJECT MANAGEMENT RESEARCH

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RETHINKING THE ROLE OF CLASSIFICATION IN PROJECT MANAGEMENT RESEARCH

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DEDICATION

To my lovely Mona

To Yosef, Farzaneh and Baba Jamal

And to
All those who work toward advancement of Science and Reason

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RÉSUMÉ

La vision universelle du projet, longtemps entretenue dans les cadres normatifs, cède peu à peu la place à une approche différenciée, où la notion de classification devient prépondérante. Toutefois, il semble bien que la communauté scientifique tarde à s'y intéresser; ce thème reste largement sous-étudié dans la littérature contemporaine dédiée à la gestion de projet. Il s'en suit une certaine confusion sémantique au sein de la communauté, touchant à la fois les postures philosophiques, mais aussi la terminologie et les processus qui y sont reliés.

Cette thèse vise à établir la classification des projets comme sujet de recherche spécifique. À cette fin, et sur la base des contributions issues de plusieurs domaines scientifiques, ce projet doctoral propose une réflexion sur le processus de classification selon une perspective cognitiviste.

Le premier article de cette thèse porte sur les différents processus cognitifs pouvant être sollicités par des acteurs organisationnels lors de la construction de systèmes de classification de projets. Le second article poursuit l'analyse en examinant empiriquement la compréhension que détiennent différents groupes vis-à-vis certaines catégories de projet. Ensemble, ces deux premiers articles ouvrent donc la "boîte noire" du processus cognitif de classification, et offrent une analyse sur la façon dont les classifications de projet sont établies par les chercheurs et les praticiens. Ce faisant, elles permettent de réduire la confusion et les multiples interprétations relatives aux catégories de projet, et qui ont longtemps constitué des freins à l'utilisation efficace de systèmes de classification, tant en recherche qu'en pratique. Dans le troisième article, la distinction entre les notions de classification et de typologie est analysée. On y soutient que la classification devrait constituer une condition préalable pour définir des types de projet et pour établir des théories "de portée intermédiaire (*middle-range)";* on y défend également l'idée qu'une typologie de projet bien développée peut elle-même être considérée comme une théorie.

En plus de proposer des retombées pratiques et concrètes pour les milieux de pratique, l'ensemble des articles de cette thèse permettent de jeter les bases d'un programme de recherche au sein de la communauté scientifique; ils contribuent également aux efforts actuels visant à consolider les bases théoriques de la gestion de projet.

Mots clés: Classification du projet, catégorisation du projet, typologie des projets, taxonomie des projets, réussite du projet, théorie de portée intermédiaire, théorie de la gestion de projet

ABSTRACT

Moving away from a universal view of projects, classification of projects has been recognized as an essential requirement for any investigation of project management. Yet classification as an independent topic of research has been understudied and undervalued in the project management literature. This issue has resulted in the development of semantic confusion among the project management researchers, with regard to philosophical stands, terminology, processes and implications of project classification.

By rethinking the role of classification in a project management context, this dissertation aims to address this issue and establish project classification as an independent research topic. To that end and to keep up with recent advancements in classification research in other fields, this dissertation focuses more on evaluating the process of classification from a cognitive perspective.

Accordingly, in the first article, different cognitive processes that individuals might apply to construct their project classification schemes are discussed. Delving further, the second article empirically examines the shared understanding of different groups vis-à-vis project categories. By opening the black box of the cognitive process of classification, the first two articles shed light on how and why different researchers or practitioners developed their project classification schemes. Thus, they reduce the ambiguities, inconsistencies and multiple interpretations of project categories, which have been identified as a main obstacle to the effective use of project classification systems in both research and practice. In the third article, the distinction between the definitions and implications of classification and typology is discussed. In particular, it is argued that classification should be a prerequisite to delimit project types and build up middle-range theories and that a well-developed project typology itself can be regarded as a theory.

The collection of articles in this dissertation not only has important practical implications but, by laying the groundwork for establishing project classification as a research topic, fosters the theory development in the project management field.

Keywords: Project classification, project categorization, project typology, project taxonomy, project success, middle-range theory, project management theory

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LIST OF SYMBOLS AND ABBREVIATIONS

ANOVA	Analysis of Variance
CFA	Confirmatory Factor Analyses
CFI	Comparative Fit Index
DEA	Data Envelopment Analysis
PMO	Project Management Office
PPM	Project Portfolio Management
RMSEA	Root Mean Square Error of Approximation
SAPPHO	Scientific Activity Predictor from Patterns with Heuristic Origins
SSE	Sum of Squared Errors
TLI	Tucker-Lewis Index

CHAPTER 1 INTRODUCTION

From the time of ancient Greek philosophers such as Plato and Aristotle to modern advances in different scientific fields such as natural science and biology, physics, chemistry and social science, "classification" has always been an important topic of debate and an inevitable part of reasoning, advanced conceptualization and data analysis in any scientific investigation.

Project management is another field in which classification plays a crucial role, both in its theoretical conceptualization and in practice. After the universal approach toward projects was called into question (Cicmil & Hodgson, 2006; Shenhar & Dvir, 1996), many studies called for a more diverse theoretical picture of projects (Engwall, 2003). In particular, many researchers highlighted the need to develop a variety of middle-range theories (Packendorff, 1995), whose scope is limited to particular project types.

For that purpose, use of appropriate project classification schemes to delimit project types is highly suitable, indeed necessary. Moreover, having a clear project classification scheme in place and being explicit about the category of projects about which one is developing a theory will help other researchers to compare and unite isolated theories. As a result, more unified theories can be developed, which in turn will help the current state of theorizing in the project management field to flourish (Söderlund, 2011b).

In addition to its theoretical implications, the use of an appropriate project classification scheme is inherently part of the organizational practices involved in a variety of situations such as the adoption of management approaches, selection of project managers and project team members, and preparation of a project's organization (Crawford, Hobbs, & Turner, 2005). Moreover, proper project classification has also been linked to project success (Belassi & Tukel, 1996; Dietrich & Lehtonen, 2005; Evaristo & van Fenema, 1999; Shenhar, 1998; Shenhar & Dvir, 1996). Organizations that deal with a multitude of single projects or groups of projects need to develop a project classification scheme as an essential part of their project portfolio management practices.

Despite the great importance of "classification" in project management research and practice, there are very few systematic studies in the relevant literature dedicated to classification as an independent research topic. In fact, the main spark of this research endeavor was generated during

thinking sessions, in the early days of my PhD studies, when I was reflecting about a particular requirement in applying an efficiency measurement model (called Data Envelopment Analysis – DEA) to the project management context. The requirement was the "homogeneity" of entities that are entered into that mathematical model. Thinking about the concept of homogeneous categories immediately generated questions about definitions of homogeneity, which in turn made me consider the more fundamental issue of categorization and delimiting homogeneous projects. However, a review of the project management literature showed that project classification, like homogeneity as a concept, had never been explicitly defined and addressed. And, although the topic of classification has been extensively dealt with in other fields, it still remains undervalued and understudied in the project management literature.

As a result of noticing the lack of attention to such an important issue, the main topic of my doctoral project became project classification. This research endeavor resulted in the three main articles in this dissertation. Interestingly enough, the article about the application of the efficiency measurement method mentioned above in the project management context, which gave rise to this dissertation, was developed as a side project and published separately.

At start of this research, because there were very few resources dedicated to project classification, I took an interdisciplinary approach and looked into other fields such as biology, library and information systems science, and organization and management studies because of their long history of research on classification. At that time, my expectation was to find a guideline or classification principles that could be used as blueprint in project management context.

However, in my review of the history and prominent publications on "classification" in each field, it became clear that every field with a history of using some sort of classification incorporated different definitions, processes and philosophical assumptions with regard to the topic (Hjørland, 2017). I found it extremely hard, if not impossible, to find a single guideline on how a classification scheme should be developed. Even in the sciences, there are different perspectives and contradictory views usually exist about the value of any particular classification scheme.

At that point, I took a higher-level look at classification topic and reviewed the philosophical stands to classification as a phenomenon. I found that, historically, some classification schemes were taken for granted and categories were regarded as kinds of objective characteristics of each entity.

However, with recent advancements in cognitive psychology, categories as a phenomenon are regarded as cognitive artifacts that are highly influenced by the social environment, research context and individuals' theoretical views and judgment. This recent ontological shift toward subjectivism vis-à-vis classification helps one better understand the reasons for the existence of such diverse classification schemes in every field.

In continuing this research, I noticed that these advances in cognitive psychology had led many scientists to assess the importance of cognitive frameworks and the cognitive process of classification in their specific fields. For example, in strategic management, researchers have started examining participants' perspectives in shaping markets or making "strategic groups" of organizations.

However, a review of project management shows that most project classification schemes have been taken for granted and there is no explicit explanation of why and how they were developed. As a result, the focus of this dissertation is on discussing and evaluating the process of project classification from the cognitive perspective. Meanwhile, different philosophical stands, terminologies, and theoretical and practical implications of project classification are also discussed.

The results of this research is expected to reveal the reasons underlying the confusion and multiple interpretation of categories in project management practice. These insights are expected to help project management researchers and professionals use project classification systems more efficiently in their work. In particular, by pointing out the issues related to the implications of creating explicit project classification schemes, this dissertation advocates for project management researchers to start working on middle-range theories in a more structured way. Consequently, if researchers are explicit about project types, isolated theories in project management can be compared and linked together, which in turn will help improve the current state of theory development in the field. As a result, project management should be acknowledged as a more theoretically robust research area within the larger community of organizational and management science.

The structure of this dissertation is in a three-article format. Before introducing the three articles that constitute the core message of this dissertation, a literature review chapter presents the background. In the first part, the classic and modern philosophical stands with regard to

classification are reviewed. The second part of the literature review is dedicated to a review of different definitions related to classification in order to get a sense of the complexity that this research topic entails. Following on these definitions, the third part of the literature review examines the three main *classification processes* (theoretical, empirical and cognitive) that an individual might apply in constructing a classification scheme.

The next three chapters comprise the main articles making up this dissertation. Throughout these articles, we advocate for rethinking *the role of project classification in project management research* by pointing to the implications that research on project classification will have for project management research and practice. In the first two articles, project classification is evaluated from cognitive perspective, both theoretically and empirically. The third article takes a higher-level approach and discusses the essential impact of more research into classification (and typology) on the theoretical development of project management. Practical and research implications are extensively discussed in each article.

In the discussion chapter, a general overview of project classification as an independent research topic is portrayed. Moreover, the contribution of each article to the major areas of classification research is highlighted. This chapter also mentions the limitations of this research and makes some suggestions for future research on the topic. This discussion is followed by the conclusion, which summarizes the main takeaways from the articles in this dissertation.

CHAPTER 2 LITERATURE REVIEW

The purpose of this chapter is to review different philosophical stands, terminologies and classification processes. It highlights some of the most prominent authors in the fields in which classification has been studied as an independent topic. This literature review provides an overview of classification research and will help us identify the major areas that have already been addressed by project management and the research gap that still remains to be addressed.

2.1 Philosophical views

The discussion about philosophical stands with regard to the phenomenon under study is a critical step in embarking on any research endeavor. Thus, this section reviews classical and modern philosophical stands with regards to classification.

2.1.1 Classical view

"Classification" has always been an interesting subject for deep thinking and debate among philosophers and scholars. The teachings of Plato were the basis for what is called the *classical view* or *realism* with regard to classification (Smart, 1963). "Carving nature at its joints*"* is Plato's famous metaphor for the existence of a "correct" arrangement of entities into categories (Plato, c.370 BC). In this classical view, all entities have a real feature (or real essence) that naturally distinguishes one from another. Therefore, classification criteria are naturally deduced from the "essence" of entities.

Accordingly, by grouping entities based on those fundamental essences, we are simply discovering the correct classification of entities. For example, by differentiating between "cats" and "birds," we are "carving nature at its joints," meaning that we are uncovering a real distinction that already exists in nature (Campbell, O'Rourke, & Slater, 2011).

This classical view of classification also refers back to Aristotle, who argued that membership of a category is determined by *necessary* and *sufficient* criteria (Apostle, 1980). In Aristotelian logic, to be a member of a category, an entity should have all the necessary features. If an entity also has all the sufficient features, it will be included in a category. Accordingly, each category has a precise definition, and comparison of a new entity against that definition will determine its category

membership. Because of the important role of objects' features in defining how classification should work, this classical view has also been called the *feature theory of classification* (Frické, 2016; Moss, 1964; Parry & Hacker, 1991).

Following the same logic, Carl Linnaeus in the 18th century came up with the term *natural classification,* arguing that all natural phenomena have a fundamental essence by which they can be named and subsequently grouped (Blau & Scott, 1962; Parsons, 1956; Perrow, 1967). This view of classification is similar to what is called *rationalism,* which suggests that entities are constructed "logically" from a fundamental set of categories (Hjørland, 2011), or *essentialism,* which argues that categories appear naturally as a result of the fundamental similarity of species (Mayr, 1969), or *monothetic classification,* which argues for existence of a univocal classification scheme (Beckner, 1959; Rijsbergen, 1979).

Epistemologically, regardless of what it may be called, the classical views of classification contend that the ultimate order of the world is accessible to us and human cognition has the means to grasp that reality as it "actually" is (Hjørland, 2017). Ontologically speaking, the classical view adheres to the *objectivist perspective* by viewing the existence of categories as independent of the observer's perception.

In summary, the main arguments of classical philosophy regarding classification can be summarized in these two points:

(1) There is a single set of categories for each phenomenon that exists independently of social actors;

(2) This correct/natural classification is based on a set of essential properties.

2.1.2 Modern stand

The classical view of classification has long been part of the background assumptions of a wide range of sciences, including biological systematics, geology, and physics. This view of classification was taken for granted for centuries, and it was only in the middle of the 20th century that some scholars started to examine its assumptions empirically (Lakoff, 1987).

As argued above, Aristotelian logic suggests that category members have at least one common shared feature. Yet in the 1950s, by introducing the concept of "family resemblance," Wittgenstein

(1953) claimed that a category can be constructed in a way that some of its members may be alike in one dimension while other members may be alike in another dimension. For example, he claims that no feature can be found in the category of "games" that is shared by all kinds of games.

This alteration of the long-held classical view of classification launched a series of experiments in cognitive psychology. The pioneering work of experimental psychologist Eleanor Rosch (1978) demonstrated that categories in humans' minds are shaped by their overall similarity to a "prototype," instead of being defined by necessary or sufficient criteria. This groundbreaking work revealed that, contrary to the classical view that all members of a category are regarded as equal, humans usually consider some members of a category as more representative of that category; these members are the prototypes of that category.

Another blow to the classical view of categories was the existence of borderline entities (category members that could equally well be members of two or more categories). In the classical view, positing the existence of borderline entities was meaningless because, by knowing the fundamental essence of entities and knowing the definition of categories (necessary and sufficient criteria), one should be able to easily assign entities to clearly bounded, non-overlapping classes. Accordingly, in cases of confusion about assigning an entity to a clearly defined category, it was the person who was at fault, and there was nothing wrong with the classification scheme.

However, Rosch (1975) *prototype theory* explained that categories are fuzzy and overlapping and each has a dense center called the prototype. As a result, an entity can be equally similar to the prototypes of two categories (Rosch & Mervis, 1975). This explained why humans consider some things to be borderline entities.

The introduction of prototype theory gave rise to a wave of modern criticism of the *essentialist* idea that classification criteria are deduced from what are considered essential criteria and everything has a unique place in the classification scheme (Frické, 2016; Wilkins, 2013).

Accordingly, Dupré (1993) contended that there is no unique way of carving nature at its joints to reach the ultimate correct classification method. Spiteri (2008), Hjørland, and Albrechtsen (1999) and Beghtol (2003) also criticized the unitary descriptions of concepts and argued that so-called natural classifications represent only particular points of view and are situated within specific contexts in which the classification scheme is supposed to function. Similarly, Mai (2004, p. 41)

claimed that “any classification is relative in the sense that no classification can be argued to be a representation of the true structure of knowledge.” Along the same lines, Andersen, Barker, and Chen (2006) argue that, in each field, we may need alternative models and so-called “dynamic frames” that best represent alternative classification schemes.

Overall, critics of the classical view argued that the existence of “natural” classification has often been connected with a problematic *positivist view* (Marradi, 1990) and advocated for embracing a *post-positivist* epistemology, where “grand narratives” and pluralistic views exist (Mazzocchi, 2017, p. 373). These modern critics abjure the view that structures of the world are mind-independent (*realism*) and argue in favor of viewing categories as artifacts projected into the world (*relativism*) (Hjørland, 2017).

From the ontological point of view, the advancement of cognitive psychology and highlighting of the role of individuals in the classification process required an ontological shift from objectivism toward *subjectivism*. The subjectivist stance with regard to classification contends that there is nothing in the real world but individual entities and “classes” are just a fiction created by the perceptions and consequent actions of social actors.

2.2 Terminology

Reviewing terminology is another critical step in embarking on research related to the concept of classification. In fields such as biology, sociology, psychology, organization and management, the meanings and applications of most classification-related terms are extremely diverse. In this lexicon, the terms *classification, categorization, taxonomy* and *typology* are among the most fundamental ones.

In project management too, these terms are used interchangeably, causing a semantic confusion among researchers. Yet researchers in other fields such as knowledge management, biology, and organizational and management science seem to be more concerned with differentiating among these terms than researchers in project management.

In the following subsections, some widely used definitions of *classification, categorization, taxonomy* and *typology* are presented to demonstrate the diversity that characterizes the meaning of these terms. These definitions can be regarded as a starting point; in later chapters, the three

articles making up this dissertation will show the intricacies involved when trying to define and connect them.

2.2.1 Classification

Originating from the Latin stem *classis*, which refers to a division of the people, an army or fleet (Etymonline.com, 2017b), *classification* is a noun referring to the action of dividing things into classes. The word *class* is also derived from the same Latin word.

In general, *classification* does not have a unique definition, as it has been defined and used differently in different fields and by different researchers. Likewise, the term *class* has been referred to in different ways, depending on the context of study. Nevertheless, Hjørland (2017) considers that *classification* can be defined in two ways. One definition represents a *broad sense* of the word and the other is a *narrower sense* and is usually specific to a particular field.

Regarding the broad sense of classification, Suppe (1989) argued that it is inherent in the use of language and is inevitably involved in conceptualizing our experiences and surroundings. Bliss (1929, p. 143) defines classification as "a series or system of classes arranged in some order according to some principles or conception, purpose or interest, or some combination of such." Yet he emphasizes that, like other words in English that end with *-ion*, *classification* is sometimes used for the *process of classifying things* and sometimes for the *product* (classification scheme).

McKelvey (1978, p. 1428) refers to *classification* as a method of retrieving the appropriate knowledge in order to organize it around readily defined, described and labeled *classes*. In another instance, Bowker, and Star (2000, p. 10) define *classification* as "a special, temporal, or spatio-temporal segmentation of the world" and *classification system* as "a set of boxes (metaphorical or literal) into which things can be put to then do some kind of work-bureaucratic or knowledge production." For Bowker and Star, a classification system is an information infrastructure that demonstrates how we represent the world "out there." Similarly, Mayr (1969, p. 98) defines classification as "a communication system and the best one that combines greatest information content with the greatest ease of information retrieval."

In a narrower sense, *classification* sometimes has very specific definitions depending on the field it is used in. These definitions can be quite similar to the more general definitions but they add

some extra requirements. The added requirements usually concern how the classification process should work and what kind of properties the final categories should have (Hjørland, 2017). For example, Bowker, and Star (2000) added three requirements to their classification definition by stating that a classification system should (i) have a unique classificatory principle, (ii) be complete, and (iii) entail categories that are mutually exclusive. The third requirement also applies in natural sciences such as biology. In the classification of species, for example, most authors have considered "being mutually exclusive" to be a requirement of a classification scheme, whether species are grouped based on common ancestors or on some other characteristics. In this particular field, the narrow definition of classification has also been referred to as *systematic classification* (Suppe, 1989, p. 292).

Overall, the narrow definitions of classification are very context-specific and often impose some particular requirements, such as being mutually exclusive, that may not be generalized to other disciplines. For example, in library and information systems science, it is possible to construct a classification scheme whereby an entity such as a book can belong to multiple classes and be assigned multiple labels (Kwasnik, 2000). In the project management context, multiple labels can be assigned to the same project (e.g., a project can be both "R&D" and "complex"). As a result, narrow definitions of classification should be regarded with caution and are best understood in the specific context where they are intended to be used.

In the project management literature, many project classification schemes have been introduced and used. In many instances, project classes has been referred to as project "types" (Müller & Turner, 2010; Shenhar, 1992; Shenhar & Dvir, 1996). Nevertheless, in most studies, no explicit definition or requirement is introduced to explain how the project classification scheme was developed. In that regard, the first article in this dissertation discusses the reason for and possible logic behind existing project classification schemes.

2.2.2 Categorization

Category is derived from the Greek *katēgoriai* and Latin *categoria*, which were related to verbs meaning "to speak against, to accuse, assert, predicate." Category originated in the work of Aristotle, who used the term in the sense of the possible kinds of things that can be the subject or predicate of a proposition (Etymonline.com, 2017a). Today, however, from an interdisciplinary

perspective, the words *category* and *categorization* are often used in the same sense as *class* and *classification*. Compared to the word *class*, which is associated with *classify*, *category* is often used with the verb *categorize*. Nevertheless, some researchers have distinguished between *classification* and *categorization*.

In library and information systems science, Jacob (2004) is one of the authors who differentiates these terms by defining *categorization* as a process of dividing the world of experience into classes whose members have some similarity within a given context and *classification* as the process of assigning the entities into predefined, mutually exclusive and non-overlapping classes (Jacob, 2004, pp. 527-528).

Because Jacob's definition of *categorization* is context-dependent, it allows both the flexibility and the power of cognitive categorization (Jacob, 1992). Consequently, Jacob regards *category* boundaries as being fuzzy and overlapping, in contrast to *classes* (in a classification scheme), which are clearly defined and mutually exclusive.

Schmidt, and Wagner (2004) agree with Jacob's stand. They define *categorization* as a linguistic operation of attributing a particular phenomenon to a category, not necessarily categorizing it. In this view, *categorization* is making a conceptual proposition (e.g., "red is a color"). In contrast, they define *classification* as a special practice whereby a pre-established classification scheme is applied to identify, name or order the phenomenon.

However, from an interdisciplinary perspective, Hjørland (2017) argues that Jacob's distinction is based on the narrow meaning of *classification*. He concludes that, in almost all scientific fields, *classification* is the term used in reference to both the "process" of making categories and the end result of the process, in which entities are assigned to pre-established classes. Thus, these two terms have the same sense or meaning and choosing one term over the other depends on practices and does not necessarily refer to the distinction that Jacob made. Likewise, Bowker, and Star (2000) argue that anything consistently called *classification* and "anything treated as such" can be included in the term.

In project management, Crawford et al. (2005) stick to Jacob's distinction and use the term *project categorization* when talking about sorting the world of projects. However, other researchers such as Shenhar (2001) use the term *project classification* in almost the same sense. As a general rule

of thumb, it can be concluded that both terms (classification and categorization) can be used in the sense of dividing the world of projects into categories. Accordingly, in this dissertation, I will use the term *classification* in general except in direct quotations.

2.2.3 Taxonomy

Coined irregularly from the Greek words *taxis* ("arrangement") and *nomia* ("method") (Etymonline.com, 2017c), the term *taxonomy* was first used by Candolle (1813), referring to the classification of organisms such as plants and animals. Subsequently, the word was widely used in biological studies, spreading from there to other fields such as organizational studies. In Mayr (1969) interpretation, *Taxa* (*taxon* is the singular) refers to any group of real and concrete entities. For example, animals or plants can be considered as *taxa* but *category* may refer to broader sorts of entities such as artifacts or real, homogeneous or heterogeneous groups of entities.

In general, taxonomy has been referred to as an "empirical" process of identifying the differences in clusters of entities and selecting the attributes on which we base a classification (Mayr, 1982; McKelvey, 1982). The development of taxonomies usually incorporates the use of numerical methods and multivariate clustering algorithms to identify natural clusters and groups of entities (Everitt, 1986). Accordingly, Rich (1992, p. 761) considers taxonomies as numerical, hierarchical, or theoretical classification systems that are empirically derived. Likewise, Miller (1996, p. 507) refers to taxonomy as a process that uses quantitative data to discover important regularities.

Although some researchers, such as Landwehr, Bull, McDermott, and Choi (1994), argue that taxonomies are a particular kind of classification that usually relies on a "theory," others, such as Hjørland (2016), argue that *theoretical taxonomy* is an oxymoron because other kinds of classification can also be based on a theory. Overall, the only common element in the different definitions of *taxonomy* is the use of empirical data in the process of making the classification.

Another common term used in parallel to *taxonomy*, usually in natural science and biology, is *systematics*, which is the label Simpson (1961) gave to the study of principles and systems of classification and nomenclature. Systematics was a logical starting point for classifying and modeling species, and subsequently organization and management science also used the same label (*organizational systematics*) and developed various organization taxonomies (Haas, Hall, &

Johnson, 1966; McKelvey, 1982; Miller & Friesen, 1980; Miller, Friesen, & Mintzberg, 1984; Pugh, Hickson, & Hinings, 1969; Ulrich & McKelvey, 1990).

In *organizational systematics***,** a *category* or *class* may be an abstract group of taxa and symbolizes an unspecified rank in a hierarchical classification of organizations, whereas a *taxon* stands for actual measurable organizations, such as manufacturing companies (McKelvey, 1982). Taxonomies in organizational science are usually extracted from studies using rich historical data from individual companies; they laid the groundwork for tremendous volumes of empirical research (Alvesson, 1994; Kets de Vries & Miller, 1987).

Similarly, some project management work can be labeled as *taxonomies*. For example, Dvir, Lipovetsky, Shenhar, and Tishler (1998) ran multivariate analyses and came up with a project taxonomy that clustered projects into six cells based on the attributes of project scope, number of projects and hardware output. Although many authors in the project management literature have claimed to have created a project taxonomy, their so-called taxonomies just represent a heuristic classification without the use of empirical data or numerical methods.

Overall, by taking an interdisciplinary perspective, it can be concluded that the major feature that is shared among taxonomies is the incorporation of empirical data in their development. In this regard, the second paper in this dissertation presents an in-depth discussion of the methods used in a taxonomy.

2.2.4 Typology

Typology is derived from the Greek word *typo-logos,* which literally means the study of types (particular kinds of things) (Hjørland, 2017). Rich (1992, p. 761) defines typologies as "classification of data into types based on a theoretically derived, and more or less intuitively categorized, qualities of observed phenomena." Yet, based on this definition, a typology is not much different from a classification, which is understood as a system of classifying entities that puts similar types of entities together. This kind of confusion about the distinction between *typology* and *classification* may explain why some existing "typologies" in organizational science are simply classification schemes. Typologies such as those suggested by Woodward, Dawson, and Wedderburn (1965) and Perrow (1967) illustrate this confusion.

Nevertheless, Marradi (1990, p. 129) defines typology as a kind of classification in which the classifier simultaneously incorporates more than one classification criteria. Another definition of *typology* was provided by Bailey (1994, p. 4): a particular kind of conceptual classification that is distinguished by its "multidimensionality." The multidimensionality of a typology has also been recognized in many other studies as a distinguishing factor (Hall, Haas, & Johnson, 1967; Katz & Kahn, 1966; Pugh et al., 1969). However, general classification schemes can also be multidimensional. Therefore, such definitions of *typology* do not provide a unique distinction, compared to definitions of *classification*.

Nonetheless, Doty, and Glick (1994) introduced a unique definition of *typology* that has a different purpose from the usual classifications. Based on Doty and Glick's definition, each typology is composed of two parts:

1. The description of the "ideal types" as multiple unidimensional constructs;
2. The set of assertions about relevance of the ideal types to the dependent variable.

Simply put, a *typology* is similar to a system in which the deviation between the features of an entity (e.g., an organization) and those of an "ideal type" can explain a relevant outcome (a dependent variable).

Doty and Glick's definition of *typology* is compatible with many instances of organizational typologies. For example, Mintzberg's famous organizational typology comprises five types of organizational structures that predict the maximal organizational effectiveness (Mintzberg, 1979, 1983). Another example is Porter's three ideal-type strategies that affect the organization's competitive advantage (Porter, 1979, 1985).

In a project management context, although many typologies have been developed, the only example in compliance with Doty and Glick's definition is the work of Shenhar, and Dvir (1996), which introduced a project typology in which some ideal project types were introduced such that divergence from these types could explain any decrease in level of project success.

The development of a typology in a project management context is discussed extensively in the third article in this dissertation, which also explains the important role of project typologies in the advancement of theory development in this field.

To sum up, Table 2.1 presents general, interdisciplinary definitions of classification-related terms.

Table 2.1 Classification terminology

Term	Definitions
Classification	• As an action, it refers to the "process" of dividing the world into similar groups • As a result, it refers to a "classification scheme," which is the final representation of classes
Categorization	• Jacob (2004) defines *categorization* as dividing the world of experience into classes whose members have some similarity within a given context and *classification* as pigeonholing the entities into predefined, mutually exclusive and non-overlapping classes • From an interdisciplinary perspective, *category* and *categorization* are generally used in the same sense as *class* and *classification* (Hjørland, 2017).
Taxonomy	• A classification scheme that has been developed based on empirical data (Miller, 1996) • A taxonomy cannot be purely neutral and is always inspired by a theoretical view or subject matter influence.
Typology	• A typology is the description of some "ideal types" as multiple unidimensional constructs, along with a set of assertions about the relevance of those ideal types to a dependent variable (Doty & Glick, 1994)

2.3 Classification processes

Closely related to the definition of the different terms associated with classification, the process of selecting classification criteria is another fundamental issue in reviewing the science of classification. In many cases, the distinction among terms resides in the "process" researchers have defined for picking classification criteria and constructing the final classification scheme. Accordingly, this section reviews different "classification processes." Taking an interdisciplinary perspective, Table 2.2 presents the three main ways of making a classification scheme. Building upon the three main classification process proposed by Ketchen, and Shook (1996) in organizational science, Table 2.2 links different terms found in the relevant literature from other fields to the closest of these three main classification processes.

Table 2.2 Overview of classification processes

Classification process (Ketchen & Shook, 1996)	**Selection of classification criteria** (Ketchen & Shook, 1996)	**How final categories are formed**	**Other labels related closely**	**Result of process**
Empirical	Inductive	A posteriori: taken from arithmetic and data analysis	• Natural classification (Bather, 1927) • Numerical taxonomy (Rich, 1992) • Systematics (McKelvey, 1975) • Clustering (Marradi, 1990) • Empirical taxonomy (Warriner, 1977) • Empiricism (Hjørland, 2011) • Numerical phonetics (Mayr, 1969; Rich, 1992) • Phenomenal classification (Parrochia, 2016)	• Categories emerge from the empirical procedures used to sort features on the basis of similarity or association • Categories are not developed purely neutrally but are still influenced by theoretical view, analysis method or expert judgments
Theoretical	Deductive	A priori: deduced from a theory or theoretical principles	• Theoretical taxonomy (Rich, 1992) • Historicist approach (Hjørland, 2003) • Phyletics (McKelvey, 1978) • Phylogenetic classification (Gnoli, 2006) • Phylogenetic systematics (Hennig, 1965).	• Categories are formed prior to the assignment of entities to these categories and with the properties, deduced from the underlying theory • Fulfill only the specific purpose of a particular study or practice, and are not useful for another study • Represent how categories "should" be made, not necessarily how they "are" perceived and understood by researchers or practitioners
Cognitive	In classifier's perception	Based on prototyping, classifier's goals or detection of causal relations	• Traditional/common sense approach (Warriner, 1977) • Nominalism (Mayr, 1969) • Pragmatism/critical theory (Hjørland, 2011)	• Categories are formed in social actors' cognition and are influenced by their perceptions, goals or knowledge • Categories "are" individuals' mental artifacts and are fuzzy and overlapping, explaining the existence of prototypes and borderline entities

2.3.1 Empirical classification

Empirical classification is the process of identifying clusters of entities in order to maximize the likelihood of discovering meaningful differences (Mayr, 1982; McKelvey, 1975, 1978, 1982). Usually referred to as *empirical taxonomy* (Warriner, 1977), the empirical process of classification assumes that an objective or natural grouping will emerge a posteriori if one gathers enough characteristics by which to quantitatively measure phenomena (Goronzy, 1969; Haas et al., 1966; Pugh et al., 1969). Accordingly, this process of classification has also been called *inductive classification* because of its exploratory nature (Farradane, 1952; Ketchen, Thomas, & Snow, 1993).

Moreover, with an interdisciplinary perspective, one can see that other labels such as *clustering* (Marradi, 1990), *numerical phonetics* (Mayr, 1969) and *phenomenal classification* (Parrochia, 2016) have been used in the same sense when referring to the empirical method of making a classification.

Since the first attempt to create an empirical taxonomy of organizations by Haas et al. (1966), many authors have developed different empirical taxonomies (Goronzy, 1969; McKelvey, 1975, 1978, 1982; Pugh et al., 1969; Samuel & Mannheim, 1970). The development of such taxonomies is a necessary prerequisite for the maturation of organization science and has important implications for current and future directions of management theory (McKelvey, 1975).

Yet many proponents of empirical taxonomies, in different fields, adhere to the *empiricist* philosophy, whereby classification should be performed based on neutral criteria, not on the criteria influenced by certain theoretical points of view (Hjørland, 2011, p. 74). Likewise, there is an implicit assumption that, because taxonomies usually use numerical methods and clustering algorithms (Everitt, 1980), they represent an objective or natural way to classify. However, many authors have stood against this view, arguing that taxonomies inherently face some important issues (Carper & Snizek, 1980).

The first issue is related to existence of “raw data” or “unprejudiced observation” or “passive experience.” Many scientific scholars and philosophers argue against the existence of such data, claiming that observation and experience are the results of active exploration with an aim (to find, to check) in search of regularities or invariants (Johnson-Laird & Wason, 1977). First, the human

mind makes a hypothesis, then observation is inspired by the hypothesis, and not the other way around (Popper, 1959, 1972). Accordingly, "facts never just speak for themselves, but must be interpreted through the colored lenses of ideas" (Shermer, 2002, p. 4). Authors such as Bowker (2005, p. 184) and Gitelman (2013, p. 1) go so far as to say that "raw data is an oxymoron" and argue that the data used in a research study are always influenced by a theoretical basis, which is usually hard to recognize or control. Therefore, there can be no such a thing as *purely objective* or *universal* or *natural* taxonomy that does not use any a priori assumptions (Lakoff, 1987; Latour, 1987).

The second issue affecting empirical taxonomies is related to the influence of the classifier on the process, whether it is through the selection of particular method or the choice of variables on which the taxonomy should be based. Each clustering method has its own procedure for clustering observations. Therefore, to develop a taxonomy, a researcher needs to choose among multiple numerical methods. As a result, by selecting a particular model, researchers are inevitably imposing a particular view, often implicitly, of how the clustering of entities should work. For example, all clustering algorithms aim to group "similar" entities together (and thus separate unlike entities). Yet each method may have a different procedure to reach the satisfactory level of "homogeneity" within clusters and "distinction" between clusters. Simply put, without guidance from the classifier, the clusters in an empirical taxonomy may simply be statistical artifacts resulting from random numerical variation (Ketchen & Shook, 1996; Thomas & Venkatraman, 1988). Moreover, it would be nearly impossible to harness and consider all the related intrinsic, organizational and contextual attributes in a single study. Numerical methods themselves are not able to separate trivial from significant attributes or dimensions because no attribute is "objectively" more important than any other (Hjørland & Nicolaisen, 2005). As a result, the input of subject-matter knowledge in inevitably required (Abrahamowicz, 1985). That is why empirical taxonomies have been criticized for their arbitrary and narrow selection of variables (Fiegenbaum & Thomas, 1995; Ketchen et al., 1997; Reger & Huff, 1993).

The third problematic issue embedded in taxonomies is the instability of its the scheme (clusters) because, if we change the sample just a little bit or drop a single variable, the clustering will be different and entirely different clusters will emerge (Miller, 1996). For example, if one gathers 10 different organization-related variables (e.g., size, type of product, return on capital, etc.), adding

or removing one variable (e.g., amount of contribution to environment) can potentially change the number and the members of the final categories in an empirical taxonomy. This is another major reason why organizational science could not develop a widely accepted (universal) categorization scheme (McKelvey, 1975).

Overall, the empirical process of classification explains the fact that such classification schemes cannot be presented as purely objective, neutral or the result of so-called natural classification. Simply put, "objectivity is neither possible nor desirable in classification" (Nobes & Stadler, 2013, p. 573).

2.3.2 Theoretical classification

Another approach to classification relies on the use of established theories or principles in selecting classification criteria. This way of developing a classification scheme is referred to as *theoretical taxonomy* (Rich, 1992) or the *deductive* approach to classification because the classification criteria are deduced from a theory (Ketchen & Shook, 1996; Ketchen et al., 1993).

The theoretical process of classification is usually specific to a particular field of research. Scientists in biology, information science, cognitive science and organizational configuration have been developing different theories about how to build a classification with certain properties. The natural sciences, including biology, have been pioneered in this regard. For example, *phyletics* is a classification process based on the underlying assumption that natural grouping occurs based on genotype groupings (McKelvey, 1978). Accordingly species are classified based on either the most recent branching of the evolutionary tree (*cladism*) or the historical common ancestor (*evolutionary classification*) (Rich, 1992). This particular theory of classification has also been referred to as the *historicist approach* (Hjørland, 2003), *phylogenetic classification* (Gnoli, 2006) and *phylogenetic systematics* (Hennig, 1965).

Inspired by advances in biology, some researchers in organizational and management science have developed different theories about how to build a classification of organizations, calling it *organization systematics* (McCarthy, 1995; McCarthy, Ridgway, Leseure, & Fieller, 2000; McKelvey, 1978). Likewise, some researchers in project management have introduced theoretical principles to differentiate among projects. In particular, researchers adhering to the contingency

school of thought have drawn their classification criteria from different project contingency factors, with the underlying assumption that project classification based on contingency factors (e.g., uncertainty, complexity or risk) can explain other variables such as project performance and success.

Although theoretical classifications are very useful in any scientific endeavor, like empirical classification methods, they face some problematic issues.

The first issue is the "generalizability" of theoretical classifications. In each domain, there exist some theories that distinguish between the important and trivial aspects of a phenomenon. Such a distinction can be used as a guideline to group entities in such a way that the final categories demonstrate a certain structure and correspond to certain predefined properties (Hjørland & Nicolaisen, 2005). As a result, the value of a proposed classification scheme is totally dependent on the validity and legitimacy of that particular theory within the scientific community where it was developed. In other words, the discussion of the values of different classification schemes reflects different theoretical influences on the domain in which the classification was done (Hjørland, 2017). That is why the members of each domain may disagree about the value of a particular classification scheme (Hjørland & Nicolaisen, 2005). As a result, each theoretical classification serves only a specific purpose in a specific context and may not be appropriately generalized to other situations. For example, phyletics introduced some principles designed to classify living species. Hence, one may find it difficult to justify the generalization and use of phyletics for classifying projects.

The second issue is the implicit assumption behind theoretical classifications that claim to be the correct way to classify entities. Classifications constructed on the basis of a theory usually have a "prescriptive" tone in the sense that they prescribe how a classification "should" be. Implicitly, they assume that the "correct" classification method is the one that conforms to their selected theory. This underlying belief that there is a "correct" kind of classification is called *essentialism* (Mayr, 1969) or *rationalism* (Hjørland, 2011) and has been severely criticized by many recent scholars. Critics argue against seeing classification as an independent object that can be claimed to be correct or natural. On the contrary, they argue that categories remain artifacts that are justified and influenced by the researcher's cognition researcher and the social environment (Frické, 2016; Wilkins, 2013).

Overall, the critiques associated with theoretical classification induced researchers to look into the cognitive process of classification to find out how categories "are" really constructed in experts' or researchers' cognition, rather than how a correct classification "should" be constructed.

2.3.3 Cognitive classification

Cognitive process of classification relies on the perceptions of classifiers and the meaning that they attach to a phenomenon (Ketchen & Shook, 1996). The evaluation of classification from a cognitive perspective is drawn from *personal construct theory* (Kelly, 1955), which states that individuals have a cognitive system that acts like a filter and creates their perceptions of the objective world. Simply put, individuals are not passive observers of the environment; rather, they actively interact with their environment, form constructs and categories and attach meaning to them. This view argues that categories are a socially constructed reality (Berger & Luckmann, 1966) and assumes that groupings of phenomena have no existence outside of human perception (Carroll, 1984; Hannan & Freeman, 1977).

The empirical study of cognitive classification started in the 1970s, when the results obtained by the empirical cognitive psychologist Eleanor Rosch and her colleagues (Rosch & Lloyd, 1978; Rosch & Mervis, 1975) demonstrated that humans do not naturally classify objects based on precise, clear-cut and mutually exclusive definitions. On the contrary, mental categories are fuzzy and overlap each other. This explains why humans consider some entities to be neither completely included nor completely excluded from a given category (Murphy, 2002). Accordingly, the cognitive process of classification is similar to what Warriner (1977) called the *traditional* way of classifying, where the classifier does not precisely define the contents of categories.

The advances in the study of classification from a cognitive perspective have also demonstrated that a classifier's goals, preferences and prior knowledge (of causal relations) affect how mental categories are formed (Murphy, 2002). Accordingly, cognitive classification can be seen to be closely related to what Hjørland calls the *pragmatic and critical approach* to classification, which argues that, in a given classification, the goals, values, interests, policies, and consequences of classification should be reflected (Hjørland, 2011, 2017). Nevertheless, the pragmatic and critical approach argues in favor of classifications that are constructed based on the classifier's "explicit"

interests, whereas cognitive classification is usually used in a broader sense, arguing that categories, as mental artifacts, are influenced by both implicit and explicit factors.

Moreover, cognitive classification is also closely related to what Mayr (1969) referred to as *nominalism*, which argues that categories are "artificial constructs" that do not exist outside of human minds. However, the underlying assumption in nominalism is that the grouping of phenomena exists only to serve the scientific community's interest (Baum, 1989). Cognitive classification, on the other hand, does not restrict itself to this requirement and often examines the process of classification at the individual level. In other words, cognitive classification examines how different classifications are developed, and justified, to fulfill different personal goals, and not necessarily the scientific community's goals. Simply put, cognitive psychology discusses what categories really "are" perceived to be, rather than how they "should" be.

Furthermore, because cognitive classification does not directly make a final scheme based on principles of a priori theory, Ketchen, and Shook (1996) have viewed it as a "conceptual cousin" of inductive classification. However, unlike inductive classification, for which the classification criteria arise a posteriori from data analysis, in cognitive classification, the perceptions of expert informants such as industry executives play a major role in selecting the variables of interest for classification (Ketchen & Shook, 1996; Murphy, 2002).

Overall, by highlighting the inevitable role of the classifier's cognition in developing a classification scheme, a new avenue of research has been opened up to study classification from a cognitive perspective. By emphasizing the existence of categories and mental artifacts, this new research approach required a modern philosophical foundation and an ontological shift from objectivism toward subjectivism.

CHAPTER 3 STRUCTURE OF DISSERTATION

This chapter first discusses the research gap and then introduces the articles included in this dissertation.

3.1 Research gap

Following the advances in cognitive psychology and ontological shift toward subjectivism regarding classification, many scientists started to assess the importance of cognitive frameworks in related fields. Likewise, organization and management scientists also considered cognition as a major component of the understanding of organizations (Zerubavel, 1997). For example, many researchers in strategic management started examining participants' perspectives in making "strategic groups" of organizations. These researchers argued that strategic groups are the result of researchers' perception and cognition rather than of a theoretical framework or data-driven clustering (Dutton, Fahey, & Narayanan, 1983; Huff, 1990; Mason & Mitroff, 1981; Reger & Huff, 1993).

In the project management context, the modern philosophical stands toward classification mean that project categories are not something that exists independent of the observer; instead, they are mental artifacts created in the classifier's cognition and assigned to projects. Yet, to date, there has been no substantial debate in the project management literature about the role of cognition and mental representations in project classification.

Moreover, a review of the project management literature shows that, although some project classification schemes were derived on the basis of a theory (e.g., classification of projects based on contingency factors) or an empirical method (e.g., development of empirical project taxonomies), most project classification schemes were developed heuristically without any explicit explanation of the underlying processes. This issue requires an examination of the cognitive process of classification in order to understand how project management researchers (cognitively) developed their proposed classification schemes.

Filling this research gap in the project management literature is important because the perceptions and understandings that researchers, industry experts, top managers or any other classifiers attach

to a project category have direct consequences for organizational action and, ultimately, project performance and success. For example, if there is some confusion or multiple interpretations of project categories, a project may not be appropriately placed in an already established project classification scheme. As a result, that project will face some social sanctions such as decreased resource acquisition and organizational support (Crawford et al., 2005).

Accordingly, the **main objective of this dissertation** is to *evaluate the process of project classification from the cognitive perspective*. More specifically, this dissertation aims to open the black box of cognitive classification process in order to better understand how project classification schemes are developed and understood. With reference to the title of this dissertation, conducting this research required **rethinking the role of project classification in a project management context**, from a blindly used hierarchical sketch to a more complex cognitive artifact that has great influence on both project management practices and the future state of theory development in the field.

3.2 Introduction to articles

The content of this dissertation is presented in three articles format. Each article initially takes an interdisciplinary approach and looks at decades of research in different fields with a long history of discussions about classification. Only then is the meaning of different concepts and terminologies discussed in the project management context. Each article has a specific research purpose and addresses some important areas related to classification, particularly the cognitive process of classification.

The **first article** explains that classification is a cognitive phenomenon that forms in the eye of beholder, meaning that no such a thing such as objective or neutral classification exists. The main purpose of this article is to open the black box of the cognitive process whereby each individual reflects on and chooses project classification criteria. Accordingly, the main research question of this article is ***how and why are some particular attributes picked as project classification criteria?*** Drawing on insights from cognitive psychology, it is argued that, in addition the project's features, the classifier's goals, ideals or preferences and knowledge of causal relations may also be reflected in the selection of classification criteria. Clarifying these concepts provides a more coherent, rational picture of how project classification works in the perception of different individuals.

The **second article** goes further in evaluating classification from the cognitive perspective and empirically examines the cognitive structures underlying the perception and understanding of categories. The main argument of this article is that, although individuals may refer to the same category label, their perception and understanding of that category may differ significantly. In other words, there is no universal understanding of project management categories and different groups of like-minded individuals may incorporate different "configurations" in reference to a concept or category. Accordingly, by introducing a methodology to empirically capture the complex, multivariate configurations for perceiving and understanding the same project category, the second article tries to answer the research question of ***is there a universal perception of project categories or do distinctive "shared understandings" exist?*** As a result, different groups of like-minded individuals who have shared understandings of a particular project category are parsed out. In a nutshell, this article maps different groups' mental representations of a particular project category.

After examining classification from the cognitive perspective, the **third article** takes a high-level view and points to the lack of uniformity and semantic confusion with regard to the definition and implications of classification and its related concepts. It is then argued that this issue has prevented project management from flourishing theoretically. As a result, there is a need to rethink the role of classification in the project management context. Accordingly, the main research question of this article is ***how can research on classification benefit the current state of theorizing in project management?*** Accordingly, it is explained that project classification is the basis for constructing homogeneous project categories, delimiting project types, and developing middle-range theories (Merton, 1968) which are the theories whose scopes are limited to a particular project type (Packendorff, 1995). Moreover, a typology itself is a unique form of theory that can be used as an important and useful theory development in project management. The third article concludes that more guided research and development with regard to classification and typology will help the current state of theory development in project management to thrive and reach the same level as in organizational and management science.

Overall, the articles included in this dissertation shed light on important areas of "project classification" as an independent research topic. The specific practical and research implications of each article are discussed extensively in their own implication/discussion sections. Figure 3.1 depicts an overall view of the structure of this dissertation.

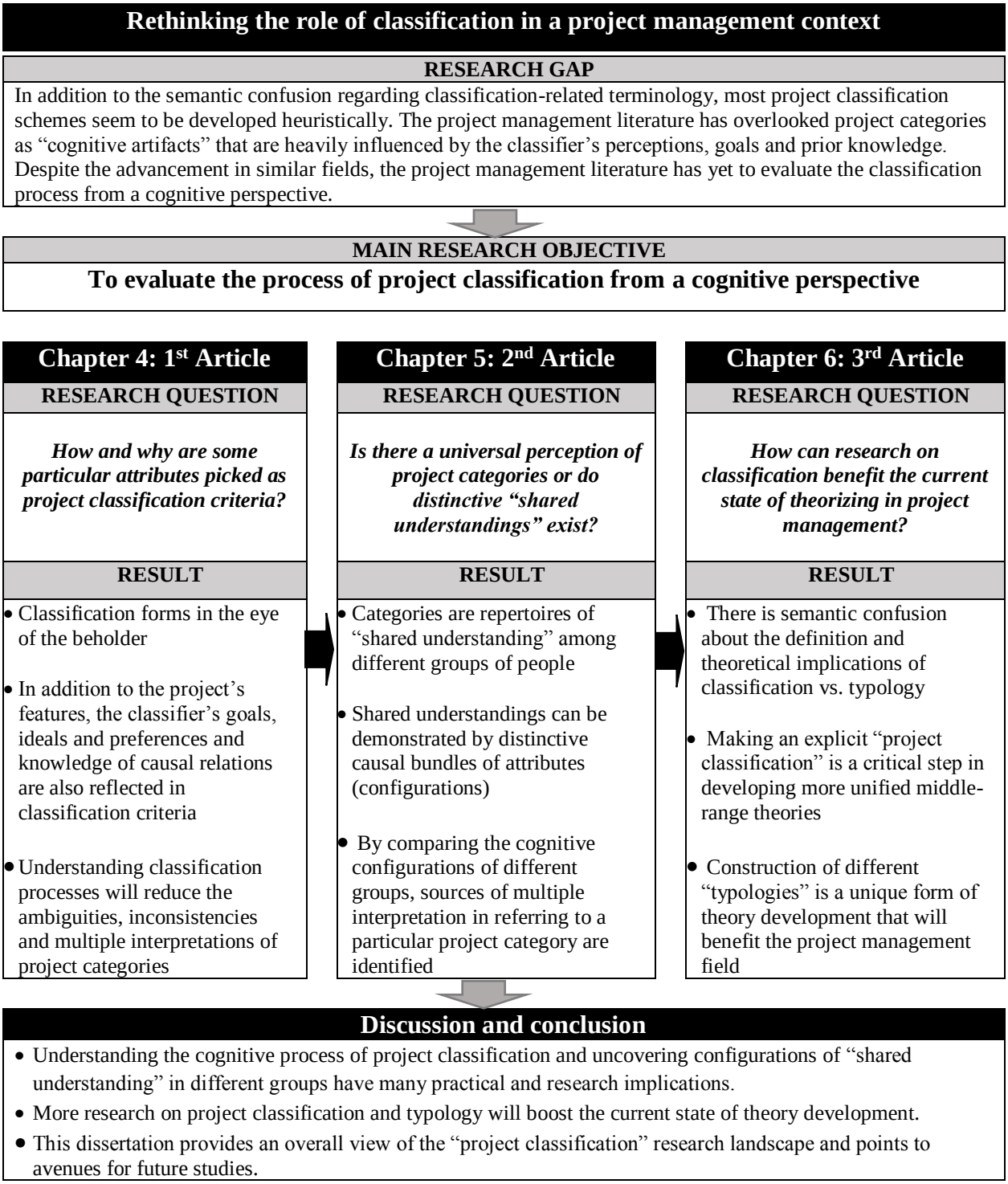

Figure 3.1 Structure of dissertation

CHAPTER 4 ARTICLE 1: IN THE EYE OF THE BEHOLDER: OPENING THE BLACK BOX OF THE CLASSIFICATION PROCESS AND DEMYSTIFYING CLASSIFICATION CRITERIA SELECTION

Chapter Information: An article based on this chapter has already been published, as per the following reference:

Niknazar, P., & Bourgault, M. (2017). In the eye of the beholder: Opening the black box of the classification process and demystifying classification criteria selection. *International Journal of Managing Projects in Business*, *10*(2), 346-369.

Abstract

Purpose: projects have high stakes in how they are categorized. The final place of a project within a classification scheme depends on the inclusion or exclusion of certain classification criteria. So far, many researchers and organizations have used a variety classification criteria to construct different project classification schemes. However, most of these classification criteria have been taken for granted and the process of selecting them to categorize projects still remains a black box. The main purpose of this paper is to open the black box of classification process and explain how it is reflected in picking the classification criteria.

Design/methodology/approach: drawing on insights from cognitive psychology's literature, we examine the main views of classification process to provide insight into the unknown or implicit reasons that one might have to pick particular attributes as project classification criteria.

Findings: we argue that classification occurs in the eye of the beholder; it is not only the project's features per se but also the classifier's 'goals, ideal and preference' or 'knowledge of causal relations' that are reflected in the classification criteria.

Research limitations/implications: by elaborating the classification process, we brought the project context into the big picture of classification and provide a more rational, and coherent picture of how project classification works. This contributes to a theoretical blind spot, raised by prior researchers, related to the selection of project classification criteria.

Practical implications: understanding classification processes will reduce the ambiguities, inconsistencies and multiple interpretations of project categories and help people increase their projects' visibility and legitimacy within an already established classification scheme. These implications help organizations in addressing some of the main obstacles to using categorization in project management practice.

Originality/value: our review of prior work in the category research literature and the insights from this paper will provide project management scholars with a useful toolbox for future research on project classification, which has long been understudied.

Keywords: Project classification, Project categorization, Classification criteria, Classification process, Cognitive classification

4.1 Introduction

The decline of the universal view of projects (Engwall, 2003; Koskela & Howell, 2002a; Maylor, 2001; Morris, Patel, & Wearne, 2000; Shenhar, 2001; Shenhar & Dvir, 1996; Winch, 1996) has triggered a critical need for appropriate project classification.[1] Shenhar (2001) argues that there is no single theory of project management, nor is there a single, universal theoretical model that fits all types of projects. Moreover, Archibald (2004) explains that the one-size-fits-all approach to project management is a root cause of many project failures, because the wrong project management methods are often applied in the absence of agreed-upon project categories. Therefore, proper project classification prior to the recommendation of any customized management style appears to be a must in order to better execute projects and increase the chance of their success (Shenhar, 1998). Furthermore, the results of a recent empirical study by Besner,

[1] In the majority of studies reviewed in this paper, the word *classification* is often used interchangeably with *categorization*, with almost the same meaning. However, Jacob (2004) differs in this regard, as he defines *categorization* as dividing the world into classes and classification as pigeonholing entities into predefined classes. In this paper, we follow the vast majority of authors and use both terms with the sense of dividing the world into classes. We use *classification* most often; *categorization* is used only where it was originally used by the cited authors.

and Hobbs (2012) show that each project category is associated with a different pattern of practices and support the critical need for an appropriate project classification.

The need for project classification has induced scholars and organizations to classify projects in a multitude of ways (Crawford, Hobbs, & Turner, 2002). Each of the suggested classification schemes includes different categories and places a given project in one of them. Accordingly, the place of projects in a classification scheme has a huge impact on different aspects of project management such as recourse availability (Crawford et al., 2005), use of project management tools (Besner & Hobbs, 2012; Evaristo & van Fenema, 1999), leadership style (Müller & Turner, 2007b), and project portfolio success (Müller, Martinsuo, & Blomquist, 2008).

The final place of a project within a classification scheme depends on the *classification criteria* used to classify projects. For example, consider classifier A, who classifies projects based on *complexity,* versus classifier B, who classifies the same projects using only *strategic importance of a project* as the criterion. In a government agency, for example, a complex national IT project would be put in the "highly complex projects" category by classifier A and in the "national security projects" category by classifier B. Clearly, changing the class and label of a project from just a "complex technology project" to a "national cyber-security project" may have a significant impact in terms of resource availability, accountability, stakeholder relations, and critical information management.

Nonetheless, despite its great importance in project management, in reviewing the project management literature, we noticed two major issues with regards to selection of classification criteria.

The first issue emerged from our extensive review of project management literature from the past 30 years that presented an explicit project classification scheme. In our literature review, we found that, in addition to intrinsic project characteristics (e.g., project cost or scope), many authors used contingency factors (e.g., complexity (Davies & Mackenzie, 2014; Shenhar & Dvir, 2007) or uncertainty (Howell, Windahl, & Seidel, 2010; Loch, Solt, & Bailey, 2008)) as criteria to categorize projects. We noticed that there is little or no discussion about why and how the classifiers picked those particular criteria – and not any of the other possible ones – to categorize projects.

This is an important issue because lack of insight into the logic behind choosing the criteria for classification can result in confusion; it increases ambiguity and results in multiple interpretations of a category (Durand & Paolella, 2013). As a result, organizations that must deal with multiple projects can find it difficult to select, steer and manage their project portfolios (Crawford et al., 2002). Moreover, because of the large body of characteristics affecting project management and the vast, almost unmanageable multitude of factors (Hanisch & Wald, 2012), a new researcher in the field or an organization may wonder which of these factors are appropriate to include as classification criteria when creating a project classification scheme from scratch.

The second issue was raised by Crawford, Hobbs, and Turner (2005; 2006), who examined the different *purposes* that organizations pursue in creating a project categorization system and the most common *attributes* that organizations use as their *classification criteria*. Surprisingly, they found many cases where organizations using different classification criteria were pursuing the same purpose; likewise, many organizations used the same classification criteria in pursuit of different purposes. Crawford et al. found that the classification criteria selection process is context-specific but were unable to fully explain the logical link between the purpose of classification and the selected classification criteria. Therefore, they suggest that future research look for a more complex model of project categorization to explain this issue.

Lack of clarity in underlying logic of classification criteria selection and the need for explanation of the link between classification purpose and selected criteria led us to formulate a central research question: ***How and why are some particular attributes picked as project classification criteria?*** In addressing this question, we contend that insights from cognitive psychology hold the key to unlocking novel understandings about the underlying logic of classification criteria selection. We argue that **classification is in the eye of the beholder**, meaning that setting category boundaries and making sense of categories depend not only on projects' intrinsic characteristics but also on the classifier's level of knowledge and goals and ideals.

We consider the *classification process* as the logical link between the classification purpose and the classification scheme whereby the classifier weighs different attributes in order to use them as classification criteria and group entities into categories (Murphy, 2002). If the classification process remains a black box (implicit or unknown to a new audience), there are no guidelines as to how and why particular criteria should be picked to categorize entities and a new audience may wonder

why these entities were classified in a particular way by the classifier. That is why we should deepen our understanding of the classification process so we can move beyond the taken-for-granted categories and explain how classification criteria selection actually works (Kennedy & Fiss, 2013).

In opening the black box of the classification process, we review three main views of cognitive psychology: the *prototype view,* the *goal-based view* and *the causal view.* The prototype view explains that we naturally construct categories such that items are placed into the same category based on the similarities of their features to the prototype of each category created (Rosch & Mervis, 1975). The goal-based view argues that sometimes entities are classified according to their perceived alignment with the classifier's specific goal or ideal rather than the perceived similarities of their features to the prototype (Barsalou, 1983). Finally, the causal view explains that there are cases where categories are derived based on the classifier's prior knowledge of the causal or relational associations among the objects' features (Ahn, 1999; Rehder, 2003a, 2003b; Rehder & Hastie, 2001). Further explanations of these views are provided later in the paper.

Using these views of the classification process as lenses, we examine the various project classification criteria used in project management to hypothesize the most plausible classification processes that led to their selection as classification criteria. We explain that, if the classification process is based on prototyping, the classification criteria are restricted to project features (e.g., project cost or size). On the other hand, if it incorporates the goal-based view, the classification criteria are also based on the classifier's goals or ideals (e.g., strategic importance of project or project mission). And if the project classification process incorporates the causal view, criteria which involve relationships, linkage, or influences between certain features or project contingency factors are picked as the classification criteria.

Ultimately, we hope this study will make a theoretical contribution to project management research by adding the classification process as a link between classification purposes and classification schemes. In so doing, we are contributing to a better understanding of classification criteria selection, particularly in the context of project management and addressing the issue raised by Crawford et al. (2005) regarding the need to explain the role of context in the selection of classification criteria. We provide a rational and coherent model of project classification that considers the role of the project's context in the selection of classification criteria. From a practical

perspective, this research addresses some issues that are among the main obstacles for use of a categorization system in project management practice (Crawford et al., 2005). With the help of this study, researchers and practitioners will be able to reduce:

- Ambiguities, inconsistencies and multiple interpretations of categories
- Lack of visibility and legitimacy of projects outside of categories

This article is organized as follows. In section 2, we review the category research literature and the current state of category research in project management. In section 3, we argue that it is necessary to incorporate the classification process into the modeling of classification. In sections 4 and 5, we review the various views of the classification process and explain how they are reflected in a project management context. In section 6, we summarize the key points for understanding the views of the classification process in project management and explore the process's theoretical and practical implications. We conclude by presenting an overview of this paper's contributions along with promising avenues for future research.

4.2 Literature review

4.2.1 Research on categorization

Some sort of ordering or classification is an essential precondition for any scientific investigation (Crowson, 1970). Although many classifications of organizations, industries and markets have been proposed in the literature, it was only in the past 15 years that organization scholars started to look at classification as a field of research in itself and to understand the important role categories play within organizations and markets (Vergne & Wry, 2014). In general, literature on categories falls into two perspectives: a *sociological* perspective and a *cognitive psychology* perspective.

In the sociological perspective, scholars theorize about categories as components of a firm's external environment (Zuckerman, 1999) and focus on examining the macro-social consequences of different categorizations of organizations (Vergne & Wry, 2014). The results of studies in this perspective provide valuable insights into the significant impact of different kinds of organizational classification on markets and on firms' performance.

The main argument of studies in this perspective is that the more mismatch among the shared understanding/expectation of classifier and the external audience about a category of an organization, the less performant the organization becomes (Hannan, Pólos, & Carroll, 2007; Lounsbury & Glynn, 2001; Navis & Glynn, 2011; Wry, Lounsbury, & Glynn, 2011). This mismatch also leads to some social sanctions for the organizations such as decrease in resource acquisition (Durand, Rao, & Monin, 2007; Hannan et al., 2007; McKendrick, Jaffee, Carroll, & Khessina, 2003). For example, if the presentation of an organization from the industry that it belongs differs from the perception/expectation of stock analysts about a particular industry, the shares of that organization would trade at a discount in capital markets (Durand & Paolella, 2013; Hsu & Hannan, 2005; Wry, Lounsbury, & Jennings, 2014; Zuckerman, 1999). The reason is that the mismatch between the organization and stock analyst's (external audiences) category structure related to characteristics and type of industries. The evidence for this degrading effect has been reported in other situations such as in the performance or rating of entities such as restaurants or movies (Hsu, 2006; Hsu, Hannan, & Koçak, 2009; Kovács & Johnson, 2014).

On the other hand, in the cognitive science perspective, categories are regarded as a cognitive phenomenon that are "both the building blocks of social reality and mirrors of it" (Kennedy & Fiss, 2013, p.1151). Studies that adopt this perspective draw heavily on insights from the cognitive psychology literature, which discusses the micro-cognitive mechanisms underlying category perceptions and categorization processes.

Such studies aim to answer questions such as *How do humans pick the classification criteria to form the structure of various categories?* (Rosch & Lloyd, 1978), *How do individuals make sense of entities that mix elements from multiple categories?* (Cohen & Murphy, 1984; Hampton, 1988), *How different is the basis for constructing categories?* (Spalding & Murphy, 1996), and *Why are the same objects categorized differently?* (Johnson & Mervis, 1997). The application of this perspective in the organizational sciences started with Porac, Thomas, and Baden-Fuller (1989), and continues in many related fields such as strategy, entrepreneurship, and organization theory (Durand & Paolella, 2013).

Because the sociological perspective analyzes the consequences of mismatched perceptions rather than exploring the reasons underlying them, we choose to focus on examining literature in the

cognitive science stream that can potentially explain deviations in category perceptions, which is what our research question seeks to address. However, before doing so, we will review the current state of category research in the project management literature.

4.2.2 Category research in project management

Despite the critical role of classification in project management and all the advances in category research, there has been very little systematic research on project classification as a separate field. Many project management studies state the *purpose* of making a classification, present the attributes used as *classification criteria*, or suggest a project *classification scheme,* but the majority do not look at the big picture of classification or explore how the mechanisms underlying project classification may work.

In general, we consider the classification process as the logical link between the classification purpose and the classification scheme. **We view the classification process as a "course of thoughts" whereby the classifier weighs different features in order to use them as classification criteria in such a way that the final classification scheme fulfills the initial purpose of classification**. Figure 4.1 depicts our view on main components of a classification and the role of classification process in between.

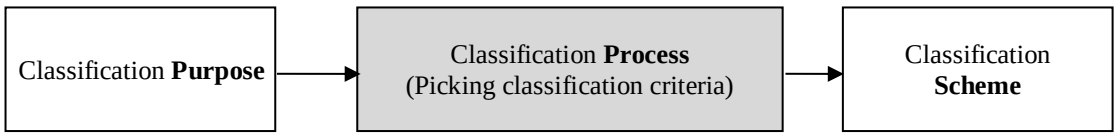

Figure 4.1 A view on classification components

We will elaborate on each of these components in following parts.

4.2.2.1 Classification purpose

The **classification purpose** is a key element in project classification, as it determines both the *raison d'être* and the ultimate goal that the final classification scheme should serve. In one of the few studies of project categorization, Crawford et al. (2005) empirically searched for different classification purposes that organizations use in developing their project categorization systems. They found that each organization – whether implicitly or explicitly – creates a project

categorization system based on its own particular purposes. They found that *resourcing and planning, matching methods to projects, risk assessment, prioritization, matching resources and skills to projects* and *budget allocation* are among the most common organizational purposes served by project categorization systems. Nevertheless, a researcher's purpose in developing a project classification scheme may differ from an organization's purpose in classifying its projects.

A researcher's purpose in creating a project classification scheme is usually derived from the study's research questions, albeit implicitly. Project classification helps researchers *compare* projects without facing the challenges arising from the specific characteristics of each one. In general, when researchers want to compare some aspect of projects, they group the similar projects in various categories so they can find "the differences that make a difference" (Crawford et al., 2005). In addition to project comparison, *finding appropriate success factors* is another reason why researchers may construct a project classification (Belassi & Tukel, 1996; Dietrich & Lehtonen, 2005; Evaristo & van Fenema, 1999; Shenhar, 1998; Shenhar & Dvir, 1996). In this approach, authors seek to create some sort of project classification because success factors are found to be contingent on project type and project management type (Dvir et al., 1998; Lecher, 2000; Shenhar & Dvir, 2007).

Prescribing the appropriate management styles and tools for each project type is another common purpose of researchers in developing a project classification. Project classification is a key requirement for determining project types so that appropriate project management styles, tools and methods can later be prescribed for each type of project (Besner & Hobbs, 2012; Dvir et al., 1998; Evaristo & van Fenema, 1999; Müller & Turner, 2007b; Payne & Turner, 1999; Shenhar, 1998; Turner & Cochrane, 1993). It has been shown that a tailored management approach for each project category yields better results (Payne & Turner, 1999).

4.2.2.2 Classification criteria

The **classification criteria** used in the project management literature have been either regular project features such as cost (Youker, 1999), scope (Levene & Braganza, 1996; Shenhar, 1998; Shenhar & Dvir, 2007), application area (Müller & Turner, 2007a) size, and resource types (Payne & Turner, 1999) or else contingency factors such as complexity (Davies & Mackenzie, 2014; Shenhar & Dvir, 2007), uncertainty (Howell et al., 2010; Loch et al., 2008) and risk (Barki, Rivard,

& Talbot, 2001; Floricel & Miller, 2001). In addition to the criteria used in the literature, Crawford et al. (2005) report that in project management, the attributes most frequently used by organizations to classify projects are application area, nature of work, customer, complexity, cost, size, strategic importance, risk level, organizational benefit, deliverables, priority, and contract type.

4.2.2.3 Classification scheme

Once the classification criteria have been selected and projects grouped into categories, the **classification scheme** is the cognitive representation of the structural relationships between categories (Vergne & Wry, 2014). The classification scheme specifies how categories differ from and relate to each other (Kwasnik, 2000). It allows one to identify how projects are assigned to categories and how the categories are differentiated from one another. To put it more simply, the classification scheme can be considered as a set of boxes into which projects are placed. We can often visualize classification schemes by representing them in hierarchical order or tables. Darwin's tree of life (using common ancestor as classification criterion) and the Periodic Table of Elements in chemistry (using atomic mass as classification criterion) are two well-known examples of classification schemes.

While by no means an exhaustive list, creating categories of "incremental" and "radical" or "short-term" and "long-term" projects (Matheson, Matheson, & Menke, 1994), or "strategic projects" and "operational projects" (Shenhar & Dvir, 2007), or "exploration projects" and "exploitation projects" (Cooper, Edgett, & Kleinschmidt, 2001; Killen & Hunt, 2010) are just some examples of project classification schemes. In particular, only a few project classification schemes in the literature are comprehensive and mutually exclusive. Turner, and Cochrane (1993) classification scheme, which classifies projects as "projects with well-defined goals and methods," "projects with well-defined goals and poorly defined methods," "projects with poorly defined goals and well-defined methods" and "projects with poorly defined goals and poorly defined methods" is one of them. Evaristo, and van Fenema (1999) three-level classification scheme based on "number of projects" and "number of project sites" is another good example of such classification scheme.

4.2.3 The black box of classification process

We consider the classification process as a "course of thoughts" whereby the classifier weighs different features in order to use them as classification criteria. Classification process is what causes a feature to be included or excluded from the classification (Murphy, 2002). Thus, besides the initial purpose of the classification, the final shape of the classification scheme is also heavily dependent on how the classification process works (Durand & Paolella, 2013).

In the project management literature, researchers rarely explain why and how they cherry-picked certain attributes – and not others – as the classification criteria in constructing their classification scheme. In other words, the classification process that justifies the selection of "classification criteria" remains a black box.

Nevertheless, cognitive psychology scholars have made substantial efforts to understand the cognitive processes whereby a classifier picks classification criteria and constructs a classification scheme (Cohen & Murphy, 1984; Hampton, 1988; Rosch, 1978; Spalding & Murphy, 1996). Accordingly, we wish to open the black box of classification process (in project management) by discussing different views of the classification process proposed by cognitive psychology researchers over the past four decades.

The aim is to provide some insight into the underlying logic that may have been used in picking the classification criteria and constructing a project classification scheme. By doing so, we are trying to answer our research question, *How and why are some particular attributes picked as project classification criteria?*. In the next section, we will examine each view of the classification process in detail.

4.3 Views on the classification process

Based on Aristotle's rhetoric, philosophers have long assumed that definitions are the appropriate way to characterize categories (Apostle, 1980). In this classical view, categories are precisely defined in terms of *necessary* or *sufficient* features or a combination of both (Pothos & Hahn, 2000). To be a member of a category, an entity must have all the necessary features of the definition. Moreover, if an entity has all the sufficient features specified in the definition, it must be a member

of that category. Thus, a new entity is evaluated against the category definition and assigned to a predefined category. We can find examples in many fields. For instance, the Dewey Decimal Classification of books and the Nursing Interventions Classification place entities into categories based on a priori category definitions according to necessary and sufficient features.

As neat as this view appears, however, many researchers in the 1970s showed that it is very hard to find a precise definition for mental concepts that involve human behavior and judgment (Murphy, 2002). In fact, human classification contains many borderline entities that are neither completely included in nor completely excluded from a category. For example, we may be uncertain about including a book about projects as temporary organizations in either the "organizational book" category or the "project management book" category. If our mental classification process worked in the way the classical view suggests, there should be precise definitions of these categories, which would make it very easy to classify any book by observing its features. However, in our natural classification process, it is hard to construct a clear-cut definition of categories that are clearly bounded and mutually exclusive for all the books in the world.

Starting with the ground breaking work of Rosch (1975), researchers found that, contrary to the classical view, natural mental concepts are *fuzzy*: neither tidy nor clearly bounded. They concluded that category fuzziness is an integral feature of the mental classification process and not a case of incorrect categorization (Murphy, 2002). Thus, the problem is not that our book belongs to a particular category (organizational vs. project management) and we have a problem identifying this category, but instead that our mental categories of organizational and project management books are shaped such that our book can be a member of either one.

Furthermore, in the classical view, anything that meets the definition criteria is an appropriate category member, with no distinction between the members of a given category. However, this cannot explain the *typicality effect* (Barsalou, 1987; Rosch, 1975), whereby humans consider some members of a category to be typical and other members of the same category to be atypical. The classical view argues that if, for example, we construct a mental category to include all books related to project management (e.g., using the Dewey Decimal Classification system), all these books should equally represent the project management book category. However, we do not actually consider all the books in this category to be equally representative. For instance, we might

consider certain highly reputed books to be more typical of this category. Based on experiments with similar examples, Rosch (1975) argues that it is the not the "category definition" but rather a "typical item" that serves as the cognitive reference for the construction of categories.

The inability of the classical view to explain borderline entities or the typicality effect in categories provided the main impetus for a new research stream that attempted to explain how we conceptualize and categorize entities. Since then, various views of the classification process have been proposed:

- Prototype view (Rosch & Mervis, 1975)
- Goal-based view (Barsalou, 1983)
- Causal view (knowledge-based view) (Rehder, 2003a)

Each view is the outcome of gradual advances in the understanding of how and why we naturally categorize entities. In the following sections, we will examine these views and explain them in detail.

4.3.1 The prototype view

The pioneering work of Eleanor Rosch in the 1970s first highlighted the deficiencies of the classical view. In their experimental studies, Rosch (1975) and Rosch, and Mervis (1975) found that *family resemblance* in terms of similarity of features between objects had a dominant effect on how a mental classification was formed. Known as *prototype theory*, this view has dominated thinking on the classification process since then (Hannan et al., 2007).

Rosch and Mervis (1975) explain that, when entities are observed in terms of their features, humans who want to make a classification assign more weight to features with low variability. For example, to form a class called "birds," if most birds were the same size and varied mainly in terms of color, we would assign more weight to the "size" feature than the "color" feature. In other words, we would emphasize similarity of size over color when constructing the "bird" category.

Assigning more weight to certain features results in what is known as family resemblance, and thus the final classification scheme contains categories in which the members have more heavily weighted features in common with each other than with members of other categories.

Consequently, the categories can be represented as clusters having a dense center and fuzzy edges that overlap with other categories. Rosch (1975) called the dense center of a category the *prototype* of that category.

Prototypes are typically more representative of their category, and are considered the best or most outstanding members of that category. For example, a typical pigeon may serve as a mental prototype of the cognitive category "bird." However, prototypes are not necessarily existing members of a category. Instead, they can be thought of as *summary representations* of all the members of a category.

Rosch and Mervis argue that, the more features an object has in common with the prototype, the more securely it is placed in the same category as the prototype. Thus, if an object overlaps with the central prototype, it is more readily classified (Rosch, 1975). Entities that are less like the prototype are situated increasingly further from the category's center, until some objects are barely similar to the prototype. As these entities become more similar to the prototype of another category, they are assigned to that other category (Rosch & Mervis, 1975).

The prototype view accounts for both the typicality effect and the existence of borderline entities. The more features an entity has in common with the prototype, the more typical a category member it is. Moreover, borderline entities are have the same degree of similarity to the prototypes of two different categories and therefore can be considered members of both categories.

To illustrate this view in the context of project management, we can imagine a researcher who wants to divide the project world into categories. According to the prototype view, after observing the features of projects, the classifier would assign more weight to the project features with low variability. By doing so, the features with more weight would be the basis for devising the classification. For example, imagine that the project world consists of 100 projects. Furthermore, these projects involve 100 different budgets and numbers of workers. However, 30 projects involve the same product (e.g., software), and only 15 have the same geographic location. So we have 71 different product types, 86 different geographic locations, and 100 different budgets and numbers of workers. According to the prototype view, the "project product" feature would be assigned the most weight because it has the lowest variability. In addition, the classifier would assign more weight to geographic location than to budget or number of workers. The prototype view argues that

the classifier would cluster the projects into categories that are more similar in terms of product and geographic location. Moreover, the classifier would form a mental prototype for each category. Subsequently, each new project would be compared with the prototypes and then assigned to the category where it has the most similarity with its prototype.

In summary, according to the prototype view of the classification process, the similarity of entities in terms of their features is the main basis for forming categories. Rosch and Mervis (1975) provided empirical evidence that natural classification schemes are constructed such that the members of each category have many more features in common with the prototype of that category than with the prototypes of other categories. Nevertheless, although the prototype view can explain many established classification schemes, researchers have found other human classification schemes that it cannot fully explain. Consequently, many researchers have dug further into how natural classification can be explained.

4.3.2 The goal-based view

In the wave of research that followed the demise of the classical view, the experimental results obtained by Barsalou contradicted the prototype view (Barsalou, 1983, 1985). Many study participants placed certain identical objects into different categories, and a significant percentage of the variation in category membership could not be explained by family resemblance (prototype theory). Barsalou observed that a category goal or ideal set by the classifiers was the main explanatory factor for the classification scheme. He demonstrated that we often construct categories that are formed solely by the degree to which the members contribute to fulfill a predefined goal. These categories are often referred as goal-derived categories and the explanation of this process is called the goal-based view of classification.

The goal-based view of classification claims that natural categories are not formed in isolation from our prior knowledge, and that mental pressures drive us to make our classification schemes consistent with what we already know or expect from the categories. Therefore, classification involves a reasoning process that infers certain properties for the categories to be created (Murphy, 2002). This view contrasts with the classical or similarity-based view that some features (necessary, sufficient or critical) determine the classification of an object, regardless of the other information available about this object (Pothos & Hahn, 2000).

In goal-based classification, this property is the goal or ideal that each category should fulfill. This ideal or goal is not inherent in the observed entities, but is set a priori by the classifier and is derived from the classifier's general knowledge, preference, or judgment about the categories.

An illustration of goal-based classification is the categorization of foods into "foods that we like" and "foods that we don't like." In this classification, two almost identical cakes could be placed in different categories because they were eaten in different circumstances. To illustrate more, consider the "menu" of a restaurant as the classification scheme of foods served at a restaurant. In such a case, the menu's organization is an illustration of goal-based classification, as the restaurant changes and shuffles the foods based on its objective, derived from its knowledge of customers (e.g., menu for special night, lunch menu or wedding menu). So basically, when the classifier's goal or objective changes, the categories are modified to satisfy the new objective. For example, depending on the occasion, a particular soup can be moved from the starter category to the main dish category or vice versa.

In the above examples, the prototype view is insufficient to explain how the final scheme has been shaped, because based on family resemblance or similarity, two identical objects (cakes or soups) should belong in the same category. Nevertheless, taste or preferences can play a major role in classification, overriding the features of the cakes that are actually similar. Thus, the major difference between the goal-based view and the prototype view is that in the latter categories are *perceived* to be constructed based solely on information about the items and their features but the goal-based view also considers the classifier's prior knowledge, goal or ideals that may influence the formation of categories.

The goal-based view of the classification process contends that the goals of the categories are initially defined, the entities are then observed, and the categories are constructed accordingly (Durand & Paolella, 2013). As a result, entities that serve the same ideal or goal will be placed into the same category. Thus, two different entities (e.g., a hamburger and cake number 1) could be placed into the same category ("foods I like") because they serve the same goal (Do I like them or not?). Moreover, two virtually identical entities (cakes number 1 and 2) could be placed into different categories ("foods I like" and "foods I don't like") because they serve different ideals or goals.

In addition, studies of project portfolio management (PPM) provide excellent examples of goal-based classification. In PPM, organizations may decide to classify projects according to the degree of alignment of the goal with their strategy or objective instead of according to a project feature per se (Killen & Hunt, 2010; Project Management Institute, 2013). Thus, regardless of the project's features, projects in each category should align with one of the organization's strategies or objectives. Therefore, the features of the projects in a given category may differ greatly from each other but they all serve the goal the classifier established for that category.

In the wake of Barsalou (1983)'s work on goal-based classification, other researchers were inspired to pay more attention to the role of the classifier's knowledge in classification. In various experiments, researchers found that people can also impose category properties when they have prior knowledge about the relationships among an object's features (Spalding & Murphy, 1999). These findings opened the way to a more comprehensive view of the classification process, called the causal view.

4.3.3 The causal view

In his pioneering work, Barsalou (1991) found that not only are the classifier's knowledge, perception, and judgment used to construct goal-derived categories, they are also important factors for constructing other types of categories based on causal relationships or relational associations. Since then, several authors, particularly in cognitive psychology, have introduced the idea of causal classification (also known as the knowledge-based view) as an alternative view of the classification process (Ahn, 1999; Rehder, 2003a, 2003b; Rehder & Hastie, 2001). Like the goal-based view, the causal view also imposes prior properties on categories. However, in this case, the properties are causal relationships that some features in each category should demonstrate. Therefore, in addition to the similarity of features in each category, the causal relationships between some of those features largely determine how the categories are constructed.

In cognitive terms, the neural system is predisposed to detect regularities in sequences or groupings of similar objects without active exploration or effort (Hunt, 1982). According to the causal view, we assign more weight to features that are involved in known causal relationships. Subsequently, we construct categories so that their members not only have these heavily weighted features but also demonstrate a certain level of the causal relationship between them (Rehder, 2003b).

To illustrate, suppose we want to form a classification of birds and we have prior knowledge that birds fly and that their wings are the main enablers of flight. The causal view holds that the similarity of birds' characteristics to each other is not the only factor in the classification and that the *relationship to* the "ability to fly" is also a determinant for making categories. This view explains that, in light of our prior knowledge of this causal relationship, we will assign more weight to the features "having wings" and "ability to fly" than to other features (e.g., color or size). It also explains that we construct the categories based on different degrees of the causal relationship between these two heavily weighted features (the wings' contribution to the ability to fly). Thus, bird categories will be differentiated according to how well the wings enable the birds to fly. For example, penguins would not be classified in the same category as eagles, because penguins' wings do not contribute to their ability to fly. In an imaginary scenario, if a penguin's wings enabled it to fly, then according to the causal view, the penguin would be placed into the same category as eagles because it is only then that penguins correspond to the causal relationship for category membership.

An understanding of the causal view of classification process would be useful for making sense of how classification criteria are picked in project management contexts. As researchers and practitioners gain more experience and insight, they become aware of certain regularities in how projects are carried out in practice. By identifying these regularities in terms of causal relationships, they can pick the features involved in the causal relationship as the classification criteria and develop relevant project categories.

To illustrate, consider a case that, as project managers gain more experience, they will notice that having a good project planner is necessary for projects to be completed on time. The causal view argues that being aware of the causality between the "project planner" and "projects completed on time" constitutes prior knowledge and consequently influences how project categories are shaped. In this case, the categories can be shaped based on the degree of project planner's influence on the timing of projects' completion. Assuming that the project planner can change the priorities of project tasks and fluctuate the timing of projects' completion, the hypothetical final categories could be "projects with limited time fluctuation" (where project planners' influence on project time-line is limited), "projects with moderate time fluctuation" (where project planners moderately influence the time-line of the project) and "projects with high time fluctuation" (where project planners strongly influence the time-line of the project). In such a case, the projects in each category

demonstrate a certain degree of the causal relationship with the project planner's ability to influence the timely completion of each project.

Rehder (2003b) explains that, if a classification process implies causality between certain features, then neither the prototype nor the goal-based view can completely account for these interactions. However, by building on the other views, the causal view adds a complementary explanation of how humans construct different classification schemes. This explanation resides in the human ability to form concepts and connect them using the basic behavioral laws of regulation or perceived cause-and- effect. Nevertheless, because the classifier's knowledge may have been informed by different general theories (Murphy & Medin, 1985) or expertise (Cowley & Mitchell, 2003), different classifiers may focus on different patterns of events or features. Therefore, different classifiers may construct different classification schemes for the same entities when their knowledge of the relationships between the features differs.

We should also note that the relationship between prior knowledge and classification is not clear-cut, resembling the case of the chicken and the egg. This relationship works both ways: categories are shaped by our general knowledge, and new categories in turn shape our general knowledge (Murphy, 2002).

4.4 Identifying the classification process in project management contexts

We have reviewed different views of the cognitive classification process in order to better understand how we naturally pick classification criteria, form categories and construct classification schemes. We have explained that not all classifications are based solely on similarity of features, and that the complexity of the classifier's prior knowledge, in terms of goals or causal relationships, can give rise to different categories of entities. By providing some examples, we have illustrated how, according to the prototype view, it is only the features of individual projects that determine how the categories are formed. On the other hand, according to the goal-based and causal views, the classifier's knowledge may determine the classification criteria, which may not be the project features per se. These insights have given us a global understanding of how categories are formed and what they actually represent (Durand & Paolella, 2013).

In the following subsections, each view of the classification process will be used as a lens through which we examine how classification criteria are picked in project management contexts. Each subsection provides examples in which the selection of particular classification criteria can best be explained by a particular view of the classification process.

4.4.1 Prototype-based project classification

The prototype view argues that the intrinsic features of items constitute the only information that a classifier uses to classify the entities. Therefore, we hypothesize that classification schemes whose classification criteria are restricted to intrinsic project features must have used the prototype view in constructing their classifications. We interpret "intrinsic project features" as being features that belong only to the project (e.g., cost, size, etc.) and do not involve the project's organizational context and contingencies or the classifiers' goal and preference. We argue that the prototype view is the predominant view of the classification process in the project management literature. We found that the main assumption of authors in most project management studies is that projects with similar features should be placed into the same category. Although labeling of some project features as intrinsic is not a clear-cut task and different opinions may exist on a particular feature, some examples of common features used to construct prototype-based categories are:

- Project industry sector, project application area (Bubshait & Selen, 1992; Youker, 1999)
- Size of project, resource type (Payne & Turner, 1999)
- Geographic location, stage of the project life cycle, product (Youker, 1999)
- Contract type and life-cycle stage (Müller & Turner, 2007a)

Because the above classification criteria that are used in project classification include only the features which are not directly related to the classifier's goal, preference or knowledge about project organizational context and contingencies, we hypothesize that the prototype view best explains how the classification was formed. In the prototype view, the features of items are the only information one uses to create a classification scheme. The more similar the features of a new project are to the features of the prototype in a particular category, the more readily that project can be placed into that category.

In the literature, we found that many studies introduce some classification criteria for projects but do not specify a classification scheme (Archibald, 2003, 2004; Bubshait & Selen, 1992; Levene & Braganza, 1996; Müller & Turner, 2007a; Payne & Turner, 1999; Shenhar & Wideman, 1997). For example, Bubshait, and Selen (1992) suggested categorizing projects based on the two criteria of "industry sector" and "application area" but did not specify how many or what kinds of project categories they would create. Therefore, readers are not aware of their final classification scheme and are unable to place a new project into a single category that incorporates both features. Still, even in cases where the final scheme is not apparent, the prototype view implies that, if a new project involves the same industry and has the same application area as certain other projects, it will be placed in the same category as those projects.

In addition, a few project management studies have proposed a classification scheme without defining the differentiation criteria for the categories. In such cases, giving the author the benefit of the doubt, he may have assumed that the prototypes for each category were obvious to the audience and simply took the classification criteria for granted. For example, Archibald (2003, 2004) introduced some project categories such as "communication systems project," "information systems project, "product and service development project," "R&D project," etc. Because there is no explicit indication that Archibald incorporated any personal goals, preferences, or causal relationships as criteria, it would be more conservative to assume that he simply placed similar projects (in terms of project features) into the same category. Therefore, we hypothesize that it is the prototype view that best explains how projects are grouped together in a category.

4.4.2 Goal-based project classification

In this subsection, we argue that, if classifiers add a classification criterion based on their goals, ideals or preference, they have incorporated the goal-based process of classification. In goal-based classification, the classification criterion is the classifier's goals, ideals or preference, and not an intrinsic project feature per se. This criterion is derived from the classifier's knowledge of the goal that the category should fulfill, generally expressed in terms of alignment with the classifier's goal, mission, objective or preference.

In project management, project portfolio management (PPM) can be regarded as an example of a goal-based classification process. In PPM, organizations may decide to classify projects according

to the degree of projects' alignment with their **strategy** (Cooper et al., 2001; Killen & Hunt, 2010; Matheson et al., 1994; Project Management Institute, 2013), **organizational objectives** (Söderlund, 2005) or **organizational benefit or impact of projects** (Crawford et al., 2005). These classification criteria have been set by the classifier and are not a project intrinsic feature per se.

In such a goal-based classification, a classifier may also include other project features as classification criteria, but the classifier's goal, mission, or objective is the main basis for selecting those features. In other words, the classifier gain more conscious control over the selection of features as the classification criteria, instead of solely "letting" the features "express" themselves in category formation without the intervention of the classifier's interest. Accordingly, if there is a change in the classifier's goal, objective or preference, then regardless of projects' intrinsic characteristics, project categories may change.

To illustrate, consider a multilateral development bank (e.g., World Bank) that aims to select projects based on their impacts on the economy and health in developing countries. This organization would create a goal-derived classification scheme to put projects aligned with a particular goal in the same category. In such a classification, projects in the same category may differ in terms of intrinsic features (e.g., cost, size, geographic area). Thus, an "IT project" or a "plant construction project," although somewhat dissimilar in terms of features, could be placed in the same category if they pursue the same organizational objective (e.g., both contribute to the construction of a digitally controlled water treatment plant). Nevertheless, if organizational objectives change (e.g., to "focus on education in developing countries"), these two projects may end up in totally different categories. For example, an IT project related to education may be classified in "high-priority projects" and other construction projects may be classified as "low-priority projects."

Then again, consider a researcher who wants to classify five research projects (three related to project management and two related to supply chain management, with five different deadlines). The prototype view argues that, because the variability of "research area" is lower than that of "closeness to deadline," the researcher would construct the categories based on similarities in research area (all the project management projects in one category and all the supply chain projects in another). On the other hand, if the researcher chose the classification criteria based on his personal connections or preferences, goal-based categories will be constructed. For example, a

classification based on personal preference might put one project management related project and both supply chain projects into one category (“projects I love to work on”) and the rest in another category (“ordinary projects”).

In this type of classification scheme, the prototype view cannot explain why projects that are so different in terms of features are grouped together. The goal-based view explains that project features in a given project category may differ greatly because the items were not grouped on the basis of similarity of features but instead because they serve a common goal established by the classifier.

4.4.3 Causal project classification

In the causal view of the classification process, categories are differentiated based on different levels of causal relation among its features and each project in a category should demonstrate that specific level of causality among its features, or among project contingencies, in order to be included in that category. Rehder (2003b) explains that, if a classification process implies causality among certain features, then neither the prototype nor the goal-based view is sufficient to account for these interactions. In such cases, the causal view better explains how categories are shaped.

In this section, we point out the signs that show that a classifier incorporated the causal view of the classification process in classifying projects. These signs indicate the selection of classification criteria that may include a **relationship, linkage, or influence** between certain features or between features and an external factor such as a project contingency factor. The inclusion of such criteria when classifying projects shows that classifiers have incorporated their prior knowledge about the causal relations among project features or project features and context into the classification process. Therefore, it is the causal view of the classification process that is able to make sense of the underlying reason for selecting these factors as classification criteria.

A common example of causal-based classification is project or portfolio manager’ construction of project classification based on the dependency of tasks or work packages. In the project management literature, some other signs that the causal view of the classification process has been incorporated include using criteria such as:

- **Linkage** between core concepts and components (Henderson & Clark, 1990)

- Ambiguity of **logical relationships** in projects (McElroy, 1996)
- **Influence** of environmental changes and innovation on the project (Collyer & Warren, 2009)
- Historical and contextual **links** between project and organization (Engwall, 2003)

Among the studies mentioned above, Henderson, and Clark (1990) found the **linkage** between core concepts and components to be an important factor for distinguishing projects. As a result of this prior knowledge, they devised four categories: "project with incremental innovation," "project with modular innovation," "project with architectural innovation" and "project with radical innovation." Similarly, McElroy (1996) used the ambiguity of logical relationships in projects to classify projects as "soft projects" and "hard projects."

The study by Collyer, and Warren (2009), who proposed the classification of projects based on the "influence of environmental changes," is a fine illustration of how the classifier's prior knowledge of a causal relation is reflected in project classification. In that study, projects on which the environment has the same level of influence would be placed into the same category, indicating a clear causal relationship between "environment" and "risks." As a result, based on the increase in the level of this relation, the authors suggest that projects be classified as "operational projects," "classical projects" and "dynamic projects." Figure 4.2 provides the illustration of this classification scheme.

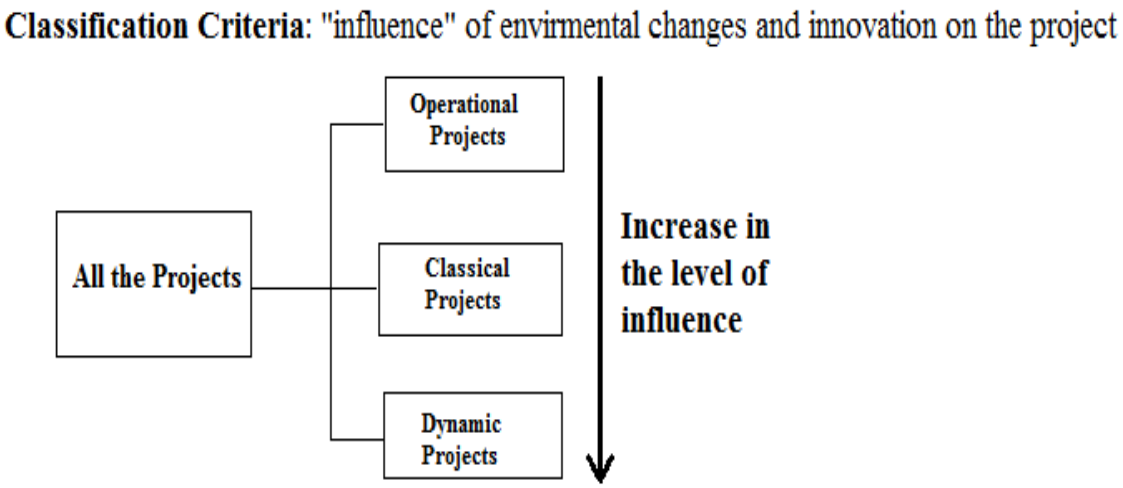

Figure 4.2 Example of causal-based project classification drawn upon Collyer, and Warren (2009)

In this type of classification, it is not enough to be familiar with the project characteristics or the relevant environment in order to categorize a project. It is the **relationship** between these two features that is most determinant in constructing categories. In this case, classifiers have prior knowledge of the causal relationship between environmental factors and projects, most probably based on earlier studies (Floricel & Miller, 2001; Killen & Kjaer, 2012; Müller, Martinsuo, & Blomquist, 2008; Pheng & Chuan, 2006; Thamhain, 2004; Turner & Müller, 2005). Thus, it is the causal view that best accounts for how such a classification criterion is chosen.

Moreover, some project management researchers may emphasize on **project contingency factors** to be as the classification criteria. Because project contingency factors are essentially based on the relationship between a project's features and its context, we argue that the causal view of the classification process best explains how the categories are shaped when project contingency factors are used as the classification criteria. As an example, consider the study by Engwall (2003), who argues that historical and contextual **links** between project and organization are contingencies influencing a project's interior process dynamics. These contingencies are "prestige of a project in the organization," "uniqueness of a project management approach" and "legitimacy of project managers." Accordingly, if a classifier decides to classify projects based on such contingencies (set these contingency factors as the classification criteria), it is not project features but the **causal relations of projects with those contingency factors** that determine how the projects are

categorized. Therefore, the classification process underlying this example can be explained by the causal view.

Some of the other project contingencies that are used to classify projects, just to name a few, include *complexity* (Davies & Mackenzie, 2014; Shenhar & Dvir, 2007), *uncertainty* (Howell et al., 2010; Loch et al., 2008), *risk* (Barki et al., 2001; Floricel & Miller, 2001) and *project institutional environment* (Dille & Söderlund, 2011; Scott, 2012). **The causal view of the classification process contends that the underlying reason behind the selection of these particular contingency factors as classification criteria is the classifier's prior knowledge, whether it is acquired from prior studies or personal experience, about the relation of these particular contingencies with other project features.**

4.5 Discussion and implications

We refer back to the original **purpose** of this paper: to open the black box of the classification process in order to explain *how and why some particular attributes are picked as classification criteria.* After our review of the different views of classification process, we are in a better position to answer this question. We explained that, in addition to the similarity of project features (prototype view), the classifier's goal or ideal can also be set as a particular classification criterion (goal-based view). Moreover, we pointed out that sometimes the classifier's knowledge, experience and expertise about a causal relation (among a set of project features or contingency factors) plays the main role in choosing selection criteria (causal view). Table 4.1 summarizes our discussion of how and why particular attributes are picked as project classification criteria.

Table 4.1 Different views of the classification process in context of project classification

Classification process	Prototype view (Rosch & Mervis, 1975)	Goal-based view (Barsalou, 1983)	Causal view (Rehder, 2003a)
Type of classification criteria	Project features	Personal or organizational goal or ideal	Causal relations/links within project features, or between project features and project contingencies
Why are such criteria picked?	The similarity of project features is what matters in defining a category	The classifier's goal that each category should fulfill is key	The demonstration of a causal relation/link in projects is what matters in defining a category
How are classification criteria picked?	Classifier observes the project features and picks the classification criteria based on their level of variability	Classifier reflects his/her own specific goals or ideals as the classification criteria	Classifier's prior knowledge about causal relations/links in the project management context is reflected in the classification criteria
How is a new project assigned to a category?	The project features are compared to the prototype of each category and projects that resemble the prototype are placed in the same category as the prototype.	Projects that fulfill the goal or ideal set for each category (by the classifier), will be placed in that category.	Projects that demonstrate the intended relation/causality among their features or context will be assigned to categories depending on the strength of the relation or causality.
Examples of classification criteria used	• Cost • Size • Scope • Industry sector • Application area • Resource type	Strategic alignment of projects' outcome with classifier's objectives, strategy or preference	• Project contingency factors • Influence of environmental changes and innovation on the project • Historical and contextual links between project and organization

Overall, by opening the black box of classification process and explaining what different classification processes represent in the project management context, we are better positioned to understand how and why particular attributes are picked as classification criteria. Still, we should note that each view of the classification process is the outcome of a gradual advance in the understanding of how and why we naturally categorize entities. Because humans are predisposed to combine different pieces of conceptual knowledge, it is difficult to formulate hypotheses and evaluate a comprehensive theory (Murphy, 2002). Accordingly, cognitive psychology field has focused on simpler experiments to explain the classification process one factor at a time. Each classification view has been built upon the experiments and findings of prior views. Neither the

goal-based nor the causal view refutes the prototype view, but they argue that, in addition to the similarity of features in each category, other important factors also determine how a classification is constructed.

Each view of the classification process can be perceived as a partial theory about how categories are naturally formed, which may explain the differences among the existing views. Therefore, we cannot assume that a single view of the classification process is sufficient by itself to completely account for all possible classification schemes (Murphy, 2002). Nevertheless, an understanding of the different views of the classification process and how they may be reflected in a project management context raises some theoretical and practical implications. We will discuss these implications in detail.

4.5.1 Theoretical implications

This research sheds light on a theoretical blind spot in project classification research, namely the lack of discussion about why and how a classifier picks particular criteria for making categories and classifying projects. To date, most studies have been explicit about the purpose of classification and the final classification scheme. But the classification process itself has remained a black box (implicit or unknown to audience). By integrating insights from the cognitive psychology literature into the modeling of project classification, this paper provides a more rational, coherent picture of how classification works and what factors affect the selection of classification criteria.

Moreover, by adding the missing link – project classification processes between – classification purposes and classification schemes, this paper answers Crawford et al. (2005) call to better explain *why* and *how* some organizations use the same classification criteria to fulfill different classification purposes or different classification criteria in pursuit of the same classification purpose. In their analysis of organizations that use some sort of project categorization system, Crawford et al. hypothesized that picking classification criteria is contextual and called for a more complex model of project categorization systems that would adapt to an organization's specific context. We argue that the insights from our study both address the puzzle of the relations between classification purpose and selection of classification criteria and also confirm the role of context in moderating between the two.

First, we contend that organizations with the same classification purpose may take different views of the classification process and therefore select different criteria for their classification. The reason is that organizations may have different levels of expertise or knowledge with regard to project features and contexts. Therefore, despite an intent to fulfill the same purpose, they might apply different classification processes depending on their goal or knowledge of the project world. This results in the selection of totally different classification criteria and the construction of different classification schemes.

Second, with the insights from the goal-based and causal views of classification process, we put forward the role of context in the selection of classification criteria. We have explained how the classifier's expectations and knowledge about the project and its context is reflected in the goal-based or causal classification process. Moreover, it is the classifier's awareness of the project context and contingency factors that enables him/her to pick a classification criterion such as "complexity," "environmental risk," or "influence of environmental changes and innovation on the project." The use of these kinds of classification criteria is derived from the classifier's expectations or knowledge of the project context. Therefore, integrating the classification process into the modeling of classification could explain the role of project context in the selection of classification criteria.

4.5.2 Practical implications

In terms of its **practical implications**, this research addresses some of the obstacles to using a project categorization system in practice that Crawford et al. (2005) highlighted. We argue that understanding how the classification process works can help organizations to reduce:

- Ambiguities, inconsistencies and multiple interpretations of categories
- Lack of visibility and legitimacy of projects outside of categories

According to Crawford et al., the primary obstacle to using a project categorization system in practice is **ambiguities, inconsistencies and multiple interpretations of categories**. The existence of such obstacles and the absence of agreed-upon project categories cause misuse of project management methods and tools and ultimately affect projects' outcomes (Archibald, 2004; Besner & Hobbs, 2012). Our research cuts through this problem, which is caused due by a lack of

information about how the classifier's goal and prior knowledge affect the classification process. We argue *that* ***classification is in the eye of the beholder***, meaning that category boundaries and sense-making depend on the classifier's level of knowledge, goals and ideals (Durand & Paolella, 2013). Thus, a lack of understanding about the possible logics underlying the classification process can result in ambiguities, inconsistencies and multiple interpretations of categories. Once the classification process is made explicit (by forming hypotheses about the underlying classification process), we can gain some insight into how researchers construct their categories, and the problems described above are reduced.

For example, both McElroy (1996) and Crawford, and Pollack (2004) both propose project classification schemes that include "soft projects" and "hard projects." By just looking at the category labels, we can see that each audience may interpret these categories quite differently, thus resulting in ambiguities, inconsistencies and multiple interpretations. However, McElroy's classification scheme seems to fit into the causal view because it incorporates causal analysis of the relationships among certain features, in that he uses the "ambiguity of logical *relationship*s" as a classification criterion. On the other hand, Crawford and Pollack's classification scheme may be better explained by the prototype view because it includes criteria such as "success measures" and "degree of participation," which are related to the characteristics of projects and imply that similarities among project features play a major role in categorizing projects. We can see that, by looking at classification criteria and deducing the underlying classification processes, we can reduce the ambiguities, inconsistencies and multiple interpretations of categories and clarify what the classifier intends in classifying projects in a particular way.

Another obstacle to using a project categorization system is the **lack of visibility and legitimacy of projects outside of categories**, meaning that projects that do not fit into project categories do not receive adequate attention from organizations and/or users. This problem ultimately results in poor project performance (Crawford et al., 2005). This problem in project management is in line with the finding presented in the category research literature that the greater the mismatch between the shared understanding/expectations of the classifier (e.g., Amazon.com, which provides a product classification) and the external audience (e.g., Amazon.com users, who have certain expectations of a product category), the less legitimate the category becomes for the people who use that classification. As the result, an organization or a product can receive unfavorable feedback

from its audience/users (Hannan et al., 2007; Lounsbury & Glynn, 2001; Navis & Glynn, 2011; Wry et al., 2011).

Similarly, the greater the mismatch in "what a project category should represent" between the project classifier (e.g., a program manager who classify projects into different categories) and category audience/users (e.g., project finance managers who allocates a budget to projects in different categories), the less legitimate and visible a project category becomes. As a result, projects in that category may not have access to project resources or sufficient budget.

Recently, by bringing various classification processes into the picture, Durand, and Paolella (2013) argued that the main reason for mismatches between the classifier's and the external audience's understanding/expectations of a category is their *capacity, through prototyping, goal-based or causal view, to make coherent sense of the categorical combinations*. Because the classifier and external audience have different levels of knowledge, goals or ideals and limited cognitive resources, a mismatch between their expectations may arise (Baum & Lant, 2003; Porac, Thomas, Wilson, Paton, & Kanfer, 1995).

Clearly, then, a shared understanding of the underlying classification process can bring an organization's categorical sense-giving and its audience's categorical sense-making closer and reduce the mismatch (Rhee, 2014). Accordingly, the explanation we present of in this paper about the signs of different classification processes (possible project classification criteria selected by each view) could help the audience/users in project management capture classifiers' intended category meanings. Consequently the mismatch between their expectations of project categories may reduce and project visibility and legitimacy increase.

For example, consider a researcher who must submit a project proposal to a government agency. If all the agency's project classification criteria are intrinsic to projects or it provides examples of each of its project categories (e.g., research projects categorized as "high chance of funding" are ones that (a) focus on project organization, (b) involve empirical surveys, and (c) have two Ph.D. students as members), the researcher would identify the underlying classification process as prototyping. Therefore, it would be wise to present a project that is sufficiently close to the prototype target category to be categorized in it.

On the other hand, if a funding agency's classification scheme is built around a classification criterion that represents the classifier's goal or ideal (e.g., projects get funding if they have a high social impact related to poverty, regardless of the area of research, whether they are empirical or theoretical, or the number of researchers involved), the agency's underlying classification process would be goal-based. Therefore, by focusing on the goal the project should fulfill, the researcher should be able to place the proposed project in the target category and gain the expected visibility and advantages that all projects in that category have access to. Similarly, if the classification centers on a criteria that represents a relation among features (e.g., Ph.D. students should handle at least 50% of the workload in an empirical survey), the researcher will be in a better position to comply with the classifier's causal classification. Therefore, it is more advantageous to propose a project that focuses on young researchers' contributions in order to increase the chance of being categorized as "high chance of funding."

By understanding different classification processes and being able to identify different kinds of classification criteria, one's expectation of what a particular project represents or how it should be handled will be more in line with what the project classifier expects of categories. This contributes to closing the mismatch between the audience's expectations of categories and what the classifier actually had in mind when making those categories. As the result, a project will be appropriately placed within the classification scheme and its visibility and legitimacy will increase.

Nonetheless, it is worth mentioning that, because classifiers' preferences (regarding goals or ideals) and knowledge of project contingencies are different, different classifiers may focus their attention on different classification criteria. Therefore, there is no universal recipe for picking the appropriate classification criteria. Accordingly, researchers who want to create a classification scheme or use a pre-existing one should not take any existing classification criteria or classification scheme, even popular ones, for granted. By understanding different classification processes, researchers become more aware of the "differences that make a difference" in making a classification. As a result, a researcher or organization that wants to create a project classification should first examine and evaluate its own project-specific context and see what kind of project features or contingencies are important and make sense in that specific context. Second, classifiers should verify whether their selected criteria help them fulfill their initial classification purpose. If they do, we can conclude that the classification criteria were appropriate for classifying the projects. Likewise, researchers

who want to use an existing classification, are in a better position to verify that their goal, ideals, preferences or knowledge of causal relations in projects is reflected in the classification criteria and the classification scheme they choose to use.

4.6 Conclusion

The main argument put forward in this paper is that different views on the *classification process* provide insight into the unknown or implicit reasons that one might have to pick particular attributes as project classification criteria. By presenting the prototype, goal-based and causal views, we have explained that it is not always project features such as project size or cost that are important in the classification process; rather, the classifier's goals or ideals, knowledge and causal inferences can add some other classification criteria that change how projects are classified.

This research makes some important contributions to the project management research and practice. The main theoretical contribution is the integration of insights from cognitive psychology into the modeling of project classification. By inserting the missing link of project classification processes between classification purposes and classification schemes, we provide a more rational, and coherent picture of how project classification works in terms of picking the classification criteria. Moreover, we have brought the project context into the big picture of classification by elaborating on how the classifier's knowledge of the relation between a project and its context affects the selection of classification criteria.

The practical contribution of this research is to help organizations in addressing some of the main obstacles to using categorization in project management practice. We argue that understanding and identifying classification processes will reduce the ambiguities, inconsistencies and multiple interpretations of project categories and help people increase their projects' visibility and legitimacy within an already established classification scheme.

We hope that our review of prior work in the category research literature and the insights from this paper will provide project management scholars with a useful toolbox for future research on project classification, which has long been understudied. Future studies could involve empirical investigations to identify and examine subgroups of classifiers who share a common understanding of the causality of a particular project management concept. Such studies should contribute to a

better understanding of how differently the classification process works in different subgroups with different characteristics.

CHAPTER 5 ARTICLE 2: LOUDER THAN WORDS: UNCOVERING SHARED UNDERSTANDING IN THE PROJECT MANAGEMENT CONTEXT

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Abstract

Although individuals may refer to the same label of a project category, their perception and understanding of those categories may significantly differ from one another.

We argue that a particular methodology is required to capture the complex, multivariate configuration of features underlying the 'shared understanding' of project categories. Accordingly, we initially identified groups of individuals with a shared understanding of a particular category and then uncovered the 'configurations' underlying those shared understandings.

By identifying points of disagreement about the meaning of categories, this study help effective use of project categorization systems in practice and theory development of project management.

Key words: Project category, Project classification, Category perception, Project success, Perception of project success

5.1 Introduction

The project management literature abounds with studies that used or developed some sort of classification for projects. Small vs. large projects, complex vs. simple projects, successful vs. failed projects, and R&D vs. construction projects are some examples of project categories[2] that researchers or practitioners use to categorize their world of projects. As in many other scientific fields, categories in project management serve as a rich source of inferences (Haslam, Rothschild, & Ernst, 2000) that lay the ground for developing middle-range theories (Andersen, 2006; Besner & Hobbs, 2004; Turner & Cochrane, 1993). By conducting research about the same categories of entities, researchers are able to appropriately map and compare their research results with previous experiments and theories the scope of which is limited to the same category as theirs. For example, two researchers in project management would need to select the same project category (e.g., R&D projects) in order to compare, confirm or reject their results, and come up with a hypothesis or theory about R&D projects. As a result, researchers better understand and communicate about the phenomenon they are studying, and knowledge sharing and accumulation is improved (Söderlund, 2004, 2011a, 2011b).

However, as much researchers might like to work with well-defined, clear-cut categories, categories in the social sciences, including project management, are anything but. In social science in general, categories are considered to be artefacts of human perception (Carroll, 1984; Hannan & Freeman, 1977; Ketchen & Shook, 1996) influenced by the social environment (Berger & Luckmann, 1966). Advancements in cognitive science and sociology show that people may agree on the label of a category but they may have different perceptions or interpretations of it (Goldberg, 2011). In other words, in answering the basic question ‘what is that?’ (in referring to a particular category label), not all individuals have the same conceptual representations. For example, people may refer to political categories such as ‘liberal’ or ‘conservative’ but they may not have the same idea of the particular attributes that construct those categories. People who label themselves as ‘liberal’ may use different causal bundles of attributes (different levels of government spending or

[2] Also referred to as ‘project types’.

different stands on social issues such as gender equality) to describe what the category of liberal persons should include.

In view of the heterogeneity of perceptions and understandings of categories, cognitive scientists contend that categories in human minds are fuzzy and cannot be limited to a rigid set of characteristics or clear-cut definition (Barsalou, 1987; Rosch, 1975). Likewise, a review of project management studies that proposed or used some sort of project classification suggests that heterogeneous perceptions and understandings can be observed in numerous project categories, meaning that people may refer to the same project category 'label' (e.g., complex projects, innovative projects, large projects, etc.) without any clear consensus about the definition and characteristics of those categories (Niknazar & Bourgault, 2017a). For example, both McElroy (1996) and Crawford, and Pollack (2004) refer to the categories of 'soft projects' and 'hard projects' in their studies. However, McElroy uses classification criteria such as 'ambiguity of logical relationships' while Crawford and Pollack construct their categories with criteria such as 'success measures' and 'degree of participation'. This illustrates how a universal understanding of a particular project category label remains difficult to reach.

The existence and consequences of heterogeneous perceptions and understandings of the same category have been addressed in many empirical studies in cognitive psychology, sociological studies and management science. Many studies have shown that multiple interpretations and confusion about category meanings lead individuals to ignore or devalue products or organizations (Hannan et al., 2007; Hsu, 2006; Leung & Sharkey, 2013; Paolella & Sharkey, 2016; Zuckerman, 1999). For example, in the film industry, Hsu (2006) showed that confusion and lack of consensus among movie critics as to how to classify films reduces the appeal of movies and consequently has a negative effect on their performance at the box office. Likewise, in the financial industries, Zuckerman (1999) showed that a mismatch in the perceptions and expectations of stock critics results in a considerable discount in an organization's stock price.

Similarly, in the project management context, heterogeneous perceptions and understandings of project categories create confusion and multiple interpretations of the same category label. Crawford et al. (2005) contend that confusion and multiple interpretations of project categories constitutes a major obstacle in using a categorization system in practice. Moreover, they found that

confusion about a project's category can make it difficult for that project to access appropriate resources and increase the risk that it will be disregarded in an organization.

Despite the existing body of research highlighting the importance and implications of considering respondents' heterogeneity in perceiving and understanding categories, the project management community seems to have largely ignored this question. This paper aims to tackle the challenge by proposing an empirical investigation using a set of data collected from professional project managers. More specifically, the main objective of this research is to *uncover managers' heterogeneous perceptions of project categories.* Because heterogeneity of perceptions is the corollary of the existence of different shared understandings of the same category (Goldberg, 2011), the objective of this research can also be interpreted as *revealing different groups' distinctive shared understandings of the same project category*.

We argue that shared understanding of a project category inheres in the cognitive 'configuration' that different groups focus on among the category's various features. As a result, shared understanding is *louder than words* in describing a category. Accordingly, after discussing the cognitive process underlying the development of shared understanding, we use a two-stage methodology to identify like-minded individuals and the configuration underlying their shared understanding. First, a well-known and widely used method, namely cluster analysis, is used to identify groups of like-minded individuals who share the same understanding of a particular project category. Second, to identify and compare the configurations of shared understanding in each of the identified clusters of respondents, a multinomial logit regression model, which deals with categorical outcomes, is used to identify the important variables (i.e., most predictive variables) in assigning a project description to a given category label. These configurations are viewed as proxies for cognitive structures underlying the existence of different shared understandings of the same category.

The suggested methodology was examined and implemented in a project management setting with two categories: 'successful projects' and 'less successful/problematic projects'. Uncovering the configurations underlying the shared understanding of some critical project categories constitutes an essential step for different groups to comprehend each other's perceptions and find out about each other's points of agreement and disagreement with regard to the meanings they attach to those categories.

By using the methodology applied in this paper, project management researchers can verify whether they are referring to the same project categories in their studies. Consequently, study results and theories should be fairly comparable, thereby allowing the project management field to move toward developing more unified middle-range theories (Packendorff, 1995), which focus on a particular project type. Moreover, the insights from this research will help practitioners increase the legitimacy of project categories among different groups inside an organization. As a result, projects will have a higher chance of being placed in their target category.

This article is organized as follows: in the next section, we review the cognitive processes underlying the perception of categories and introduce cluster analysis as an appropriate method to uncover distinctive shared understandings. Then we present the methodology for implementing cluster analysis in a real-world project management setting, followed by the empirical results. We then discuss and elaborate on the originality and implications of this study and the path forward for this research stream. We conclude by presenting an overview of the insights emerging from this study.

5.2 Research background

5.2.1 Cognitive process behind the development of shared understanding

What are 'categories', really? That is a question that philosophers and scientists have long struggled to address. Building upon Aristotelian logic, philosophers assumed for centuries that all natural phenomena have a fundamental essence by which they can be named and subsequently grouped (Blau & Scott, 1962; Parsons, 1956; Perrow, 1967; Thompson, 1967b). In this classical view, by formulating a specific definition for every category, humans should be able to easily put entities in clearly bounded, non-overlapping categories (Apostle, 1980).

However, over the last decades, researchers in cognitive psychology have found that it is hard to formulate a precise, clear-cut definition of categories; rather, categories constitute cognitive artefacts that remain rather fuzzy and overlapping (Barsalou, 1987; Rosch, 1975). Accordingly, new lines of research in cognitive psychology have emerged that focus on the evaluation of category development and membership from a cognitive perspective (Murphy, 2002).

In one of the most advanced and comprehensive developments in this regard, known as the *causal-based view* of classification, cognitive psychologists explain the role of individuals' prior knowledge, in the form of the multiple causal associations among features, in the construction and perception of categories (Ahn, 1999; Rehder, 2003a, 2003b; Rehder & Hastie, 2001). According to this view, features that are perceived to be involved in a causal relationship will have more weight in category construction. Consequently, each category not only has certain heavily weighted features but also demonstrates a certain level of the causal relationship between those features (Rehder, 2003b).

To illustrate, consider a project management researcher or practitioner who, through empirical research or by gaining more practical experience, gradually becomes aware of certain causal relations in how projects are conducted and managed. The causal view argues that he or she is more likely to construct a project category scheme based on the project features which were perceived to be involved in the detected causal relationship (Niknazar & Bourgault, 2017a). For example, using project contingency factors as the classification criteria, such as complexity (Davies & Mackenzie, 2014; Shenhar & Dvir, 2007) or uncertainty (Howell et al., 2010; Loch et al., 2008), is an indication of incorporating prior knowledge about the causal relations among project features and their context into the process of cognitively constructing project categories.

Although the causal-based view can explain the complex comprehensive process of category emergence, it also states that one cannot assume *a priori* the existence of consensus about which features audiences attend to and incorporate into a causal process to perceive a particular category (Durand & Paolella, 2013; Murphy, 2002). The reason is that each person is likely to possess a different overall view of the world (Murphy & Medin, 1985) and different expertise (Cowley & Mitchell, 2003). Moreover, people may refer to the same concept, but at different levels of abstraction (Lawrence, Kudyba, & Klimberg, 2007). Consequently, although many people may use the same category label (e.g., complex projects, successful projects), they may have used different cognitive causal processes to perceive and understand that category (Murphy, 2002).

Building upon the advances in cognitive psychology, there is a particular field of research in sociology that evaluates human perceptions and the meaning people attach to categories (Ketchen & Shook, 1996). This line of research rests on the basic assumption that categories are socially constructed realities (Berger & Luckmann, 1966) and assumes that groupings of phenomena have

no existence outside of human perception (Carroll, 1984; Hannan & Freeman, 1977; Ketchen & Shook, 1996).

Sociologists have long been involved in analysing the perceptions and understandings of different groups of individuals to identify cultural meanings (Mohr, 1998) or political stands (Converse, 1962). For example, Converse (1962) examined multiple belief systems that voters rely on in forging their political positions, and Goldberg (2011) examined how people refer to the same musical genres while having different understandings of them. In other words, different groups exist within society that have different shared understandings of what jazz is. In such studies, researchers identify different perceptions and understandings that individuals associate with each category by their positions or opinions vis-à-vis some criteria (Mohr, 1998). As a result, sociologists view *categories as repertoires of shared understanding* among groups of people (Goldberg, 2011), meaning that distinctive belief systems (Converse, 1962) and distinctive shared understandings of the same categories exist (Baldassarri & Goldberg, 2014).

Shared understanding is usually demonstrated by distinctive causal bundles of attributes, also referred to as *configurations* (Abbott, 2001; Abbott & Hrycak, 1990; Ragin, 2000), that lead to the same outcome (Ragin, 1987). These configurations emerge from respondents' positions, opinions or perceptions in respect of different criteria, when they think of a particular category (Garip, 2012).

5.2.2 Uncovering heterogeneity of perceptions and understandings with cluster analysis

In order to discover the heterogeneity of perceptions and understandings among different groups of people, cluster analysis has been widely used and tested (Garip, 2012). Cluster analysis assigns observations to homogeneous groups (i.e., clusters) so that entities within each group are similar to one another with respect to the variables of interest (important dimensions), and the groups themselves are distinct from one another (Tryfos, 1998). In essence, clustering is similar to statistical factor analysis except that, rather than trying to group variables together, it groups observations.

A major reason for the popularity of cluster analysis is its advantages over linear regression models, which aggregate observations and then use the average differences to arrive at a conclusion. As a

result, the heterogeneity of observations is reduced to a singular regression line and is often lost (Garip, 2012). However, cluster analysis recognizes the heterogeneity of observations and, before applying further analysis, groups the data into clusters.

For example, consider a case where a researcher has administered a questionnaire in which respondents are asked their opinion of different dimensions of an innovation project. In this case, a linear regression model would aggregate the respondents' scores and calculate average scores for each variable. Consequently, the results can be presented in such a way as to show that certain characteristic are important factors for a project to be labelled as innovative. Although this common practice is an appropriate and very useful way of answering certain research questions, it relies on the implicit assumption that all respondents have an identical understanding of innovation projects, and thus that, by taking their average view, this universal understanding can be revealed. On the other hand, cluster analysis discovers distinctive combinations of dimensions (configurations) that can capture the heterogeneity of observations and, as a result, parse out different groups of like-minded individuals who share a common understanding of innovation projects.

Cluster analysis has also been extensively used in organizational and management science, such as when one wants to find firms that share a common configuration along conceptually distinct variables (Ketchen & Shook, 1996). Such studies aim to find different sets of features that characterize different organizational structural types. They use different labels, such as *organizational configurations* (Meyer, Tsui, & Hinings, 1993; Miller & Mintzberg, 1981; Mintzberg, 1979), *organizational typologies* (Miles, Snow, Meyer, & Coleman, 1978), *strategic groups* (Hatten & Hatten, 1987), *taxonomies* (Galbraith & Schendel, 1983)) and *archetypes* (Miller & Friesen, 1978)). Similarly, some project management studies have also used cluster analysis to find project taxonomies and configurations. For example, Lechler, and Dvir (2010) used the k-means clustering method to build a taxonomy of project management structures, and Dvir et al. (1998) used Linear Discriminant Analysis to cluster 110 observations of project groups.

Overall, cluster analysis captures the heterogeneity of observations and reveals the distinctive configurations underlying them. Accordingly, it has the potential to capture the complexity of reasoning systems and as a result, identify groups of like-minded individuals who share an understanding of a particular project category. That is why, in this paper, to fulfil our objective of *uncovering the heterogeneity of respondents in perceiving and understanding categories in a*

project management context, we use cluster analysis. In the following section, the process by which cluster analysis is implemented in the context of project management is explained.

5.3 Methodology

In this section, first the research design of the empirical experiment conducted to fulfil the study's research objective is explained and then the specific characteristics of data and variables used in the experiment are explored.

5.3.1 Research Design

As a first step in designing the proposed empirical experiment, a project category was selected from among numerous possibilities. In line with our objective, the main criterion was the lack of consensus about this category, that is, the existence of different understandings and perceptions of it.

By examining the project management literature, it appears that the categories of 'successful projects' and 'problematic/less successful projects' correspond to this criterion**.** Since the seminal work of Pinto, and Slevin (1987) in identifying project success factor and project success criteria, many valuable studies have explored project success factors, success measures and the relationship between these two (Belassi & Tukel, 1996; Butcher & Jeffrey, 2007; Cooke-Davies, 2002; Gemünden & Lechler, 1997; Joslin & Müller, 2016b; Lechler, 2000; Lim & Mohamed, 1999; Morris & Hough, 1987; Munns & Bjeirmi, 1996; Shenhar, Tishler, Dvir, Lipovetsky, & Lechler, 2002; Turner & Müller, 2005; Wateridge, 1998). However, there is still no consensus about what defines the categories of successful or less successful projects (Davis, 2014, 2016; Ika, 2009; Jugdev & Müller, 2005; Müller & Jugdev, 2012). Moreover, because these multidimensional categories remain vague and ambiguous (Belassi & Tukel, 1996), a new and significant avenue of research has emerged in project management literature, referred to as the *subjectivist* approach (Ika, 2009). The basic argument of the subjectivist approach is that categories of successful or failed projects are social constructs that are perceived differently by different individuals or stakeholders (Baker, Murphy, & Fisher, 2008; Davis, 2017; Ramos & Mota, 2014). Therefore, these categories should be evaluated at level of individuals (or group of like-minded individuals), particularly from

a cognitive perspective, in order to shed light on the configurations that caused of the heterogeneous perceptions and understandings of these categories.

Accordingly, after choosing successful projects and problematic/less successful projects as our categories of interest, we empirically implemented a methodology to:

1. Separate the different subgroups of respondents with a shared understanding of the chosen categories
2. Uncover the distinctive configurations (of characteristics) that each subgroup incorporates in its understanding of those categories

Accordingly, a popular clustering method called the k-means method was selected, as it has been widely used and tested in the social sciences, and particularly management-related studies. K-means clustering is a classic algorithm that presupposes the existence of *k* number of clusters, and tries to minimize the within-cluster variance by updating cluster memberships (Hastie, Tibshirani, & Friedman, 2009). The result of k-means clustering is the identification of groups of like-minded individuals, each forming a cluster.

Further, to uncover the underlying configurations, the response of each cluster of like-minded individuals is further analysed with the multinomial logit regression method. Contrary to linear regression models, which deal with continuous outcomes (e.g., level of success in a project), multinomial logit regression is designed to deal with categorical outcomes (e.g., whether the respondents labelled a project as successful or not). The result of a multinomial logit regression is a list of characteristics that distinguish one cluster (or subgroup) of respondents from another in the labelling process. It is assumed that the 'meaning' that individuals assign to a category resides in the relationships among the dimensions they use to describe that category (Martin, 2000; Mohr, 1998). As a result, sociologists view these bundles of important variables as the 'configuration' underlying like-minded individuals' shared understanding of a given category (Garip, 2012; Goldberg, 2011). Figure 5.1 depicts the research design of this study.

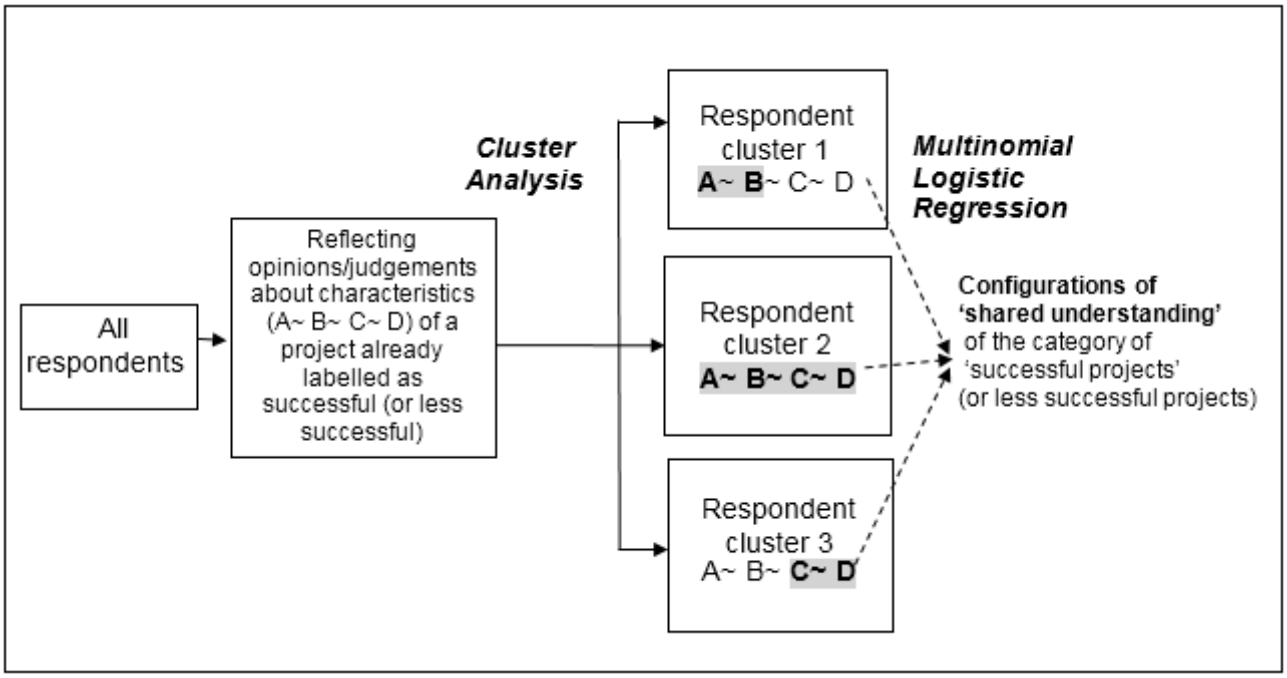

Figure 5.1 Research design of this study

In Figure 5.1, A, B, C and D are hypothetical variables describing the context of project management when respondents were thinking of a successful (or less successful) project that they had experienced. Cluster analysis identifies different clusters of like-minded individuals; the variables in boldface reflect the hypothetical configuration underlying the understanding of that project category shared by respondents in each cluster.

5.3.2 Data

After selecting the categories of interest, the second step is to gather data about individuals' perception of those categories. The data for this study come from a questionnaire administered by Daoudi (2010), which was sent to project managers and professionals, mainly working in distributed teams in the telecommunication and electronics sectors. For the purpose of this survey, respondents were asked first to identify *a successful project* and a *less successful or problematic project* and then to assess a certain number of statements about various dimensions of the projects they had experienced.

It is worth mentioning that the pairwise type of questionnaire has its roots in the SAPPHO[3] methodology proposed by Rothwell and his colleagues in the 1970s (Rothwell, 1974; Rothwell et al., 1974). Since then, it has been used extensively in several fields including innovation management (Maidique & Zirger, 1984; Radosevic & Yoruk, 2012). This type of questionnaire involves dual comparisons of the characteristics of two innovations, one that respondents consider to be successful and the other considered to have failed (or been less successful). This strategy aims to find areas of contrast and similarity (Maidique & Zirger, 1984). Similarly, Daoudi (2010) asked respondents to initially identify a successful project and a second less successful one and then assess various dimensions for each category (no specific instructions were given regarding the definition of 'successful'). By analysing the respondents' perceptions in describing a project labelled as successful (or less successful), we try to identify the configurations underlying the labelling of those projects. This kind of analysis is in line with some sociologists' assumption that the labelling of an entity (in this case, projects) inheres in the relationship among the dimensions of that category (Goldberg, 2011; Martin, 2000; Mohr, 1998).

Figure 5.2 illustrates a portion of the questionnaire used to measure respondents' perception with regard to the level of managerial support. Respondents' opinions of different aspects of the project, project team and organization were measured with standard 7-point Likert scales.

[3] SAPPHO stands for Scientific Activity Predictor from Patterns with Heuristic Origins.

D3. To what extent do you agree with the following statements?		
	The «successful» project	The «less successful or problematic» project
	1: DISAGREE completely *4: AGREE somewhat* *7: AGREE completely*	
The project team had the necessary autonomy to work efficiently.	1 2 3 4 5 6 7	1 2 3 4 5 6 7
The project team was given the training it needed to function well.	1 2 3 4 5 6 7	1 2 3 4 5 6 7
The project team had access to the material resources it needed to facilitate effective work.	1 2 3 4 5 6 7	1 2 3 4 5 6 7
The project team had access to additional human resources when needed.	1 2 3 4 5 6 7	1 2 3 4 5 6 7
The project team used common frameworks, processes, and systems.	1 2 3 4 5 6 7	1 2 3 4 5 6 7
Decision-making process was well adapted to the context of work.	1 2 3 4 5 6 7	1 2 3 4 5 6 7
Support by senior management was comparable for all sites participating in the project.	1 2 3 4 5 6 7	1 2 3 4 5 6 7

Figure 5.2 Part of the questionnaire designed by Daoudi (2010)

5.3.3 Choosing the relevant dimensions

It is nearly impossible to harness and consider all of a project's intrinsic, organizational and contextual attributes in a single study, therefore, researchers must necessarily select certain aspects or dimensions in order to fulfil a study's purpose (Ketchen & Shook, 1996). Initially, 62 questions were selected that specifically asked about different themes concerning respondents' perceptions of the selected projects (successful projects and less successful projects). Further, to aggregate and identify interpretable variables, the selected questions were analysed through a series of factor analyses (varimax rotation), and 9 variables were derived. These derived variables represent different dimensions of the project, project management team and context. Table 5.1 shows the number of questions in each theme and the derived variables in each one.

Table 5.1 Questionnaires and derived variables

Theme	Initial number of questions	Variables
Organizational and managerial support	8	Management support
	6	Leadership
	6	Participation in decision making
Dynamic of project team	6	Flexibility of project team
	5	Engagement of team members
Collaboration	6	Coordination among team members
	9	Communication within project team
Competence of project teams	7	Confidence of members
Project performance	9	Project performance

Because the study comprises two data sets, the reliability and validity of each derived variable were tested in each set separately. In terms of reliability, Cronbach's alpha for each set of questions was > .6. As for validity, two separate Confirmatory Factor Analyses (CFA) were run through each data set. The results confirmed that the introduced variables were also validated in each data set: Comparative Fit Index (CFI) = 0.918, 0.940 (>.9), Tucker-Lewis Index (TLI) = 0.907 and 0.933 (>.9), Root Mean Square Error of Approximation (RMSEA) = 0.072 and 0.061 (>.6)). Further, to prepare the data for the cluster analysis, as suggested by Garip (2012), we verified the correlations in each data set and removed the highly correlated variables (>.7) from both. Table 5.2 shows the results of the correlation analysis.

Table 5.2 Correlation results

Successful Projects*									
	1	2	3	4	5	6	7	8	9
1. Management support	1								
2. Leadership	0.62	1							
3. Participation in decision making	0.57	0.70	1						
4. Flexibility	0.59	0.63	0.64	1					
5. Engagement	0.36	0.46	0.44	0.53	1				
6. Coordination	0.64	0.75	0.59	0.71	0.50	1			
7. Communication	0.51	0.58	0.63	0.68	0.56	0.74	1		
8. Confidence	0.32	0.35	0.36	0.50	0.35	0.59	0.60	1	
9. Project performance	0.56	0.55	0.59	0.67	0.48	0.61	0.59	0.48	1

** Pearson test*

Less Successful/ Problematic Projects*									
	1	2	3	4	5	6	7	8	9
1. Management support	1								
2. Leadership	0.63	1							
3. Participation in decision making	0.57	0.69	1						
4. Flexibility	0.45	0.62	0.60	1					
5. Engagement	0.38	0.55	0.49	0.49	1				
6. Coordination	0.56	0.70	0.52	0.67	0.44	1			
7. Communication	0.47	0.43	0.33	0.29	0.20	0.51	1		
8. Confidence	0.35	0.39	0.32	0.46	0.50	0.56	0.48	1	
9. Project performance	0.37	0.51	0.42	0.44	0.44	0.57	0.43	0.59	1

** Pearson test*

Based on the correlation results, for respondents describing a successful project, we eliminated leadership and coordination because they were highly correlated with and other variables. In order to have identical sets of variables for both databases, we eliminated the same variables for the database describing less successful/problematic projects as well. In total, seven variables were selected to be entered into the clustering algorithm. In analysing the selected variables, we arrived at 103 observations describing a successful project and 98 observations describing a less successful

or problematic one. A summary of descriptive statistics of the selected variables in each of the categories is presented in Table 5.3.

Table 5.3 Descriptive statistics of model variables

	Successful Projects					Less Successful/Problematic Projects				
	Min	*Median*	*Mean*	*Max*	*SD*	*Min*	*Median*	*Mean*	*Max*	*SD*
Management support	2.50	5.51	5.47	7.00	0.97	1.59	4.75	4.70	7.00	1.18
Participation in decision making	3.00	5.64	5.56	7.00	0.93	2.00	5.00	4.81	7.00	1.30
Flexibility of project team	2.24	5.32	5.35	7.00	1.04	1.29	4.76	4.66	7.00	1.35
Engagement of team members	2.50	6.50	6.00	7.00	1.07	1.50	4.75	4.78	7.00	1.59
Communication within project team	2.34	5.64	5.35	7.00	1.06	1.00	4.30	4.29	7.00	1.28
Confidence of members	2.43	5.50	5.35	7.00	1.13	1.60	4.46	4.47	7.00	1.37
Project performance	2.42	6.00	5.97	7.00	0.87	1.00	4.50	4.33	7.00	1.55

5.3.4 Choosing the number of clusters

Use of the k-means clustering method requires one to choose the number of clusters *a priori* (Hastie et al., 2009; Tibshirani, Walther, & Hastie, 2001). Determining the appropriate number of clusters is not a straightforward task because, on the one hand, we are interested in making distinctions between entities when clustering them, and on the other hand, clusters should be perceived as sufficiently similar or homogeneous (Bowker and Star, 2000). In other words, in determining the number of clusters, researchers must respect a trade-off between *homogeneity* within clusters and *distinctiveness* among clusters.

In choosing the appropriate number of clusters, we relied on a widely used numerical method that applies a rule of thumb to determine the number of clusters. Known as the *Elbow method*, it calculates the sum of squared errors (SSE) for each number of predetermined clusters by aggregating the distance of observations from the centroid of their cluster (Gordon, 1999; Milligan & Cooper, 1985; Tibshirani et al., 2001). In some regards, the SSE represents how homogeneous the clusters are, while the number of clusters represents how much distinction we are making among the observations. Furthermore, in the line chart depicting the level of SSE for each number of clusters, the 'elbow' usually represents the place where SSE drops and remains almost the same (or drops more slowly) afterwards. The elbow can be viewed as the minimum number of clusters,

which homogeneity of the cluster will not significantly increase any further. Figure 5.3 shows the implementation of this method in our data set to find the optimal number of subgroups of respondents in each given category.

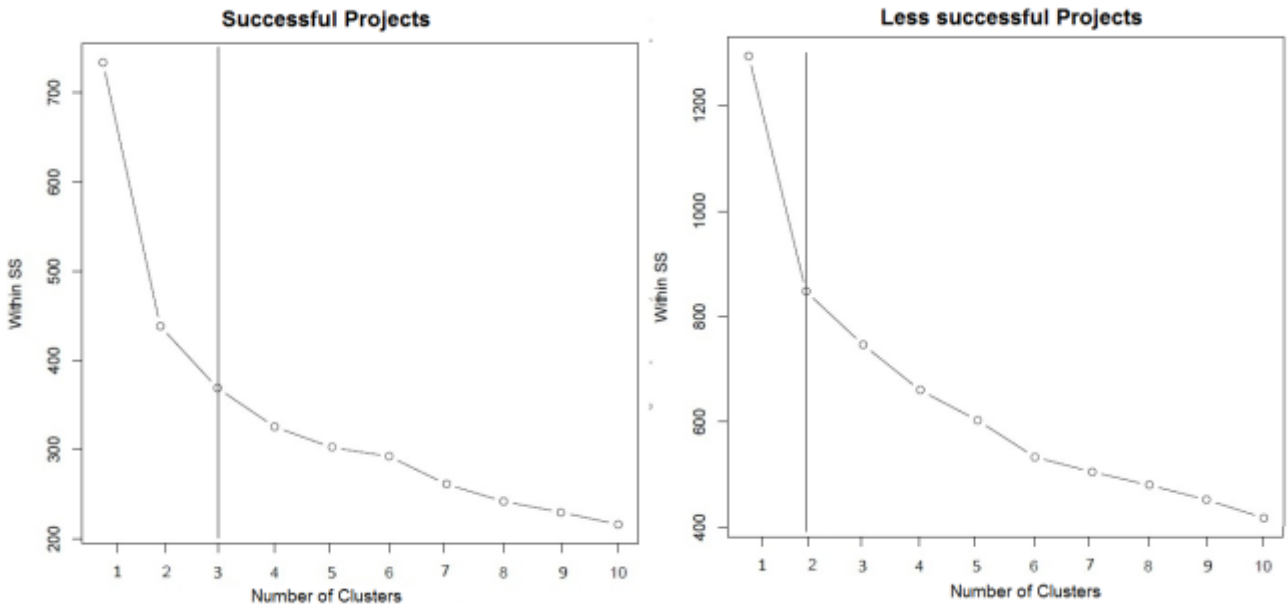

Figure 5.3 Selecting the initial number of clusters

As illustrated in Figure 5.3, the elbow for the successful project data set (respondents who described a successful project) can be located at 3 clusters, meaning that grouping the respondents in 3 groups will adequately distinguish between their shared understandings of the successful project category. For the respondents who described less successful or problematic projects, the elbow is located at 2 clusters, meaning that there are two distinct groups of respondents with shared understandings of the less successful/problematic project category. Although locating the elbow on these charts is not a clear-cut decision, such analysis can provide an initial basis for selecting the number of clusters that can later be verified and confirmed by analysing the actual results of clustering.

5.4 Results

In this section, first the clustering results are analysed and then the configuration underlying the shared understanding of each cluster of respondents is examined.

5.4.1 Clustering results

A k-means clustering algorithm was run in R software, once for observations describing successful projects and once for the ones describing less successful/problematic projects. As a way of verifying the validation of clustering, we also ran a one-way ANOVA with a pairwise comparison and Bonferroni p-value adjustment, to determine whether the average score of each variable differed significantly in each cluster. Table 5.4 shows mean scores for project dimensions in each cluster of respondents in each category. It also shows some personal attributes of the respondents grouped in each cluster. For each factor, the variables with significant differences are in boldface.

Table 5.4 Mean scores for each dimension for each cluster of respondents

		Successful Projects				Less successful projects	
		Cluster 1	*Cluster 2*	*Cluster 3*		*Cluster 1*	*Cluster 2*
		Moderates	***Easy goers***	***Conservatives***		***Pragmatists***	***Idealist***
Dimensions describing the category							
Management support	*(a)*	**5.33**	**4.31**	**5.98**	*(d)*	**4.17**	**5.31**
Participation in decision making	*(a)*	**5.46**	**4.32**	**6.08**	*(d)*	**4.15**	**5.55**
Flexibility of project team	*(a)*	**4.95**	**3.98**	**6.12**	*(d)*	**3.89**	**5.53**
Engagement of team members	*(a)*	**5.77**	**4.67**	**6.65**	*(d)*	**3.88**	**5.79**
Communication within project team	*(a)*	**5.15**	**3.78**	**6.07**	*(d)*	**3.69**	**4.97**
Confidence of members	*(b)*	4.88	4.35	**6.04**	*(d)*	**3.74**	**5.30**
Project performance	*(a)*	**5.81**	**4.83**	**6.50**	*(d)*	**3.32**	**5.46**
Characteristics of respondents							
Average time spend on the project	*(c)*	6.29	6.61	6.16	*(e)*	5.48	5.96
Years of experience	*(c)*	12.77	16.94	14.40	*(e)*	13.73	14.64
Years of project management	*(c)*	5.31	7.61	6.44	*(f)*	**7.60**	**4.83**
Number of people in the cluster		50	35	18		52	46

a) All clusters are significantly different from one another (P<0.01)

b) Cluster 3 is significantly different from clusters 1 and 2 (P<0.01)

c) No significant difference among clusters (P<0.05)

d) All clusters are significantly different from one another (P<0.01)

e) No significant difference among clusters (P<0.05)

f) Cluster 1 is significantly different from cluster 2 (P<0.05)

In the category of successful project, every dimension was significantly different in all clusters except confidence of team members, which did not differ significantly between clusters 1 and 2. In the category of less successful projects, every dimension was significantly different in the two clusters. The fact that variables in each cluster are quite strongly distinguished from each other, can be viewed as confirmation that the initial number of clusters was appropriately set.

In terms of respondents' characteristics, we did not find any significant differences among the variables except years of experience in project management among respondents describing less successful projects. Because these three variables were the only characteristics of respondents that were measured by the questionnaire, we cannot draw any clear conclusion with regard to the influence of respondents' characteristics on their thought patterns.

In cluster analysis, researchers usually label each cluster. Among the respondents describing a successful project, we labelled the respondents in cluster 3 as *conservatives* because, in their description of a project that they described as successful all the dimensions had the highest relative scores. These results can be viewed as if conservatives set the highest bar for labelling a project as successful. The respondents in cluster 2 were labelled as *easy goers* because all the dimensions of the projects that were identified as successful were scored relatively low (around 4 out of 7). These results may imply that these managers set the bar relatively low for labelling a project as successful. The respondents on the remaining cluster (cluster 1) were labelled as *moderates* because their mean scores did not show any particular behavioural attitude in labelling a project.

For the respondents describing a less successful project, we labelled cluster 2 as *idealists* because in describing a project that they had cognitively labelled as less successful or problematic, they gave relatively high scores to all dimensions, particularly project performance. This stance suggests that, in the view of idealists, projects with relatively good standing in many dimensions still did not reach the ideal level. Therefore, idealists still consider such projects as less successful. Contrary to idealists, the respondents in the other cluster (cluster 1) were labelled as *pragmatists* because the mean scores for all dimensions were relatively low, as one might expect with a less successful project. An interesting observation is that pragmatists have significantly more experience with project management than idealists. This may be a partial explanation of why pragmatists do not consider projects with relatively high scores to be less successful, as idealists do.

5.4.2 Patterns of perceptions

We have graphically depicted the patterns of answers that each group of respondents provided for each variable. Figure 5.4 shows the distinctive causal patterns for each group of respondents in answering the questions when they thought of a successful project or a less successful project. Different colours are used to distinguish among the various groups.

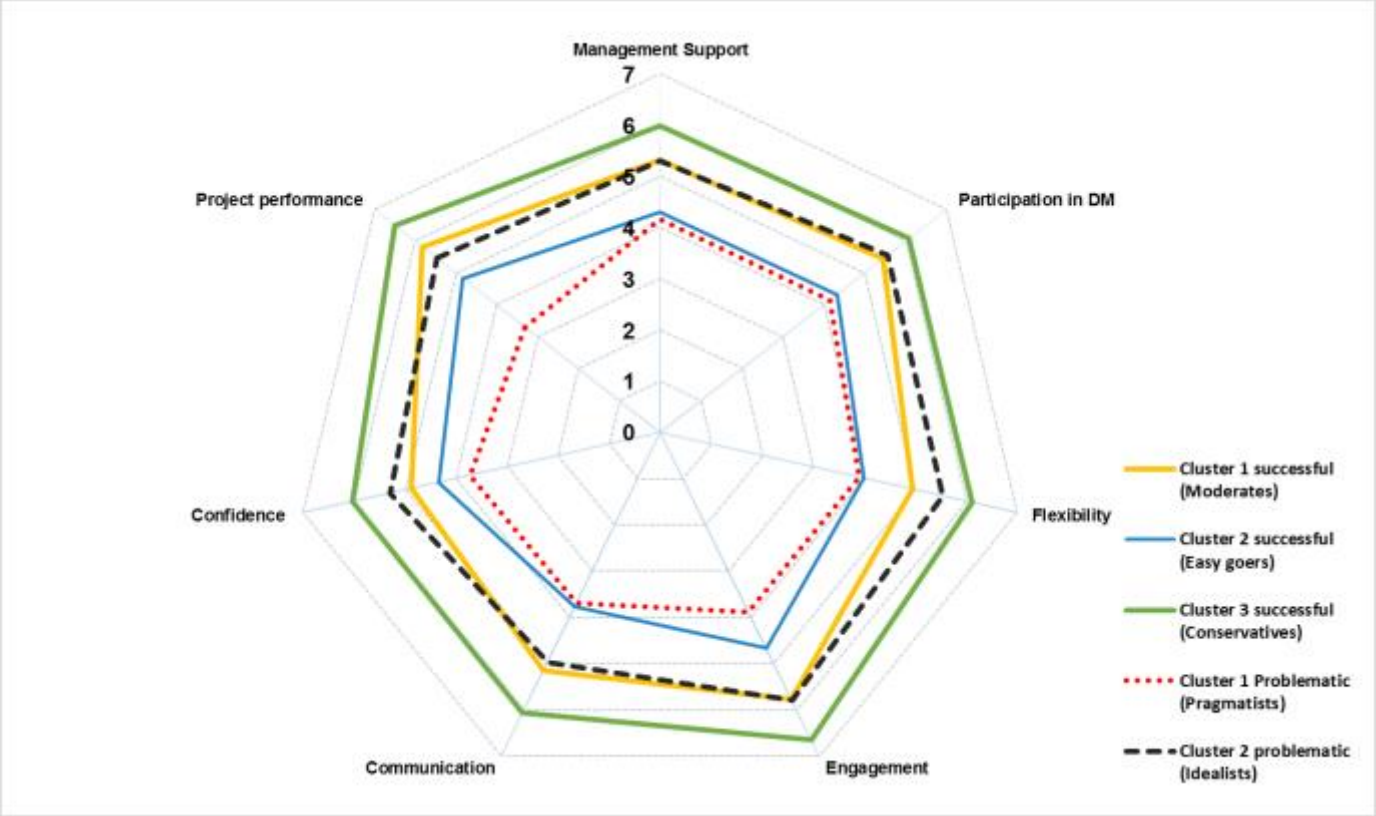

Figure 5.4 Patterns of perceptions for different clusters of respondents

An interesting observation is that easy goers (solid blue line) will label a project as *successful* in circumstances where idealists (dashed black line) would label a project with higher scores as problematic. These results tend to support Ika's suggestion that project success is a highly subjective matter (Ika, 2009).

With regard to respondents describing a successful project, we can see that, although the scores differ for the various dimensions, they follow almost the same pattern. In Goldberg's (2011) view, these results suggest that the structure of thinking of different groups is very similar but their opinion of the criteria differs.

However, although mean positions and patterns of respondents (in each cluster) with regard to each variable were crucial to detect the existence of distinctive shared understandings, *they do not provide a straight answer about how to find configuration that separate those shared understandings. In other words, evaluating the differences between mean scores for different clusters does not show which of those variables were most important for differentiating between the successful project and less successful/problematic project categories.* These important variables constitute the configuration of shared understanding, when one is labelling a project as successful or otherwise. In the next subsection, we further analyse the clusters to fulfil this goal.

5.4.3 Configuration of shared understanding in each cluster

To identify the configurations underlying the clusters' shared understandings, an investigation was conducted to uncover the bundle of important variables that have a significant impact on labelling a project as successful vs. less successful. In this setting, because the outcome is considered to be categorical (successful vs. less successful), the usual regression models cannot be used as they deal with continuous outcomes. Instead, we used multinomial logistic regression models which are designed to deal with these situations.

Logistic regression and similar methods have been used extensively in sociology when the research goal is to find the diversity of causal mechanisms leading up to a given outcome. For example, Garip (2012) analysed the predictive power of different variables in assigning observations to different migration patterns to the United States. Similarly, Bonikowski (2010) examined cross-national interaction and cultural similarity to find out which factors were strong predictors of cultural similarity. Likewise, for the purpose of this study, two multinomial logit regression models were run, one for clusters in the successful project category and one for clusters in the less successful project category.

The first multinomial logit regressions were run for the clusters of respondents in the successful project category, while the pooled sample of observations for less successful projects served as the reference group. In this way, the multinomial logit regression model compares the observations in each cluster describing successful projects with the pooled observations describing less successful projects (1: easy goers vs. all respondents describing less successful projects; 2: conservatives vs. all respondents describing less successful projects; and 3 moderates vs. all respondents describing

less successful projects). By analysing the results, we could determine, for each cluster of respondents describing a successful project, which variables were important in describing a project as successful (vs. describing it as less successful). The bundles of identified variables constitute the configuration for each cluster, shaping its members' shared understanding of project success.

The second multinomial logit regression was run for the clusters of respondents in the less successful/problematic project category, while using the pooled sample of observations for successful projects as the reference group. This time, the results would show that, for each cluster of respondents, which variables were important in labelling a project as less successful/problematic (vs. labelling it as successful). Tables 5.5 and 5.6 present the results of these multinomial logit regression models.

Table 5.5 Multinomial logit results – Labelling projects as 'successful'

	Cluster 1		Cluster 2		Cluster 3	
	Moderates		***Easy goers***		***Conservatives***	
Intercept	–8.27	***	0.19		–28.39	***
Management support	0.21		–0.10		0.49	
Participation in decision making	0.09		–0.17		0.08	
Flexibility of project team	–0.52	•	–0.73	*	0.46	
Engagement of team members	0.34		0.16		1.03	**
Communication within project team	0.49	•	–0.44		1.16	**
Confidence of members	–0.44	•	–0.08		0.01	
Project performance	1.19	***	0.84	**	1.65	**

*Note: ***: P = 0; **: P < 0.001; *: P < 0.01; •: P < 0.05*

Table 5.6 Multinomial logit results – Labelling projects as 'less successful/problematic'

	Cluster 1 ***Pragmatists***		Cluster 2 ***Idealists***	
Intercept	17.45	***	0.46	
Management support	–0.67		–0.07	
Participation in decision making	0.08		0.41	•
Flexibility of project team	1.42	**	0.35	*
Engagement of team members	–1.37	***	–0.09	
Communication within project team	–0.99	*	–0.42	•
Confidence of members	–0.11		0.34	
Project performance	–2.47	***	–0.70	**

*Note: ***: P = 0; **: P < 0.001; *: P < 0.01; •: P < 0.05*

In Table 5.5, the positive or negative signs of the coefficient estimates show whether an increase in the score for that dimension increases or reduces the probability of a project being labelled successful. In Table 5.6, the positive or negative signs of the coefficient estimates show whether an increase in the score for that dimension increases or reduces the probability of a project being labelled as less successful/problematic. The intercept does not represent a meaningful interpretation in this context but it is a necessary component of multinomial logit regression analysis.

For respondents describing a successful project, the dimensions with significant p-values (identified by *) are the ones with the strongest predictive power in labelling a project as successful. These bundles of significant variables yield distinctive configurations of shared understanding with reference to the successful project category. For example, higher scores for 'project performance' and 'communication' among within project team increase the probability that a project will be labelled as successful by the respondents in cluster 1 (*moderates*). On the other hand, higher scores for 'flexibility' and 'confidence among team' reduce the probability. Likewise, greater 'project performance' increases the probability that a project will be labelled as successful by *easy-goers* but increased 'flexibility' reduces the probability. In a quite different pattern, higher scores for

'engagement', 'communication' and 'project performance' increase the probability of a project being labelled as successful by *conservatives*.

For respondents describing a less successful/problematic project, interpretation of the significant dimensions follows the same logic but in reverse, meaning that they are the ones with strongest predictive power in labelling a project as less successful. The results in Table 5.6 show that any increase in the scores for 'engagement of team members', 'communication within project team' and 'project performance' reduces the probability of a project being labelled as less successful/problematic by *idealists*. However, greater flexibility among team members increases the probability. With regard to *pragmatists*, the higher the levels of 'communication within project team' and 'project performance', the lower the probability of being labelled as less successful/problematic. On the other hand, more 'participation in decision making' and 'flexibility' increase the probability. These bundles of significant variables yield distinctive configurations of shared understanding for the category of less successful problematic projects.

In summary, the results empirically show that there exist distinctive configurations of characteristics underlying the clusters' shared understanding of successful or less successful/problematic projects. An interesting observation is that, although 'project performance' was not the only determining factor, it still played a very important role in all the configurations for labelling projects as either successful or less successful.

5.5 Discussion and implications

Based upon the advancements in cognitive science and sociology, this paper revisits a misconception about the existence of universal (i.e., identical) understandings of project categories. The main argument put forward is that many people may use the same label for a category, but the perception and understanding of those categories may be quite different in different groups. As a result, different groups might have distinctive shared understandings among of the same category. Although the literature provides initial hints about the lack of consensus regarding project categories, the main contribution of this paper is to empirically demonstrate the existence of such heterogeneity. In particular, this research aimed to reveal specific configurations of characteristics underlying distinctive shared understandings of a given category.

Accordingly, an empirical experiment in the context of project management was designed. In this experiment, distinctive shared understandings of the category labels ‘successful project’ and ‘less successful project’ were investigated. The selection of these categories was justified by a comprehensive review of project management literature, which showed a lack of consensus around the meanings of these category labels (Ika, 2009). The existence of multiple interpretations of categories makes them appropriate candidates to map out different shared understandings. The empirical results showed that project success and project failure are not completely opposite or contradictory notions (Fincham, 2002); actually, there are some similarities and differences based on subjective views.

The results of this paper are in line with the subjectivist view of project success (Ika, 2009); empirically, they suggest that there is probably no such thing as absolute project success, but there are distinctive shared understandings of what project success means. Yet, the methodology of this paper differs from that of similar studies which identify multiple perception of project success among different stakeholders. For example, Davis (2014, 2016, 2017) identified multiple perceptions of project success among different stakeholders such as project manager, client, owner, user and project team. Accordingly, Davis aggregated the results from the citation analysis and semi-structured interviews from pre-defined group of stakeholders, to identify the most common project success dimensions among each one of them. However, the methodology of our paper does not consider any a priori groups (e.g., specific group of stakeholders), instead, only after the data analysis, it constructs the groups of ‘like-minded individuals’ which can consist of individuals from any background or group of stakeholders. This way, we considered the possibility that in each group of stakeholders, there may be different sub-groups with the same perception or a group of like-minded individuals (who share similar perception of successful projects) be constructed from different type of stakeholders.

Although the empirical experiment described in this paper involved two categories of projects – successful and less successful – it could be carried out with any other contested project category labels. The categories of ‘complex’ vs. ‘non-complex’ projects or ‘business’ vs. ‘innovation’ projects or ‘big’ vs. ‘small’ projects are just some instances that are used on a daily basis but without any consensus about their meaning among researchers or practitioners. Hence, any of these

categories could be an appropriate candidate to uncover different groups' shared understanding of them.

In terms of methodology, an argument has been made that shared understandings of the same outcome cannot be fully captured by conventional regression analyses, and thus there is a need for another method to consider the heterogeneity of observations. Thus, a two-stage methodology was used. First, a cluster analysis was used to group like-minded individuals who had a shared understanding of a given project category. Second, information in each cluster of respondents was analysed with a multinomial logit regression model, which deals with categorical outcomes (whether a project is labelled as 'X' or 'not X'). The results revealed different configurations underlying the shared understanding of the chosen categories.

The methodology used in this research is widely used and has been tested in different studies. However, the originality of this paper resides in its use with different approaches and for different research purposes. Traditionally, studies that try to find configurations (or taxonomies) of organizations or projects use a continuous dependent variable such as the *level* of effectiveness or project success. In other words, such studies aim to find out how different configurations of organizations or projects change the level of organizational or project success. For example, Mintzberg (1973, 1979) investigated some organizational configurations and made the main argument that fit (or divergence) between an organization's structure and those configurations would result in the increase (or loss) of organizational effectiveness. Similarly, Shenhar and Dvir proposed some hypothetical project configurations and argued that the more (or less) similar the structure of a new project is to that of their proposed configuration, the more (or less) successful and effective it will be (Shenhar & Dvir, 1996, 2007)

However, in this paper, we tried to find various configurations which led to a categorical dependent variable: whether a category was labeled as 'successful' or not. Accordingly, instead of verifying whether the fit with the configurations increased or decreased a project's success level, we took 'being labeled as successful' as a given outcome and then tried to find cognitive configurations that would lead to this outcome. By doing so, we were not looking to create another project taxonomy or project configuration but to identify distinctive groups of respondents who shared the same understanding of successful (or less successful) projects as a category.

5.5.1 Implications

In terms of implications for research, the insights and methodology used in this paper constitute an essential tool for researchers to see if they share the same understanding with other researchers, when they refer to a particular project type or category in their studies. Consequently, the project management field would be better equipped to compare isolated middle-range theories (Packendorff, 1995) that have been developed about the same project category (/type), with more confidence and come up with more united theories (Niknazar & Bourgault, 2017b). Such 'unified theories' would help researchers better understand and communicate about the phenomenon they are studying and also contribute to better knowledge sharing and accumulation (Söderlund, 2011b).

Furthermore, the 'meaning' that a classifier attributes to a particular category reveals different behavioural expectations of that category (Baum & Lant, 2003; Porac et al., 1995). In other words, by identifying the specific configuration underlying 'meaning/understanding' for individuals in an organization, practitioners learn what is actually expected of a particular category. Accordingly, they are better able to align their proposed project with what an organization expects of a particular category. As a result, project proposals will have higher chances of being assigned to a desirable category.

Likewise, Davis (2017) argue that comparing multiple perceptions of different groups improves the mutual understanding and in turn "will enhance the dynamic engagement of stakeholders and the ability to respond to possible changing priorities of different stakeholders by altering success dimensions" (Davis, 2017, p. 615). Using the term 'strategic categorization', Rhee (2014, 2015) explored this practice in organizational environments by examining how organizations can strategically manage self-categorization labels to meet potential investors' expectations and receive favourable evaluations.

To illustrate this claim in a project management context, consider an organization that may develop a project classification scheme and only provide substantial financial assistance to projects labelled 'strategically important'. Now, consider an analysis that shows 'alignment with the organization's goals' and 'long-term social benefits' as configurations underlying the shared understanding of individuals in that organization (with regard to the category of 'strategically important projects'). In view of this analysis, a project proposal can be modified to specifically emphasize the project's

strategic and social benefits. As a result, the proposed project has a higher chance of being labelled 'strategically important' and benefiting from the possible advantages, such as financial rewards, that such labelling would bring. Although the implementation of this kind of strategy is not a straightforward task, the insights and the methodology of this paper provide a useful tool in that regard.

5.5.2 Limitations and future studies

The first limitation affecting this study concerns the technical issues inherent in the clustering method used in this study. Although cluster analysis helped us recognize and demonstrate the main issue discussed in this paper (existence of heterogeneous perceptions/understandings), it is very sensitive to sample size and the selection of variables. Therefore, if the sample were changed or another context-specific variable were used, entirely different clusters, with different configurations, might emerge (Miller, 1996). This is viewed as a major reason why there is no universal taxonomy for organizations (Ketchen & Shook, 1996) or projects (Shenhar, 1998; Shenhar & Dvir, 1996).

In this regard, there are two possible approaches that future studies can take. First, future studies can run different clustering algorithms in parallel, to test the stability and replicability of this study's clustering results (McKelvey, 1982; Miller et al., 1984; Ulrich & McKelvey, 1990). Second, they can change the sample of observations and test whether the same clustering of groups occur in other randomly selected samples too (Miller et al., 1984). Accordingly, as the respondents to the questionnaire used in this study came mainly from the telecommunication and electronics sectors, a possible extension of this research would be to gather data from managers in other industries to verify if the clusters of respondents have similar configurations to the ones we found in this study.

The second limitation relates to the scope of this paper. With regard to the subjectivist view of categories and evaluation of classification from the cognitive perspective, which is a fairly new topic of in project management, the present paper constitutes only an early milestone in recognizing an important issue, namely the existence of heterogeneity in perceiving and understanding project categories. Nevertheless, future studies can build upon this research and contribute further to classification as a research field in project management.

For example, future studies can design a similar experiment and further verify if an individual (or a group of like-minded individuals) keeps the same structure of thinking when a questionnaire concerns only one category (e.g., only asking about 'successful projects'), instead of being a pairwise questionnaire ('successful project' vs. 'failed project'). In answering the pairwise questionnaire, since the respondents take the contrast between two categories into their consideration, a certain halo effect[4] can be expected (Gemünden, 2015). Hence, a further study would be beneficial to first examine the existence of this effect and then evaluate how use of a pairwise questionnaire affects the configurations underlying understanding of project categories.

Another possible extension of this research would be to examine changes in the shared understanding of categories, for a particular group of individuals, over time or with the occurrence of an event (Kennedy & Fiss, 2013). For example, Baker et al. (2008) a pointed out that how different stakeholders perceives and evaluates project success probably changes over time. Similarly, Turner, and Zolin (2012, p. 10) state that "one needs to consider the views of multiple stakeholders over multiple time frames" as stakeholder's focus on the success factors and criteria they perceive as important shifts overtime. Thus, with using the methodology introduced in this paper, a future study could be designed to evaluate changes in configurations of shared understanding with regard to successful project category over time in any group of stakeholders. Such study would not only contribute to research on 'project success' but would be a promising contribution to 'classification' as a new and valuable avenue of research in project management.

5.6 Conclusion

This paper revisited a major misconception about project categories: the existence of a universal understanding of project categories. The main argument put forward in this paper is that different groups may use the same project category label, but their perception and understanding of that category may be quite different. As a result, distinctive shared understandings exist for the same project categories. Accordingly, the main purpose of this research was to conduct an empirical

[4] The halo effect is the cognitive tendency for an impression created about one subject to affect opinions on another subject (Thorndike, 1920).

experiment to capture the complex, multivariate configurations that constitute a shared understanding of a project category.

After discussing the cognitive processes underlying the development of multivocal perceptions in referring to a category, a cluster analysis was used to empirically identify groups of like-minded individuals who shared distinctive ways of understanding the same category in a project management setting. A multinomial logit regression model was used to analyse the configurations of shared understanding in each subgroup.

The results laid the groundwork for researchers and practitioners to learn about the source of the confusion and ambiguity surrounding any given project category. The methodology used in this paper can enable researchers to compare their understanding of a given project category and verify whether their middle-range theories really concern the same project type. Moreover, by exploring the configuration underlying shared understandings of categories in an organization, practitioners are enabled to manage expectations of a project and increase the chances for a project to be assigned to a target category.

CHAPTER 6 ARTICLE 3: THEORIES FOR CLASSIFICATION VS. CLASSIFICATION AS THEORY: IMPLICATIONS OF CLASSIFICATION AND TYPOLOGY FOR THE DEVELOPMENT OF PROJECT MANAGEMENT THEORIES

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Abstract

Although ordering and classification schemes play a crucial role in the project management field, classification as a topic of study has been undervalued in the literature. Accordingly, there is a semantic confusion and lack of uniformity about the definitions and theoretical implications of two commonly used terms in project management: *classification* and *typology*. We argue that this issue hinders project management field from developing middle-range theories and flourishing theoretically compared to other fields of research.

In this paper, we clarify the definitions and theoretical implications of project classification and typology so they can be fully used in theory development. We argue that typology – although it involves classification – is different than simple classification schemes. We also explain how theories for classification can be used to delimit project types in homogeneous project categories and develop middle-range theories; however, a typology itself is a unique form of theory that can capture the complex nature of projects. By clarifying these concepts, this paper points to promising directions for future development of theories in project management.

Keywords: Project classification, project typology, middle-range theory, project management theory

6.1 Introduction

Since the earliest development of modern theories of project management, which Morris reports as having emerged in the 1940s and 1950s (Morris, 1994), the classical project management literature has advocated a universal theory of and approach to project management, under the assumption that all projects have the same structures and processes. However, Shenhar (2001) suggests that there is no single "theory of project management", and there is little evidence in practice that an ideal model exists for all project types (Cicmil & Hodgson, 2006). Moreover, several other prominent authors (Koskela & Howell, 2002a; Maylor, 2001; Morris et al., 2000; Winch, 1996) have emphasized the need to introduce alternative theoretical approaches to the study of projects instead of searching for a single project management theory. However, only a few studies have examined the behaviour of projects in theoretical terms (Lundin & Söderholm, 1995; Söderlund, 2004, 2011b). That is a major reason why the project management literature "suffers from a scanty theoretical basis" (Shenhar & Dvir, 1996, p. 607).

Nonetheless, the discipline has developed some building blocks to help shape its theoretical foundations (Jugdev, 2008). Many schools of thought/perspectives have been introduced, and these vary in terms of how they look at the nature of projects and the type of theorizing they engage in (Bredillet, 2007b; Söderlund, 2011a; Turner, 2006a; Winter & Szczepanek, 2009). Although the existence of these diverse views shows that pluralism is growing within the field, Söderlund (2011b, p. 57) argues that "too much fragmentation hinders the communications among scholars and ultimately leads to failure of knowledge sharing and accumulation". He concludes that some kind of **unification** is also necessary in order to better understand the phenomenon under study and improve the language that we use to speak about our common cognitive problems.

The suggested unification of theories implies that project management theorists must be explicit about the **project types** that they are theorizing about, regardless of the theoretical schools of thought/perspectives they apply, the problems concerned or the different phases of the project life cycle examined (Söderlund, 2004, 2011a, 2011b). Limiting the theoretical scope to a particular project type is a remedy for a major problem in constructing sound project management theories that has been described as a lack of distinction among project types (Pinto & Covin, 1989). Moreover, by limiting the scope of the work to specific project types, the project management principles, tools and methods applied are also tailored to the types of projects (Andersen, 2006;

Besner & Hobbs, 2004; Turner & Cochrane, 1993). In other words, in the current theoretical landscape of project management, there is a need for more **middle-range theories** (Packendorff, 1995). Middle-range theories (Merton, 1968) are expressed in similar terms to traditional theories but their scope is limited to a single project type. Nevertheless, a review of the studies that used some sort of project classification reveals two major issues, which we believe are preventing the project management field from fully addressing the need for middle-range theories.

The first issue is the neglect of the essential role of "classification" in delimiting project types. By using a proper classification and construction of homogeneous categories, projects that share a certain degree of similarity in terms of specific features can be considered as a project type. However, this critical step in development of middle-range theories has been overlooked in the project management literature. Although a variety of classification schemes have been used in the corpus of studies (Crawford et al., 2005, 2006), compared to other disciplines, little systematic research has been conducted on project classifications as a separate topic of inquiry. While various project classification schemes have been developed based on in-depth knowledge of projects, few seem to have been drawn based on established theories or explicit classification principles.

The second issue is the inconsistent use of "classification" and "typology" across authors in the project management literature. These two important terms are frequently misunderstood and/or used interchangeably. In particular, there is much confusion about the definition and theoretical implications of "typology". That is why some proposed project typologies are simply classification schemes that present certain mutually exclusive project categories but are not developed into a standard, fully accepted theoretical typology (Doty & Glick, 1994). For example, Evaristo, and van Fenema (1999) developed a project classification scheme based on the emergence and evolution of new forms of projects but did not develop it into a typology. Similarly, Blismas et al. (2004) sorted clients' construction portfolios into groups that exhibit similar traits, attributes, or origins, which is better regarded as a classification scheme and not a fully developed typology, which should present some ideal types and explain a dependent variable.

A major reason for this semantic confusion between classification and typology is that most project classifications were constructed heuristically or did not incorporate the progress made by the work of other scientists, in fields such as management and organizational science, who have worked on classification or typological principles for a long time. Given that we are still in the early stages of

theory development in project management (Söderlund, 2004, 2011b; Yung, 2015), we believe that disregarding the theoretical implications of typology represents a missed opportunity and hinders project management from undergoing further theoretical development.

To address these two issues, we first clarify the definitions of classification and typology in order to alleviate the semantic confusion that reigns in most of the project management research literature. Because very few project management researchers have defined and discussed these terms, we look at other scientific fields, including the natural sciences and, most importantly, the disciplines associated with management and organizational studies. Our examination of the long history of discussions of classifications and typologies led us to some very influential authors and papers that have generated long and ongoing discussions of these concepts. Therefore, our selection of authors was guided not by the criterion of exhaustiveness but by the criterion of relevance.

We will also discuss the implications of classification and typology for the development of theories in project management. We will argue that, with the help of theories for classification, significant aspects of a subject can be selected as the classification criteria and homogeneous categories can be constructed. Next, by building samples from a homogeneous project category, we will be able to delimit a project type and then test hypotheses and develop middle-range theories. This process would provide a guideline for specifying project types and lead to the development of more vigorous and reliable project management theories, albeit theories that are narrower in scope.

Further, we will discuss how the construction of a typology is a valuable and useful way to develop theories in project management. We explain that a well-developed typology must meet the most important criterion of being a theory (Doty & Glick, 1994). We reveal that a typological theory is not similar to traditional bivariate or interaction theories but is regarded as a unique form of theory that incorporates multiple levels of theory – *a grand theory* as well as *multiple middle-range theories* (Doty & Glick, 1994). We will argue that a well-developed project typology has the capacity to capture the complex nature of projects and the various causal relationships involved (Shenhar & Dvir, 1996, 2007). In summary, we argue that:

- Classification schemes are different from typologies.
- A proper classification is a core requirement for the development of middle-range theories.
- Typology itself represents multiple layers of theory.

The insights from this research have major implications for the further development of project management theories. First, highlighting the fundamental – but often forgotten – steps for devising middle-range theories would help project management scholars to generate additive knowledge in more unified, vigorous and reliable theories, although the scope is limited to one project type. Second, we argue that developing a fully specified typology will be worthwhile, since typological theories are more likely to account for the complex, multivariate nature of many projects. By using the insights in this paper, future project management researchers can not only evaluate existing typologies for their current relevance but dig further into the new subject areas where new typologies can be constructed and tested. Overall, we hope that a clearer understanding of the definitions and theoretical implications of "classification" and "typology" in project management will lead to more ground-breaking theoretical contributions in the field.

This paper is structured as follows. In section 2, we discuss the definition of classification and theories for classification. In section 3, we discuss the definition of typology and how it is actualized in project management. In section 4, we will investigate the implications of classification and typology for the development of theories in project management and discuss some promising directions for further research. Finally, in the conclusion, we highlight the contributions of this paper.

6.2 Classification

In the scientific literature, there are many definitions of the concept of "classification". Some of the most common definitions are: "identification and assignment of organization forms to formally recognized classes" (McKelvey, 1978, p. 1428), an "information infrastructure that represents a spatio-temporal segmentation of the world" (Bowker & Star, 2000, p. 10) and "the sorting of objects based on some criteria selected among the properties of the classified objects" (Hjørland & Nissen Pedersen, 2005, p. 592). Broadly speaking, classification can be seen as the development of a *classification scheme,* which refers to a schema consisting of different classes and the relationships among them (Kwasnik, 2000).

Classification schemes demonstrate how entities are assigned to categories and how categories are differentiated from each another. We may consider the classification scheme as a set of boxes in which the entities in a class are sufficiently similar to each other while being sufficiently different

from those in other sets of classes. Classification schemes are often depicted as hierarchical orders, tables, illustrations, or graphical representations (Kwasnik, 2000). The Periodic Table of Elements in chemistry and Darwin's tree of life (representing the origin of species) are two well-known examples of classification schemes. Organizational and management researchers have a rich tradition of developing various classification schemes to fulfil different purposes (Carper & Snizek, 1980; Chrisman, Hofer, & Boulton, 1988; Gordon & Babchuk, 1959; McCarthy, 1995; McCarthy et al., 2000; McKelvey, 1978; Perrow, 1972; Thompson, 1967a; Van Ripper, 1966). These classification schemes are intended to enhance the knowledge and understanding of organizational and management-related phenomena.

Two points should be made here concerning terminology. First, classification is often used interchangeably with *categorization*. Indeed, in the majority of studies in natural science, management or organizational science, the two terms have almost the same meaning. However, Jacob (2004) differs in this regard, as he defines categorization as dividing the world into the classes and classification as pigeonholing entities into pre-defined classes. Nevertheless, like the vast majority of authors, we use these two terms with the same sense. We also use the verbs *classify* and *categorize* interchangeably.

Second, classification is also often used interchangeably with *taxonomy* (Miller, 1996; Rich, 1992). However, taxonomy is only one kind of classification (among many) for which the objects are classified based on statistical generalizations (e.g., factor analysis) or based on "similarity" (Hjørland, 2008). Rather than the perceived similarities of their features, entities can also be classified according to their perceived alignment with the classifier's specific "goal", "values" or "policies" (Barsalou, 1983) or "principles of pure reason and logic" or "study of context" (Hjørland, 2008). Nevertheless, regardless of how the classification has been constructed, there is some underlying logic or theory behind it. In the next subsection, we delve further into the possible logics behind the construction of a classification scheme: the *theories for classification*.

6.2.1 Theories for classification

In general, **theories for classification**[5] are understood as theories or theoretical principles that can be used as a basis for classifying entities. Theories for classification distinguish between significant and trivial features of given phenomena and may introduce various principles and procedures for constructing the classification of particular entities. Hjørland, and Nissen Pedersen (2005) contend that each theory for classification is domain-specific and each domain develops its own theories in order to describe, differentiate and classify objects. Each of these theories "sees" different aspects of a phenomenon; thus, each classification based on those theories is different. That is why a single entity may be classified differently by different researchers.

Biology and the natural sciences have pioneered in developing theories for the classification of species. For example, *phyletics* is a theoretical model of evolution, drawn mainly from the works of Mayr (1969) and Ross (1974), that classifies species based on the historical origin and evolution of lineages and species. Phyletics is divided into two main branches: *evolutionary phyletics* and *cladistics*. Evolutionary phyletics focuses on the degree of evolutionary similarity between branching points in order to form a class, whereas cladistics focuses on common ancestors (and not necessarily similarity) in order to place entities from different branches but with a common ancestor in the same class.

Although these biological theories for classification were intended to classify species, they are frequently applied to other fields such as organizational science, where they are used to classify organizational types. Some researchers in organizational science have used phyletics to classify organizations based on the emergence and decline of different organizational forms over time (McCarthy, 1995; McCarthy, Leseure, Ridgway, & Fieller, 1997; McCarthy & Ridgway, 2000; McCarthy et al., 2000; McKelvey, 1978). For example, McCarthy, and Ridgway (2000) used cladistics to construct a seven-stage framework for classifying manufacturing systems. They

[5] In other fields such as information science, some authors may refer to the same concept as "classification theories" or "theories of classification" (e.g., Szostak (2008); Hjørland, and Nissen Pedersen (2005); Hjørland (2008)). However, in this paper, we use "theories for classification" as we believe it bears more intuition to the theories or theoretical principles that can be used as a basis for classifying entities.

assumed that manufacturing systems evolve into new organizational "breeds" over time and can therefore be explained by the theory of natural selection.

These examples of classification in biology and organizational science highlight the fact that some established theories, although not initially intended for purposes of classification, can still be used as the basis of classification (Hjørland & Nissen Pedersen, 2005). To enrich our discussion of the role of theories in classification, we would like to highlight some important points:

1. The value of a particular classification is determined by its alignment with the classifier's purpose. Therefore, there is no such a thing as a universal classification (Hjørland & Nicolaisen, 2005). In some fields, certain classifications appear to be independent of human purposes. The periodic table in chemistry and physics is an example of this illusion. However, even in such cases, the classification has an implicit purpose (e.g., structural analysis of matter) based on the history of the field (Dupré, 2006). Each classification is appropriate for a particular purpose. For example, classification based on a "common ancestor" (cladistics) is appropriate for the purpose of explaining the evolution of a species (Dupré, 2006). However, if a classifier wished to speculate on the relationship between "heartbeat" and "animal size", cladistic classification would not be very useful. In this case, a classification based on "animal size" may be more suitable.

Dewey (1948) notes that "each classification may be equally sound when the difference of ends is borne in mind". That is why researchers in different fields may disagree about the value of different classification schemes (Hjørland & Nicolaisen, 2005). The same fundamental characteristic is true of project classification schemes; Crawford et al. (2005) argue that the success of project categorization is measured against how much it fulfils the initial classification purpose set by the classifier. That is why selection of project contingency factors may not always be an appropriate recipe for classification: it may simply not serve the classifier's purpose. For example, a project classification scheme based on "complexity" may be a good recipe for an organization like NASA but may not be appropriate for an agency like a national postal service.

2. There is no neutral way of devising a classification, because each classification scheme, whether explicit or implicit, is ultimately derived from the classifier's theories, perspectives and purposes (Hjørland & Nissen Pedersen, 2005). The selection of classification criteria is always influenced by the underlying theory, individual knowledge and expertise. Even

in a well-founded classification theory such as cladistics, the classification principles are affected by the researcher's preferences (McCarthy et al., 2000).

There is a (false) belief that statistical methods can create an objective classification scheme in the pure sense of being independent of individual perspective on reality. However, the choice of features to put into the statistical method is not just a "given"; it reflects both the entities' characteristics and the classifier's theoretical perspective/purpose (Fiegenbaum & Thomas, 1995; Hjørland & Nissen Pedersen, 2005; Ketchen et al., 1993; Miller, 1996). For example, in making use of statistical tools, non-governmental organizations may emphasize the "social effects" of projects in constructing their classification, whereas an engineering company may emphasize other properties such as "profitability" or "political risk".

In addition, each statistical method includes some prior assumptions that influence how it classifies objects. These assumptions are grounded on domain-specific theoretical perspectives. One of the assumptions in statistical methods is the "similarity measure". Two projects may be "similar" to each other in many different ways. There is no neutral ground on which to choose; for example, should similarity be measured as the distance between the averages of each project feature? Or it should be measured by the difference among the trends in project features over time? We can see that even the choice of measure to be used for statistical classification remains debatable. Thus, developing a project classification with statistical classification methods (e.g., a project taxonomy), like all other project classification schemes, cannot be a neutral and purely data-driven process but is inherently purposeful and based on certain theoretical assumptions or views.

3. The theories for classification as referred to in this paper must be differentiated from "theories of cognitive science about classification", which refer to the cognitive process in human mind whereby concepts and categories are formed and entities are included in or excluded from categories (Murphy, 2002). The cognitive process of classification is explained by theoretical views such as prototyping (Rosch & Mervis, 1975), the goal-based view (Barsalou, 1983) and the causal view (Rehder, 2003a, 2003b; Rehder & Hastie, 2001). These theories explain how the natural (cognitive) classification ***is*** constructed. However, theories for classification refer to the theoretical frameworks that dictate some rules for how the classification ***should*** be constructed. For example, by using cladistics to classify species, we apply certain rules based on evolutionary science to construct a particular

classification scheme. However, the cladistic classification scheme bears no resemblance to how the human brain, whether a scientist's or a layperson's, would naturally classify species when simply observing nature.

6.3 Typology

Despite its widespread use, *typology* is often misunderstood as meaning the usual classification of entities. However, Doty, and Glick (1994), pointed out that, unlike classification systems, typologies are not about sorting entities into mutually exclusive, exhaustive groups. Instead, typologies are conceptually derived interrelated sets of *ideal types* that explain a *dependent variable.* The typology is designed in such a way that the "fit" of an existing organization and the ideal types are believed to determine the relevant outcome, such as organizational effectiveness or success. Figure 6.1 depicts the general view of how typology is developed.

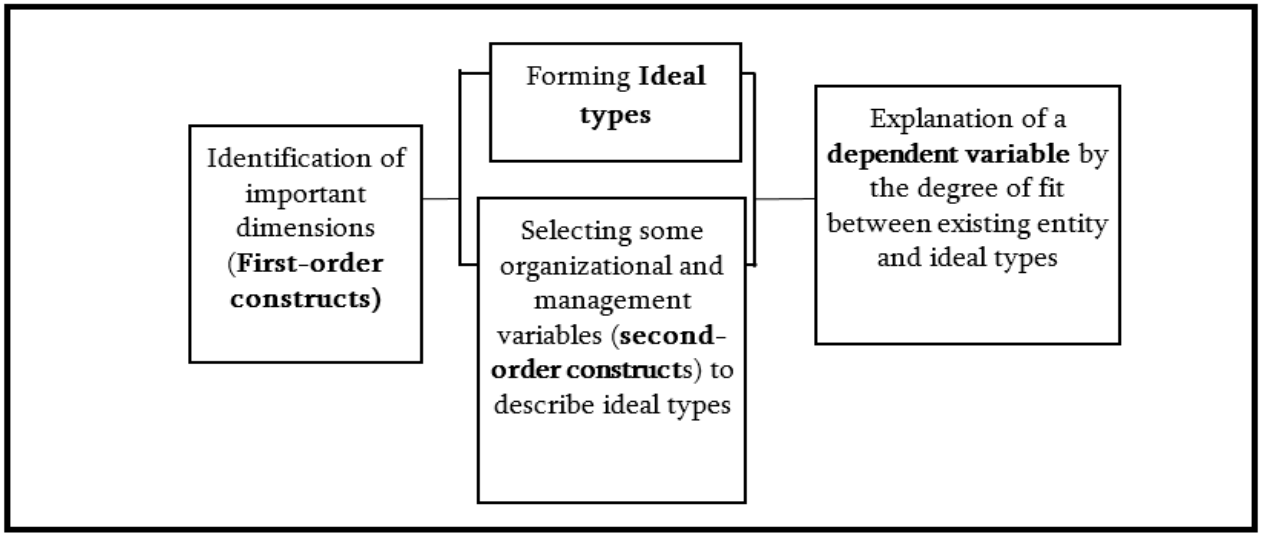

Figure 6.1 Development of a typology

Based on explanation of Doty, and Glick (1994), the first step in constructing a typology is to identify some important dimensions of the subject as the **first-order constructs**. For example, based on his prior insight, Mintzberg (1973, 1979) used dimensions such as age, size, environmental uncertainty, and so forth as the first-order constructs for his typologies of organizations.

The second step in developing a typology is to specify some **ideal types**. Ideal types are multivariate profiles of entities summarized by specific variables known as **second-order factors/constructs**. Simply put, a combination of second-order constructs is used to describe the holistic configuration of each ideal type. For example, in an organizational typology, Mintzberg (1973, 1979) used some contextual and structural factors to introduce and describe five ideal types of organizations for his typology: entrepreneurial, machine, professional, divisional and innovative organizations. These ideal organizational types do not necessarily represent real organizations. However, actual organizations may be more or less similar to ideal types.

In constructing ideal types, researchers initially search for alignment, coherence, and interdependencies among features of entities and then combine the significant features to construct ideal types (Miller, 1990, 1996; Mintzberg, 1979). Alternatively, a researcher may set the "milestones" in first-order constructs as ideal types (Doty, Glick, & Huber, 1993; Segev, 1989). For example, if we take "size" as a first-order construct, ideal type A can be set as the maximum possible value for "organizational size" and ideal type B can be set as the minimum value for "organizational size". The other ideal types would be placed somewhere between those two endpoints. The researcher then uses second-order constructs to describe the constructed ideal types. Furthermore, empirical observations of trends in second-order factors can help the researcher to emerge or refine the description of ideal types along each dimension.

Finally, a typology predicts a specified level of a **dependent variable** by measuring the fit (or difference) between the second-order constructs of real entities (e.g., real organizations or projects) and those of ideal types. Accordingly, a typology predicts the consequences for the dependent variable of the deviation of actual entities from the ideal types. For example, Mintzberg (1973, 1979) hypothesized that the fit to his five ideal types of organizational structures should result in maximal organizational effectiveness (as dependent variable). Accordingly, the divergence between an organization's second-order constructs and those of the ideal types would result in a loss of organization effectiveness. Another example is the typology presented by Porter (1980, 1985), who hypothesizes that fit to his proposed ideal-type strategies will maximize an organization's competitive advantage.

It should be emphasized that, in a typology, the measurement of deviation (or fit) between the profile of an actual organization and the ideal types does not rely on a single attribute but instead

on the relationships and complementarities between multiple constructs that describe the organization and the ideal types (Fiss, 2011). Moreover, the ideal types should be comprehensive and mutually exclusive so that the typology will be valuable and remain robust over time (Snow & Ketchen, 2014). For example, although Miles, and Snow (1978) developed their typology with a sample of 16 college textbook publishing firms, they argue that their ideal types (prospector, defender, analyser, and reactor organizations) are comprehensive and represent all of the organizational forms present in the industry. By demonstrating the existence of similar types of organizations in other industries, such as private hospitals, electronics firms, and food-processing firms, subsequent research has confirmed Miles and Snow's typology's comprehensiveness (Snow & Ketchen, 2014).

6.3.1 Typology in project management

Few studies in the project management field have claimed to have developed a typology for various dimensions of projects. For example, Griffin, and Page (1996) developed a *typology for "project strategy"* with two dimensions – "newness to market" and "newness to the firm" – to predict a product development project's overall success. In another example, Stock, and Tatikonda (2000) presented a *typology of "project-level technology transfer processes"* with three dimensions: "uncertainty about transferred technology", "organizational interaction between the technology source and recipient", and "transfer effectiveness". Accordingly, they argue that appropriate matches to their "transfer process types" represent the most effective approaches to technology transfer. Further, Mazouz, Facal, and Viola (2008) proposed a *typology for public-private partnership (PPP) projects* with two variables – "the proximity of the target" and "the capacity to generate projects" – that are believed to be relevant for the effective and efficient management of PPPs. Additionally, Kujala, Artto, Aaltonen, and Turkulainen (2010) also developed some arguments for the creation of a *typology for solution-specific business models in project-based firms*.

Although these typologies are valuable research studies in project management and provide useful theoretical insights, they did not explicitly demonstrate their conformity with the definition of a fully developed typology (Doty & Glick, 1994). Most of these typologies are not explicit about how the first-order or second-order constructs are related to the ideal types, or they have not been

subjected to empirical testing and validations. Nevertheless, the typology of projects developed by Shenhar, and Dvir (1996) represents a good example that confirms to the full definition of a typology.

For the sake of illustration and to become familiar with what a typology might actualize in a project management context, we will briefly discuss how Shenhar and Dvir's two-dimensional project typology was developed and tested. This example was chosen based on its relative simplicity and smaller number of dimensions. Initially, based on their own prior theoretical research (Dvir & Shenhar, 1992; Shenhar, 1993), Shenhar and Dvir selected the dimensions of "system scope" and "technological uncertainty" as **first-order constructs**. Thus, each project is classified based on these two dimensions. Later on, Shenhar and Dvir expanded their original typology to include four dimensions: "novelty", "technology", "complexity", and "pace" (Shenhar & Dvir, 2007). However, for ease of demonstration, we will explain their two-dimensional typology.

In the next step, some points along each typological dimension were identified as the **ideal types**. Within the technological uncertainty dimension, four ideal types (levels) were specified: low-tech project, medium-tech project, high-tech project and super high-tech project. Within the system scope dimension, the typology included three ideal types: assembly projects, system projects and array projects (programs).

After identifying the ideal types, Shenhar and Dvir selected some management tools and practices as **second-order constructs** to describe the characteristics of each ideal type. Initially, the description of the ideal types was based on the authors' prior theoretical insights and was not constrained by the existence of real projects or by project samples (Shenhar & Dvir, 1996). It was only later that empirical testing allowed them to confirm or adjust the proposed ideal types by verifying the convergence of management styles as one moves along the two dimensions of typology (from one ideal type to another). For example, the typology initially included five ideal types along the system scope dimension, but later data showed that management styles converge to only the three ideal types of assembly, system and array.

Eventually, based on the differences between the second-order constructs of real projects and those of ideal types, Shenhar and Dvir explained the level of project effectiveness/success as the **dependent variable**. Figure 6.2 depicts this project typology.

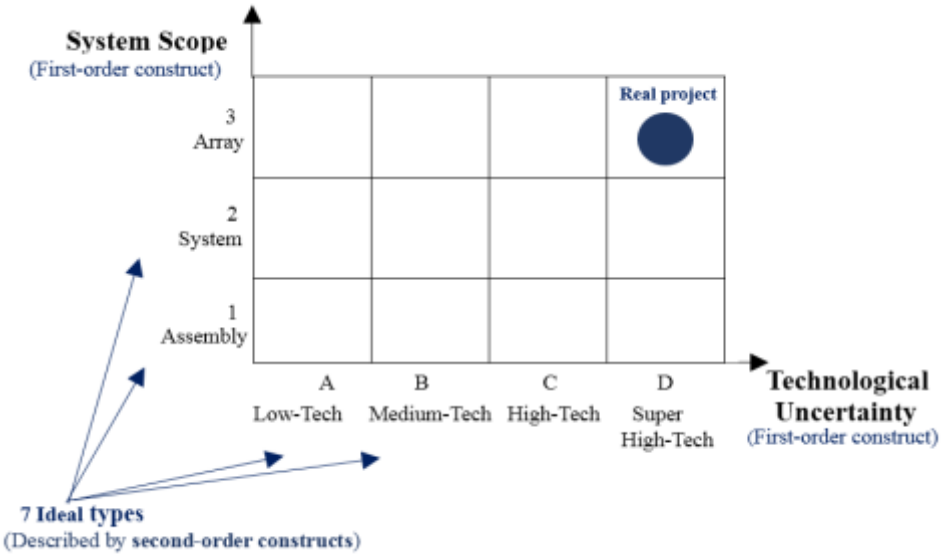

Figure 6.2 Two-dimensional project typology developed by Shenhar and Dvir (1996)

As depicted in figure 6.2, a given real project is classified an as Array/Super High-Tech project. In this typology, the degree of deviation between the managerial and organizational features (second-order constructs) of this project and those of the ideal types (Array type and Super-High-Tech type) will be measured. Finally, this deviation is used to explain project effectiveness/success as the dependent variable. For example, NASA's Challenger project in 1986 was a *super high-tech project* that needed to be managed as such with a *flexible leadership style and high tolerance for change*. However, in fact, it was only managed as a *high-tech project* with a more *formal and rigid* style (Shenhar, 1992). Shenhar and Dvir argue that this discrepancy in the project's management style (difference between second-order construct of real project and ideal type) was the reason for the project's failure. In the next section, we will elaborate on how typologies can contribute toward theory development in project management.

6.4 Implications

After clarifying the concepts and components of classification and typology, in this section we discuss the implications of these two concepts for further theory development in project management. Figure 6.3 summarizes the theoretical implications of classification and typology in project management.

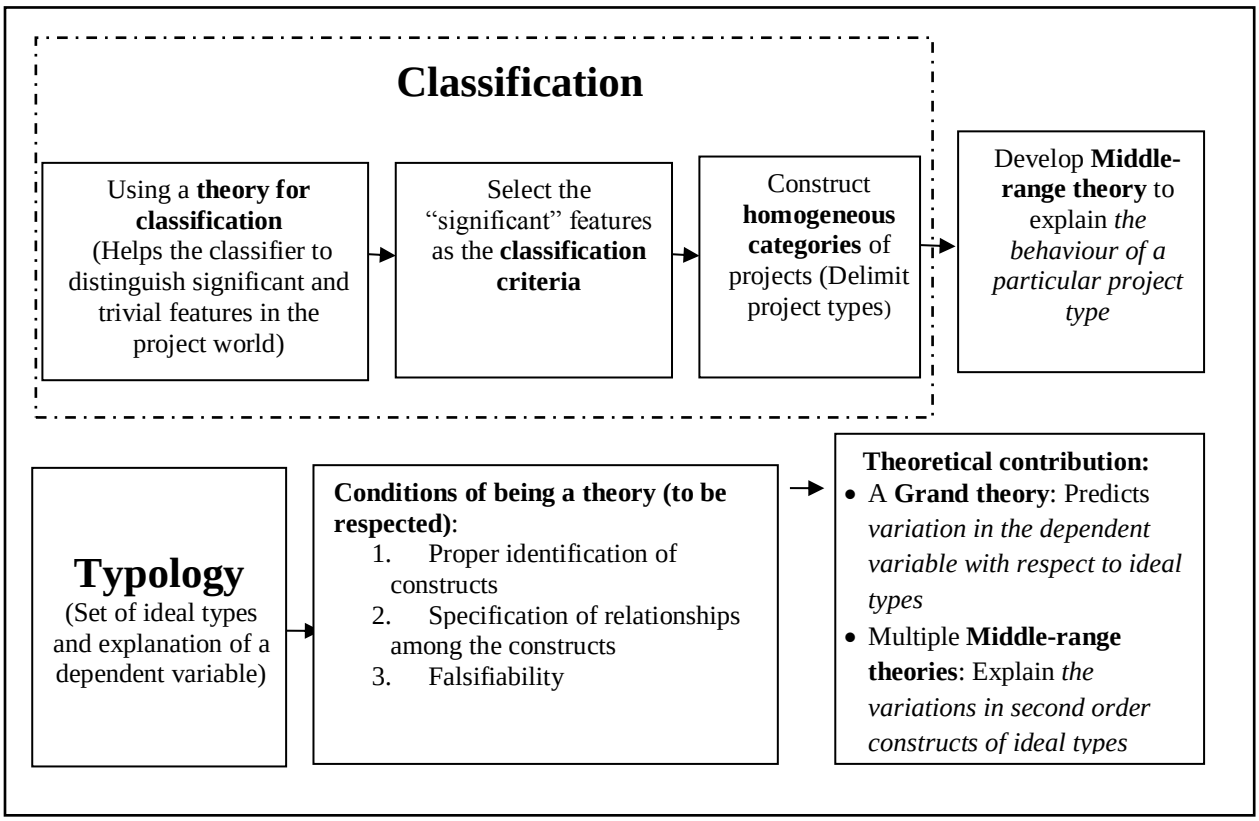

Figure 6.3 Implications of classification and typology for theory development in project management

In a nutshell, we argue that, by using a theory for classification, a researcher can select some significant features (in light of the underlying theory or theoretical perspective), make homogeneous categories, and delimit project types. These steps are essential, but often forgotten, requirements for the development of middle-range theories. On the other hand, we contend that a well-developed typology, which respects certain conditions, can itself be regarded as comprising a grand theory and multiple middle-range theories. In the next subsections, we will expand on the logic behind each of these statements.

6.4.1 Implications of *classification* for theory development in project management

In addressing Söderlund (2011b) call to specify the types of projects and develop more unified theories, we highlight the fact that lack of proper classification is a major reason hindering project management from achieving this goal.

As depicted in Figure 6.3, initially, researchers should focus on the fact that the classifier's underlying theory or theoretical perspective (**theories for classification**) plays the main role in selecting classification criteria. Each theory for classification sees the subject through its own lens and distinguishes between "significant features" of an entity and trivial ones. Therefore, a researcher who is a proponent of some theory or theoretical perspective (e.g., contingency theorist) can select the significant features of entities from that perspective (e.g., project contingency factors) as the classification criteria and classify projects based on them.

Furthermore, if similar projects, in terms of some specific classification criterion, are put into the same category, a relatively "**homogeneous category of projects"** is constructed. The more similar features projects have, the more homogeneous each category becomes. We interpret "**project type**" as a homogeneous category of projects which share a certain degree of similarity in terms of specific features. The reason is that, on one hand, most project management studies refer to 'project type' as a group of projects categorized based on similarity in some characteristics (see Müller, and Turner (2010), Shenhar (1992), Shenhar, and Dvir (1996)). On the other hand, a group of entities with similar characteristics is generally called homogeneous[6] . Therefore, by making homogeneous categories, we are able to specify and delimit types of projects. For example, if projects are classified based on "uncertainty" and "complexity", we can expect to construct two major homogeneous categories, one that could be called an "R&D project type", with relatively high

[6] Homogeneity does not have a universal definition, as different domains have diverging perspectives on the concept. For example, in cognitive science, homogeneity is generally viewed in terms of how similar category members are to one another, relative to their dissimilarities (Gelman, 1988). In physics, materials that have the same properties at every point are called homogeneous (Rennie, 2002). In this paper, we refer to homogeneity in the general sense of the word as ' being uniform in composition or character' (Merriam-Webster.com, 2014).

levels of uncertainty and complexity, and the other which could be described as a "construction project type", with relatively low levels of complexity and uncertainty.

After constructing the relatively homogeneous categories of projects and delimiting a project type, researchers can test hypotheses and build theories related to that project type. Limited-in-scope theories (Merton, 1968), which describe the laws that govern the functions, processes, and behaviour of projects within a single project type, are referred to as **middle-range theories** (Packendorff, 1995). By developing a variety of middle-range theories, the project management discipline will gain more unified theories which are focused on one project type, as envisioned by Söderlund.

Nevertheless, although researchers are encouraged to move toward the unification of theories by focusing on project types and developing mid-range theories, they should also pay attention to a holistic view of the theories developed in different study areas across all papers. An interesting suggestion in this regard is made in the work of Joslin, and Müller (2016a), who suggest simultaneously examining each theory from different philosophical perspectives. By doing so, researchers gain a more comprehensive understanding of the different ways in which the problem is seen (ontology) and understood (epistemology), and the different kinds of research methods applicable. Consequently, they should be able to better compare and evaluate the developed theories. As a result, researchers are able to know where their mid-range theory stands in the meta-view of project management theories and see the similarities and differences among various theories. This would create a balance in theory development by disregarding the possible existence of a universal theory and also avoiding isolated theories.

6.4.1.1 Potential "theories for classification" in project management

As we explained, using a theory for classification, whatever it may be, is an essential requirement for constructing homogeneous categories, differentiating project types, and developing middle-range theories. However, the majority of studies in the project management literature are not explicit about the underlying theory used as the basis for project classification. That is why most project classification schemes seem to be developed heuristically and without any solid theoretical basis.

Moreover, Crawford et al. (2005) found out that even in the majority of organizations that deal with projects, the logic underlying the development of a project categorization system remains implicit. It is a challenging task to uncover the implicit theory underlying those classification schemes. However, giving these studies the benefit of the doubt, we cannot claim with certainty that there is no underlying theory behind them, as the classification of objects or concepts in any field of science is always done from a theoretical point of view, even if implicit (Hjørland, 2008). Therefore, we will look at the possible theories or theoretical perspectives which may have been used in project classification.

There has been extensive research into the existence of different theoretical schools of thought/ perspectives in project management. In a series of editorials in IJPM, Turner launched a discussion intended to culminate in a theory of project management (Turner, 2006a, 2006b, 2006c, 2006d). Slightly later on, in a series of editorials in PMJ, Bredillet with his colleagues Turner and Anbari in a series of editorials in PMJ, take a looked at the whole theoretical perspective of project management research and identified nine schools of thought or perspectives on project management: the *optimization school, modelling school, governance school, behaviour school, success school, decision school, process school, contingency school, and marketing school* (Bredillet, 2007a, 2007b, 2007c, 2008a, 2008b, 2008c). Winter, and Szczepanek (2009) referred to this multiplicity of project perspectives as "images of projects" in order to make sense of the complex realities of projects. Slightly different, Söderlund (2011a) divided the current state of theorizing within the project management field into seven "schools of thought": *optimization school, factor school, contingency school, behaviour school, governance school, relationship school* and *decision school*.

Among the school of thoughts/perspective in project management, many studies, particularly those adopting the contingency school of thought/perspective, have proposed that **project contingency factors** are reasonable classification criteria to group similar project types together. The proponents of this view argue that, similar to "organizational contingency theory" (Burns & Stalker, 1961; Donaldson, 1987, 2001, 2006; Lawrence, Lorsch, & Garrison, 1967; Waldman, 1965; Woodward, 1958), projects are greatly influenced by the organizational contexts in which they take place (Howell et al., 2010). Therefore, contingencies are significant factors in classifying and differentiating among projects.

Thus far, many contingency factors have been introduced to classify projects, including *complexity* (Davies & Mackenzie, 2014; Shenhar & Dvir, 2007), *uncertainty* (Howell et al., 2010; Loch et al., 2008), *risk* (Barki et al., 2001; Floricel & Miller, 2001), *project institutional environment* (Dille & Söderlund, 2011; Scott, 2012), *urgency*, *team empowerment*, and *criticality* (Howell et al., 2010). As an example of how these contingencies may be used in classification, consider a researcher who classifies projects based on "risk" in order to differentiate "risky project types". In such a classification, the more projects in a category have the same level of "risk", the more homogeneous the category becomes. By doing this, the researcher can delimit risky project types and develop and test hypotheses and theories about these types of projects.

Although insights from the contingency school of thought/perspective are very valuable for project classification, they are not the only theoretical basis that can be used for classification of projects. Theoretical insights from **other schools of thoughts/perspectives** can also be used to distinguish between significant and trivial project features, and subsequently devise a classification based on those significant features. For example, a researcher in the decision school of thought would differentiate between "public investment projects" and other types (Söderlund, 2011b) by using completely different criteria for classification such as "source of funding". The reason is that "source of funding" is regarded as "significant" for project management from the point of view of decision theory. So a classifier who sees the project world through the lens of that theory or school of thought would be more inclined to use that particular feature to classify and differentiate among projects. As the result, we can see that, for the same samples of projects, each theory or school of thought can potentially create a different classification scheme.

We should note that each project category is only perceived as "homogeneous" in the particular theoretical school of thought applied. The projects grouped together as homogeneous in a particular school of thought may be perceived as quite heterogeneous and unrelated in the view of another school of thought because the "significant" features in each theory for classification are different and dependent on the particular purpose of that theoretical view. Simply put, **homogeneity (of categories) is in the eye of beholder**. Part of the reason for this phenomenon is the ambiguity of defining a project itself and the fact that each classifier sees the project world from his/her own theoretical point of view which may focus on different aspects of a project as significant features.

That is why no particular theory for the classification of projects is any better than the others when it comes to making homogeneous categories.

Alternatively, instead of using project management schools of thought/perspectives for classification, researchers could adopt **management and economic theories** to classify projects into homogeneous categories. Still, the selected theories should make sense in the project management context. While it is by no means an exhaustive list, Table 6.1 shows some examples of studies that adopted management and economic theories in the project management context.

Table 6.1 Examples of potential theories in management/economic science for project classification

Potential theories for classification	**Examples in PM**	**Potential classification criteria**
Transaction cost theory	Reve, and Levitt (1984); Turner, and Keegan (2001); Turner, and Simister (2001)	Governance tools
Authority	Stinchcombe, and Heimer (1985)	Leadership style
Principal-Agent Theory	Turner & Müller (2004, 2005); Mahaney, and Lederer (2010)	Level of *communication* between the "project owner as principal" and "the project manager"
System Dynamics	Rodrigues, and Bowers (1996); Rodrigues, and Williams (1998); Love, Holt, Shen, Li, and Irani (2002); Lyneis, and Ford (2007)	Rework cycle, feedback loops, client behaviour

As Table 6.1 shows, some researchers have applied management and economic theories in the project management context and thereby identified some significant aspects of project management. Each of these significant aspects can be further used as a project classification criterion. In this way, future researchers can make homogeneous categories of projects (in light of the applied theory) and are enabled to further develop middle-range theories about the constructed categories.

6.4.2 Implications of *typology* for theory development in project management

Not only is typology different from classification by definition, but its important role as the starting point for developing a theory (Shenhar & Dvir, 1996) is far more undervalued in the project management literature. We believe that lack of enough typology in project management represents a missed opportunity that contributes to the underdevelopment of theories in this field. To address this issue, we will explain in this section how a typology itself is a unique kind of theory and elaborate on the implications it may have for future theory development in project management.

6.4.2.1 Typology as a unique kind of theory

A theory is traditionally defined as a series of logical arguments that specify the relationships among constructs, concepts, or variables (Bacharach, 1989; Blalock, 1969; Dubin, 1969; Whetten, 1989). However, not all theories conform to this traditional definition. Doty, and Glick (1994) argue that a properly developed typology can itself be considered as a unique form of theory, even if it is not expressed in the traditional manner. Fiss (2011) also contends that typologies are unique kinds of theories because, instead of just simple correlations between a single construct and a dependent variable, they incorporate asymmetric causal relations in their configurational arguments which explain how ideal types are made. Because typologies account for multiple causal relationships among constructs by simplifying them into a few easy-to-remember ideal types (McPhee & Poole, 2001), they reduce complexity to manageable levels, both conceptually and methodologically (Fiss, 2011).

Moreover, in a typology, variation of the dependent variable is not explained by a single attribute but instead by the relationships and complementarities between multiple characteristics (Delbridge & Fiss, 2013). This multidimensional nature of typologies, along with the configurational arguments embedded in the ideal types, makes it possible to capture the complex and interdependent nature of organizations (Fiss, 2011). Such advantages make the typologies theoretically attractive (Delbridge & Fiss, 2013) and have induced many theorists to use typology to understand the complex examples of a phenomenon (Biggart & Delbridge, 2004).

Devising a typology is particularly valuable in the early stages of a scientific discipline's development, because the initial foundations for theory development are generally established through a systematic ordering of the main elements of a complex phenomenon (Snow & Ketchen,

2014). That is why the typological approach to theory development has attracted considerable attention in management and organizational science as a promising avenue for theory development (Delbridge & Fiss, 2013). As a result, some of the most important contributions in management and organizational literature are typologies – for instance, those of Miles, and Snow (1978), Mintzberg (1979) and Porter (1980).

In general, theory development has three main purposes: description, explanation, and prediction (Kerlinger & Lee, 1964). Basically, typologies are very useful for both description and prediction (Snow & Ketchen, 2014). Doty, and Glick (1994) , however, argue that typologies meet at least three key criteria that all theories must have:

1. The constructs are identified.
2. The relationships among these constructs are specified.
3. These relationships must be falsifiable subject to empirical examination.

A well-developed typology respects the first condition because it is well informed by the theory from which it draws the distinctions, relationships and synthesis of conceptual importance (Burns & Stalker, 1961; Miller, 1996). Typologies also respect the second condition because the relationships among the second-order constructs used to describe each ideal type are hypothesized and discussed coherently so they will have normative implications (Miles & Snow, 1978; Mintzberg, 1979). That is why the precise description of relationships and interdependencies among the constructs within ideal types has been the essence of organizational configuration (Miller, 1990). Typologies also respect the third condition because all the configuration arguments and predictions about the dependent variable should be stated clearly and in a testable way. All well-developed typologies have always been subject to empirical investigation and many of them have been confirmed, revised or discarded (Doty & Glick, 1994).

Typology as a theory is more complex than traditional theories because it has the capacity to capture the various causal relationships involved instead of interaction between only two variables (Doty & Glick, 1994). That is why Doty and Glick argue that a well-developed typology can be considered as a unique form of theory that includes *a grand theory* and *multiple middle-range theories*. A **grand theory** of a typology predicts a level of dependent variables based on the "fit" between the features of existing entities and the ideal types. In addition, the descriptions of ideal types (by second-order constructs), along with hypotheses about their internal consistency

(relations of second order constructs), represent multiple **middle-range theories** (Pinder & Moore, 1980; Weick, 1974). Because typologies constitute multiple ideal types to allow one to understand a single phenomenon, they require multiple middle-range theories. There is an important distinction between usual "middle-range theories" and the "middle-range theories in a typology". Traditional middle-range theories (Merton, 1968) are similar to traditional bivariate theories, which generally explain a whole phenomenon, albeit with narrower scope (e.g., a project type). One the other hand, the "middle-range theories in a typology" are concerned with the internal consistency of the typology's ideal types and refer to the patterns of second-order constructs in each of the developed ideal types. Figure 6.3 illustrated how a typology can contribute to development of theories.

Following our earlier example, Shenhar, and Dvir (1996) empirically demonstrated that their project typology met all three conditions for qualification as a theory. With full empirical testing based on a sample of 127 projects, they demonstrated that many of their proposed second-order constructs were correlated with the two dimensions of "uncertainty" and "scope", as they had predicted. For example, they observed an increase in "the number of design cycles" as the level of "technological uncertainty" rose. These kinds of arguments, explaining how second-order factors change as we move through each typological dimension (from one ideal type to another), constitute typological middle-range theories.

Moreover, Shenhar and Dvir's empirical results confirmed that projects which exhibited notable differences from the characteristics of the proposed ideal types were considerably less successful than projects whose organizational and management characteristics were similar to those of ideal types. These observations allowed the authors to restate their typological grand theory as "the more similar the project style of a project is to that of a proposed ideal type, the more successful/effective it will be". Accordingly, they argued that any discrepancy between the characteristics of a project and the ideal types would decrease that project's success/effectiveness (Shenhar & Dvir, 1996, 2007).

Although this description of typology corresponds to Koskela's expectation that "a theory of project management" should be prescriptive and reveal how action contributes to the goals set for it (Koskela, 2000; Koskela & Howell, 2002a, 2002b), we argue that it is more appropriate to consider the grand theory of Shenhar and Dvir's typology as a "theory of project effectiveness",

and not a “theory of projects”. The reason is that a “theory of projects” (Söderlund, 2004), which serves to explain and predict project structure and behaviours, has a broader sense than the “grand theory of a typology” which aims to explain only one specific variable (e.g., project effectiveness/success). The same reasoning holds true for organizational typologies, such as Mintzberg’s typology, which should be considered a “theory of organizational effectiveness” and not a “theory of organizations”, because it explains organizational effectiveness as the dependent variable (Doty & Glick, 1994).

6.4.2.2 Future directions for typological theorizing

We are aware that developing a theoretically rigorous and fully specified typology is more challenging than traditional bivariate or interaction theories. Yet we believe that this additional effort will be theoretically valuable, since typological theories are more likely to account for the complex, multivariate nature of many projects and perhaps more likely to lead to ground-breaking contributions to project management theory. We hope that by demystifying the definition and components of typology, we will enable future scholars to move beyond traditional linear theories so they can construct various project typologies and fully develop them into typological theories. Future scholars can take two main directions in typology-driven theorizing (Snow & Ketchen, 2014):

1. Evaluate existing typologies for their current relevance.
2. Identify the subject areas where new typologies be constructed and tested.

The first direction is to evaluate existing typologies in order to determine whether, in today’s project conditions, they should be maintained as is, revised, or discarded. Constant evaluation makes a typology robust and valuable. For example, Miles, and Snow (1978) typology has been widely researched and tested (Snow & Ketchen, 2014). The initial step in re-evaluation is to select a new sample of projects and reliably measure the characteristics of that sample. Then arguments about the consistency of proposed ideal types can be verified. The next step is to evaluate their proposed grand typological theory by examining the extent to which the deviation of the new sample’s characteristics from those of the ideal types predicts the dependent variable.

Following our example, Shenhar and Dvir’s typology would constitute a good candidate for re-evaluation because their sample of technical projects only included “military” and “commercial

market" projects, which may not be representative of projects in general, or in other parts of the world (Shenhar & Dvir, 1996). In this case, one could test whether in other types of projects (e.g., big data projects), an increase in "project scope" augments "project bureaucracy and documentation" as the authors claimed. It is conceivable that, given today's high usage of agile methods, particularly in software projects, such arguments should be revised. Other proposed typologies in project management such as Mazouz et al. (2008) typology of PPP projects and Kujala et al. (2010)'s typology of solution-specific business models in project-based firms are also potential candidates to be re-evaluated. This would help future researchers to supplement earlier theoretical findings.

The second direction for typological theorizing is to identify promising subject areas for developing a new typology. Although many project classification schemes, such as those of Evaristo, and van Fenema (1999) and Blismas et al. (2004), have not been developed into full typologies, their proposed classification schemes can be used as the basis for further development of various typologies. Moreover, future researchers can investigate a variety of other project management dimensions in order to propose new typologies. These dimensions can be any important aspects of projects used by prior researchers in their classification schemes. For example, some other project dimensions that could be used as the basis for a typology are *industry, size, customer, contractor's organization, political, financial, geographical situation* and so forth (Shenhar & Dvir, 1996).

Going further, it is not necessary to limit our attention only to developing typologies of "projects" as the phenomenon under study; typologies are also needed in emerging topic areas (Snow & Ketchen, 2014). Some emerging areas in project management research have great potential for typology development. For example, one such area is the development of a *typology of Project Management Offices (PMO)*. Many authors have argued that a typology of PMOs would greatly facilitate their design, description, analysis and management (Crawford, 2010; Dinsmore, 1999; Englund, Graham, & Dinsmore, 2003; Kendall & Rollins, 2003; Light & Berg, 2000) . However, many existing PMO typologies have not been empirically validated and present only a limited number of types of PMOs (Hobbs & Aubry, 2008).

In an empirical study that relied on the identification of statistical associations among the characteristics of PMOs and of their organizational context, Hobbs, and Aubry (2008) found extreme variability among PMOs. They concluded that their statistical results and their model could

only provide guidance and were not strong enough to form a well-defined typology of PMOs. In a later study, Müller, Glückler, and Aubry (2013) focused only on the relationships that PMOs had with their "stakeholders" to develop a typology. They called for more quantitative studies with a larger sample of PMOs to prove and stabilize their typological model.

In summary, we argue that, in addition to the re-evaluation of current typologies, there are still many other interesting directions for future project management scholars to develop a typology and contribute to theory development in this field.

6.5 Conclusion

This paper addresses Söderlund's (2011b) call to develop more unified theories which are focused on one "project type", regardless of the theoretical schools of thought/perspectives applied, the problems concerned or the different phases of the project life cycle. We highlighted the role of classification as the fundamental, but often forgotten, step in this process. We argue that, by using theories for classification, researchers are enabled to delimit project types and develop middle-range theories. In this way, project management scholars can generate additive knowledge for theories that are more unified, vigorous and reliable, albeit narrower in scope.

Moreover, in our review of the literature, we noticed that a consistent research vocabulary for project classification has yet to be established. In particular, semantic confusion exists between two important terms: *classification* and *typology*. That is why we tried to construct a common lexicon – definitions, components and theoretical implications – for these two terms, in an attempt to alleviate this confusion that reigns in the project management research community. This could help project management researchers grasp the differences between these concepts and hopefully use them more appropriately and more consistently in future studies.

We also pointed out that lack of typologies represents a missed opportunity in the development of theories in project management. We argued that, although developing a fully specified typology is more challenging than developing traditional bivariate theories, it will be worthwhile, since typological theories are more likely to account for the complex, multivariate nature of many projects. We also explored two promising directions that future project management scholars can take to engage in further typology-driven theorizing. First, they can evaluate existing typologies for their current relevance; second, they can work on subject areas where new typologies can be

constructed and tested. This would constitute a major strength of this paper as it takes an important step, helping the project management community to catch up with the current state of theorizing in other fields such as management and organizational configuration. The main limitation of this study is that it does not consider project classification from the cognitive science perspective, in which categories are cognitive concepts with a dense center, called the "prototype", and fuzzy overlaps (Rosch, 1975, 1978). Therefore, there is an embedded risk of category overlaps, particularly when we use the project types as the reference point of theory development. It would be worthwhile for future researchers to delve into cognitive psychology in order to examine whether prototypes of project categories (i.e., the summary representation or most typical project in a category) can be set as reference points for delimiting widely accepted project types among different researchers or practitioners.

We hope that this paper stirs up the project management community's interest in classification and typology research, which has been long neglected. Because we are still in the early stages of theory development in project management (Söderlund, 2011b; Yung, 2015), researchers who devise various middle-range theories or typologies can make major advances that could lead to ground-breaking contributions. These contributions also give managers a richer set of theoretical tools, making them better able to solve the problem they are currently facing (Anderson, 2007). After all, " there is nothing more practical than a good theory" (Lewin, 1951, p. 169).

CHAPTER 7 GENERAL DISCUSSION

This chapter highlights the contributions of this dissertation to different areas of the "classification" research stream. Further, the limitations of this dissertation are discussed and some suggestions for future studies are presented.

7.1 Contribution to the project management field

Overall, this dissertation lays the groundwork in establishing project classification as an independent avenue of research in the project management field. The hope is that this work will stir up the project management community's interest in classification research, which has long been neglected.

In this dissertation, categories are not regarded as a fixed characteristic of projects; on the contrary, they are regarded as subjective: they depend on the context and the classifier's choices. This ontological shift, advocated in the three articles comprising this dissertation, should make important contributions to how future project management research might be conducted.

First of all, it became clear that there is no one correct way of categorizing projects. Therefore, the justifications of "dividing projects based on some project contingency factors" or "development of a project taxonomy based on numerical methods" should only be applied in specific contexts and in judgments made by a specific researcher. That is why existing project classification schemes should not be taken for granted; instead, they should be evaluated with a grain of salt until authors provide explicit justifications of how and why they categorized their projects in a particular way.

Accordingly, this dissertation recommends that "being explicit about the used project classification scheme" to be a prerequisite for all studies published in the project management field. This recommendation should not be regarded as merely concerning project labeling. On the contrary, it should be seen as a three-step process of *presenting an explicit project classification scheme*, *justifying why that classification scheme was used or developed* and only then *specifying which category or categories the project sample belongs to*.

In that way, researchers will have gained better insight into other authors' perceptions and understandings of the type of projects about which they formulated hypotheses or developed a theory. This would give future researchers a basis to verify whether the project category labels they are using are similar to those of previous researchers or not.

Moreover, with an explicit classification scheme that delimits the type of projects, future researchers will have a basis to judge whether two isolated middle-range theories were developed about the same project category or not. In addition, isolated middle-range theories can be mapped and unified. This in turn will result in a considerable improvement in the current state of theory development about project management. As a result, not only will managers have a richer set of theoretical tools that will help them make better decisions and address the problems they are facing but project management should be acknowledged as a more theoretically robust research field within the wider community of organizational and management science. This advance will not happen overnight, but the insights provided in this dissertation can be seen as a leap forward.

7.2 Contributions to the classification research stream

Overall, the collection of articles, along with the literature review chapter, showed how classification should be regarded as an independent research topic in project management. In doing so, some important areas in the "project classification" research landscape were identified.

In the literature review, three fundamental areas of research into classification were identified: *terminology*, *classification processes*, and *philosophical* stands vis-à-vis *the* classification. Moreover, in depicting a high-level, comprehensive picture of classification research, the study of the *implications of classification* is considered to be another important study area usually addressed in management studies. Table 7.1 sets out a comprehensive view of all the research areas to which different parts of this dissertation have contributed.

Table 7.1 Contributions of this dissertation to the topic of "classification"

Project classification as a research topic		
Main areas	**Covered in**	**Topic covered**
Philosophical views	• Literature review	• Disregarding the classical view and considering categories as cognitive/social artifacts
Terminology	• Literature review • **Articles 1, 2, 3**	• Clarifying the distinction among *classification, categorization, typology,* and *taxonomy*
Classification process	• Literature review • **Article 1** • **Article 2**	• Review of empirical, theoretical and cognitive classification processes • Review of different views of the cognitive process of classification • Empirical examination to reveal the configuration underlying "shared understandings" of categories
Implications of classification	• **Article 3**	• Theoretical implications of classification and typology for project management

With regard to the different study areas presented in Table 7.1, this dissertation has made an original and important contribution to the "philosophical views" and "terminology" areas, which had previously been disregarded in the project management literature.

Nevertheless, the main contribution of this dissertation was the investigation of classification as a process. By evaluating project classification from the cognitive perspective, this work contributes greatly to the categorization research stream in organizational and management science, where researchers usually examine cognitive structures underlying the emergence of categories and the consequences of those categories for markets and organizations (Durand & Paolella, 2013; Hsu & Hannan, 2005; Wry et al., 2014; Zuckerman, 1999). However, in this dissertation, I evaluate cognitive infrastructures in the development of categories at the project level rather than the market or organization level. This would open up a new niche in category research, as researchers will be able to examine how project classification schemes are formed inside organizations and how different project classification methods might impact an organization's overall performance.

As for the "implications of classification" area, the third article discusses how further research on classification and typology might impact the theoretical state of the project management field.

Similar to management studies that evaluate the impact of different organizational classifications on their performance, this research area still needs to evaluate the consequences of different understandings and perceptions of project categories on the performance of both projects and organizations. This suggestion is explained in more detail in section 7.4.

7.3 General limitations

Given that classification as a topic of research has not been rigorously addressed in project management literature, and different concepts and classification-related terminologies are extremely wide-ranging and interdisciplinary, the main limitation of this dissertation is that it presents complex concepts and terms in a compressed and abbreviated way. Because I tried to convey essential ideas for project management, some more context-specific, less general terms, concepts and arguments were inevitably missed.

Another limitation is the use of the secondary data in the empirical experiment presented in the second article. Because of the time limits on PhD research and the fact that preparing the extensive theoretical and interdisciplinary part of this dissertation was a lengthy process, there was no choice but to use an available secondary data set in that article. Although the data set was extremely helpful and valuable, designing a more comprehensive survey could have generated further insights into the factors that affect the configurations of shared understanding. For example, only the effects of "average time spent on project" and "years of experience" in shaping different shared understandings were examined. However, with a more comprehensive survey, we could have looked for the differences in the other personal and contextual characteristics of individuals (e.g., age, type and industry of the organization for which they work) that make a difference in their perception of project categories. In other words, it might have been possible to better identify the *differences that make a difference* in individuals' perception.

Moreover, regarding the main areas of classification research, presented in Table 7.1, this dissertation makes a limited contribution, particularly to the "cognitive classification processes" and "implications of classification" areas. Although this work represents an initial investigation into these areas, much remains to be done and there is a need for further studies to examine and track how understandings and perceptions of various project categories emerge, propagate, and

self-justify in different groups of researchers, organizations, markets and societies. Suggestions for possible extensions of this research are discussed in the section 7.4.

7.4 Future studies

As discussed, "cognitive classification processes" and "implications of classification" are the two main research areas in which future studies can be conducted.

With regard to cognitive classification, the first suggestion is that further research be done on different individuals' or groups' perceptions and shared understandings of various project categories. The insights from first and second articles in this dissertation constitute a basis for future researchers to discover the cognitive mechanisms that people incorporate to perceive and understand project categories. Future studies need to go deeper and explore other aspects of this topic. For example, one possible extension of this research is to *examine different groups' shared understanding of project categories other than the ones used in this dissertation (e.g., complex projects, innovation projects, etc.)*. In this way, project management researchers can map the configurations underlying different groups' shared understandings of important project categories. This would constitute an important step in finding out what kinds of variables (in the identified configurations) make a difference in groups' perception of category labels. Such insights could be applied in practice to manage different stakeholders' expectations of various project categories, in a project management context.

The second suggestion for further research on the cognitive process of classification is to consider time as a factor affecting the configurations of shared understanding. This dissertation highlighted the role of context and classifier's cognition in the classification process from a static and timeless perspective. However, the drivers of classifiers' perception (goals, knowledge, experience, etc.) are dynamic in nature (Murphy, 2002). Moreover, category labels are not isolated and constantly interact with social practices, institutions and authorities (Hacking, 2002). Accordingly, different configurations may continually emerge with regard to understanding of categories (Kennedy & Fiss, 2013).

Considering the factor of time in the classification process would raise some interesting research questions, such as *How does the occurrence of an event in the lifetime of a project or organization change the configurations underlying the shared understanding of different groups?* and *How do*

shared understanding and the meaning attached to category labels evolve in different groups or organizations at any given time? The answers to such questions can show what variables enter into or exit from the configurations groups of individuals form regarding their perception of categories. This would be a valuable insight helping project or organization managers to take appropriate action in managing stakeholders' expectations of project categories and project classification systems as a whole. As a result, the chance that a project classification system will actually be used increases. Likewise, the chance of a project being neglected, because it does not match a stakeholder's time-sensitive perception of project categories, is reduced.

In the "implications of classification" area, although the category research stream in management science has long been examining the macro-social consequences of different categorizations of organizations (Vergne & Wry, 2014), such studies are still missing from project management research and further work is called for. Accordingly, future studies can examine the consequences of different understandings and perceptions of project categories for other dependent variables (e.g., performance) in both projects and organizations. In other words, configurations of shared understanding of project categories can be seen as an important factor that impacts project or organizational outcomes.

Thus, a research study could be designed to discover *how and why different understandings and perceptions of project categories impact other variables such as project or organizational performances.* After knowing how sensitive project or organization results are to different configurations of project categories, managers should be better able to take corrective actions in changing their project classification schemes or making an effort to shape project stakeholders' perceptions in the desired way.

CHAPTER 8 CONCLUSION

This chapter summarizes the main takeaways from each article and concludes on the implications of this dissertation for project classification as an independent research topic.

8.1 Summary of articles

In the literature review, after surveying different classification terminologies and processes in different fields, the modern philosophical stand vis-à-vis the classification was examined. It is now thought that categories do not exist outside of human perception. Therefore, they are artifacts of human minds and individuals play the main role in shaping the classification process. Accordingly, it was argued that "categories" (or types) are not inherent in projects (or any other entities), but rather are labels of cognitive classification schemes that individual researchers assign to projects. In a nutshell:

- Projects do not have predefined category labels.
- Categories are mental artifacts; therefore, category membership is a matter of individual perspective.

Such arguments lay the foundations for examining project classification from the cognitive perspective. Accordingly, the *first article* reviewed the most important studies in cognitive science, and explained that each individual may have a different cognitive classification process, and therefore perceive and understand project categories differently. As a result, applying different labels to a single project (e.g., whether a project is "complex" or "innovative") is totally dependent on how the classification process is developed and justified in a researcher's mind. In other words:

- There is no one "correct" way of classifying projects.
- A project classification is formed and justified "in the eye of the beholder."

To demonstrate that project classification is subjective (formed and justified by each "beholder"), the first article pointed out various project classification schemes that have all been used in the project management literature but otherwise have very little in common. The main views on how human cognition may shape categories were reviewed. It was explained that in addition to similarity to a prototype and fulfillment of the classifier's goal, the classifier's knowledge of causal relations also plays an important role in selecting classification criteria. Simply put:

- Not only a project's features per se but also the classifier's goals, ideals and preferences and knowledge of causal relations can be reflected in classification criteria.

Highlighting the role of individual cognition in the classification process does not undermine the importance of project characteristics in defining project categories. In fact, the argument is that, in the classification process:

- The weight and importance attributed to project characteristics are not intrinsic to them but are assigned by the classifier, under the influence of various factors (goal, experience, prior knowledge).

Building upon the theoretical arguments presented in the first article, the *second article* took an empirical approach to verifying the existence of different perceptions and understandings of a given project category label. Introducing the notion of "shared understanding," that article described a particular methodology as a way to capture the divergence of understandings of the same category label. In summary, this article argued and empirically demonstrated that:

- Distinctive shared understandings of the same categories exist.
- Each group of like-minded individuals uses different "configurations" (combinations of features) to make sense of a category label.

The empirical results of the second article provide some guidelines for researchers and practitioners to investigate the reasons for the confusion and multiple interpretation of project categories.

The first two articles in this dissertation directly addressed the specific research objective of evaluating project classification from the cognitive perspective. The *third article* took a higher-level approach and discussed how research on classification can benefit the current state of theorizing in project management. Although the literature review section of this dissertation alluded to the confusion about classification-related terminologies, the third article examined this issue in the context of project management. In particular, it proposed a clear distinction between the words *classification* and *typology* and argued that:

- Development of a project typology is more than just another project classification scheme.

After discussing the distinction between a classification and a typology, the important, yet often forgotten, role of these concepts in theory development for project management were discussed. It is argued that being explicit about the project classification scheme that is used can help researchers delimit the project types in a study. This would satisfy a core requirement for the development of

middle-range theories (Packendorff, 1995), which are like general theories but their scope is limited to a single project type. In conclusion:

- Development of an explicit classification scheme is a core requirement for the development of middle-range theories.

Another implication of being explicit about classification schemes in project management studies is that isolated middle-range theories can be linked and compared. As a result, the project management field will be able to move toward the development of more "unified" project management theories, as envisioned by Söderlund (2011b).

Furthermore, the third article pointed out that, as in organizational and management science, the development of various typologies is a useful avenue for the theoretical advancement of the project management field. It argued that a properly developed typology not only has the capacity to capture the complexity of project management, it also meets the criteria for being an independent theory. Simply put:

- Development of a project-related typology is a useful – yet underused – way of theory development in project management.

In summary, the third article introduced a richer set of tools that can not only lead to groundbreaking contributions in project management practice but also help the field to flourish theoretically.

8.2 Final words

In conclusion, this dissertation advocated for establishing "classification" as an independent topic of research in project management. In all the articles comprising this dissertation, it was explained that research on different aspects of project classification not only has practical and research implications but also sets the stage for further theory development in project management field.

The review and clarification of the main terminologies, processes and philosophical views was the initial step in addressing the classification research niche within the project management field. Furthermore, by rethinking the role of classification in project management context, from a blindly used hierarchical sketch to a more complex cognitive artifact, the need to evaluate project classification from the cognitive perspective was highlighted and addressed, particularly in the first

two articles. Accordingly, the main objective of this dissertation, which was *to evaluate the process of project classification from the cognitive perspective*, was fulfilled.

The hope is that, building upon the insights provided here, future researchers will continue to work on project classification as an independent topic of research. This would not only have important implications for project management research and practice but would also help project classification to be recognized as an important research avenue within the broader community of researchers interested in classification.

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