Design and Implementation of a Mixed Method Research Study in Project Management

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Abstract: This article presents a mixed methodological approach in project management research and details the terms and the conditions of its design and implementation. Assuming, on the one hand, that qualitative methods allow the study of complex processes and phenomena in their idiosyncrasy, and, on the other hand that quantitative methods produce a nomothetic science based on statistical regularities (Miles, Huberman and Saldana 2013). We argue that mixed methods research allows, under certain conditions and trade-offs in the design and the implementation, the achievement of these two objectives. Mixed methods research remains underutilised in the management sciences despite the advantages in comparison to mono methods (Molina-Azorin and Cameron, 2010). This underutilization is linked to the tendency of certain discipline traditions and preferences for quantitative approaches as opposed to qualitative approaches. This opposition is also linked to the incompatibility thesis of the epistemological paradigms combined with the exclusive links between paradigms and methods. The theoretical foundations of mixed methods is relatively young and there remains many questions relative to the process of design, implementation and integration of qualitative and quantitative research to which researchers new to mixed methods may be confronted with. This article presents research which was carried out in two stages and focuses on the comprehension and the explanation of the diversity and the evolution of project manager's roles. The paper discusses and demonstrates the objectives of a research strategy based on a mixed methodological approach combining qualitative and quantitative methods and specifies the type of mixed method research according to the implementation order, the degree of combination of the two methods and the relative weight of the qualitative and quantitative methods. We propose a practical application of the theory of mixed methods that can assist and inspire project management researchers in the design and the implementation of their own mixed methods research.

Keywords: mixed methods research, transformative design, sequential and concurrent implementation, project management

1. Introduction

Mixed methods research is increasingly being used today in many disciplines such as sociology, psychology, health, and education. Since 2007, a specialised journal has been devoted specifically to mixed methods research: *The Journal of Mixed Methods Research,* published by Sage. Many researchers point out the importance of mixed methods and their advantages in comparison to mono-methods (Jick, 1979; Creswell, 2003; Johnson and Onwuegbuzie, 2004) but despite this, mixed methods research remains under utilised in the management sciences (Molina Azorin and Cameron, 2010). This underutilization is potentially linked to the incompatibility thesis of the epistemological paradigms supported by the purists of qualitative and quantitative approaches but also, the resources relatively more important required by these methods: time, money, capacity to use the two methods, creative and reflexive capacities. Molina-Azorin and Cameron (2010, p 102) undertook a review of mixed methods studies in three organisational journals for the period 2003 to 2009: the *Strategic Management Journal, Journal of Organizational Behavior and Organizational Research Methods.* They found:

> *…it seems likely that the advantages, possibilities, purposes, designs and potential of mixed methods research may be unknown to researchers in these fields. Put differently, mixed methods research is used in organisational and management studies but it may be completely unknown and without recognition that mixed methods research constitutes a specific approach to research. Therefore, although mixed methods research is used in these business fields, these mixed methods studies may not exploit the full potential for mixing methods and researchers are probably not maximizing the extent to which they are using this approach.*

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In terms of the use of mixed methods in project management research there have been some recent chapter contributions in an edited book titled, *Novel Approaches to Organizational Project Management Research: Translational and Transformational,* edited by Drouin, Muller and Sankaran (2013) and another edited by Pasian (2015) titled, *Designs, methods, and practices for research of Project Management*. In the former there is a chapter by Cameron and Sankaran (2013) on mixed methods and in the latter there are three chapters which look specifically at mixed methods in project management research (Cameron and Sankaran, 2015; Thomas and George, 2015; Bosch-Rekveldt, 2015). Cameron et al (2015, p. 101) undertook a study of mixed methods articles published in 3 project management journals from 2004 to 2010: *International Journal of Project Management (IJPM); Project Management Journal (PMJ)*, and *IEEE Transactions on Engineering Management (IEEE-TEM)*. They found:

> *…the use of mixed methods in project management research has increased marginally since 2004; however, it is not keeping pace with the use of mixed methods in other fields of management research. Project management research papers do not explicitly acknowledge the use of mixed methods and it was difficult to identify a paper in the study that followed the guidelines for reporting mixed methods research as located in the literature of mixed methodology.*

These publications render difficult the exploitation by the researchers as to what constitutes "good practice" in conducting and reporting on mixed methods research. There are questions raised as to the conditions and the modes of conception and implementation of mixed methods: Why use mixed methods research? What should the implementation order be? the perspective of the study, the degree of combination of the quantitative and qualitative data and the weight of the qualitative and quantitative methods in order to specify the type of our mixed method research?

We try to provide an answer to these questions in this article through the presentation of the mixed methodology used in project management research. This research focuses on the comprehension and the explanation of the diversity and the evolution of project manager's roles, and was carried out in two stages. The first research stage consisted of three months spent with project teams and project managers on three building sites of big dams. During these three months the construction process and the work of project managers and their teams on the site were observed. Site meetings were attended, documents were collected and fourteen semi-directive interviews with the project managers were undertaken. This type of interview allows the researcher to guide part of the discourse with the interviewees to the themes defined in advance in the interview guide. At the end of this stage, testable propositions were formulated linking the project manager's roles and the characteristics of dams were developed. During the second stage, ten building sites of big dams were visited and twenty eight semi-directive interviews were carried out. These contained a qualitative and a quantitative analysis with the aim of validating our propositions relative to the contingent character of the project manager's roles and to explain the evolution of the latter during the life span of the project.

Our article is structured in three parts: in the first part, we discuss and show the objectives of a research strategy based on a mixed methodological approach combining qualitative and quantitative methods. In the second part, we specify the type of our mixed method research according to the implementation order, the degree of combination and the weight of the qualitative and quantitative methods. Finally, in the third part, we discuss the problematic issues associated with using mixed methods research and we address perspectives of future research.

2. Research strategy: A mixed methodological approach to comprehend the complexity of reality

Many researchers in the management sciences have had a tendency to oppose qualitative approaches over quantitative approaches. This opposition is the consequence of the incompatibility thesis where exclusive links are made between paradigms and methods. Some discipline traditions have a predisposition to associate the positivist paradigms with the quantitative methods and the interpretivist and constructivist paradigms with qualitative methods (Onwuegbuzie and Leech, 2005). Researchers who oppose qualitative methods seem to confound epistemology and methods. The link between the epistemological paradigms and the research methods is neither univocal nor sacrosanct (Howe, 1992). Without sharing the agnostic vision of James' metaphysics, we think the researcher should not, on the one hand, have and allegiance to a school of thought

and, on the other hand, should have the freedom to use the qualitative and/or the quantitative methods according to their beliefs. The most important issue is that the methods must be appropriate to the research problem and the research questions. Thus, we adhere to Morgan's pragmatic approach (2007) which focuses on the methodology as a connexion centre of abstract levels of epistemology and of mechanical levels of methods.

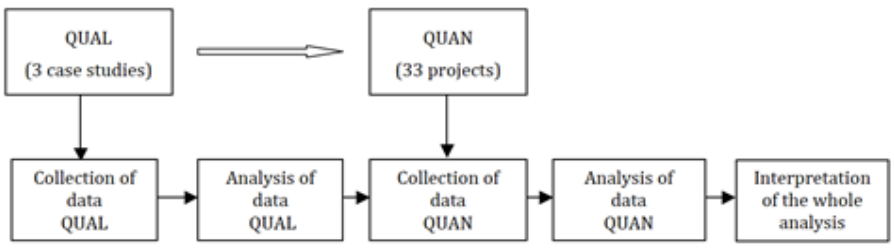
In this research, a mixed methodological approach combining qualitative and quantitative methods has been utilised. This combination is legitimized by the pragmatic approach (Morgan, 2007) which focuses on the methodology as a connexion centre of abstract levels of epistemology and mechanical levels of methods and motivated by a hybrid exploration of complex phenomena and process. Beyond that, it is also a matter of trying to reduce the weaknesses and the problems linked to mono methods, to ameliorate the validity and reliability of the results and to enrich our comprehension of the studied phenomenon and the emergence of new dimensions (Jick, 1989, Sechrest and Sidani, 1995, Teddlie and Tashakkori, 2003; Johnson and Onwuegbuzie, 2004). There are several definitions of mixed methods research. In this research, we adopt Johnson, Onwuegbuzie's (2007, p. 120) definition of mixed methods which we consider the most complete: *"Mixed methods research is the class of research where the researcher mixes or combines quantitative and qualitative research techniques, methods, approaches, concepts or language into a single study or set of related studies".*

In addition to pure quantitative and qualitative mono methods or multi methods mixed methods research constitutes a "third wave" or "movement" of research (Teddlie and Tashakkori, 2003). Webb et al. (1966) were the first to have introduced the idea of mixed methods through the invention of the triangulation term. Campbell and Fisk (1959) developed it through the idea of "multiple operationalism" and Denzin (1978) described how to implement mixed methods Thus, the latter distinguished the intra-triangulation methods (example: experimentation and investigation) which ameliorate the internal validity and the inter-triangulation methods (example: semi-directive interviews and investigation) which ameliorate the external validity.

Beyond the triangulation aim and its importance in management sciences (Denzin, 1978; Jick, 1979) other key objectives justify choosing the use of the mixed methods research. Greene et al (1989) developed five purposes for using mixed methods i) triangulation, ii) complementarity, iii) Initiation, iv) expansion and vi) development. In the same way, Creswell et al. (2007) identified four purposes for conducting mixed methods research: exploration, explanation, complementarity and triangulation. The three most pertinent purposes to our research are exploration, triangulation and complementarity, as described below. Exploration is used to understand a phenomenon and test propositions resulting from the qualitative phase, and complementarity is used when one method assists in clarifying, enhancing, or illustrating the results from the other method.

2.1 Exploration

Exploration materialises in the framework of a sequential research strategy. The researcher, for example, completes in a first stage, a study of an exploratory case allowing the researcher to understand better in depth the complexity of the phenomenon or process and thus generates propositions which can then be tested in a second stage on a larger sample (Figure 1).



Source: according to Creswell W. J., 2003, *Research Design: Qualitative and Quantitative, and Mixed Approaches*, Thousand Oaks, CA: Sage.

Legend: QUAL: qualitative method **QUAN**: quantitative method ⟹ : sequential combination of methods

Figure 1: Sequential exploratory strategy

In the first stage of our research we achieved an exploratory, qualitative case study. At the end of this stage, we obtained first comprehension of the diversity of the project manager's roles in the context of the

construction of big dams. We then built a new conceptual contingent and dynamic model and formulated propositions. These propositions have, then, been statistically tested on a sample of thirty three big dam projects and supported, completed and explicated by the qualitative analysis of the projects manager's discourse. Seen from this angle, the strategy is partly sequential with an exploratory aim. However, it has not been limited to the sequential mode since in the second stage of the research, mixed data was collected concurrently, the objective of which was the dual purpose of triangulation and complementarity.

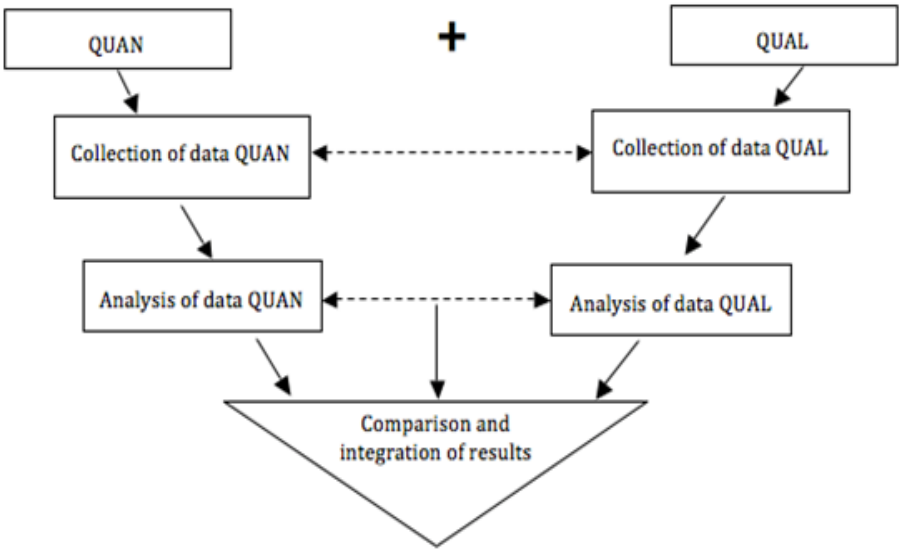
2.2 Triangulation

Triangulation is among one of the main objectives of mixed methods research. According to Denzin (1978), "triangulation is the combination of methodologies in the study of the same phenomenon." It allows the researcher to corroborate and to support the results relative to the same phenomenon with different methods and to ameliorate internal and external validity. To remain in the scope of our research, we have used qualitative and quantitative methods in a concurrent manner (Figure 2) to study the diversity of the project manager's roles in relation with the characteristics of the project. The phenomenon is the same but the collecting mode of the data was different. Thus, the use of the different and independent measuring instruments permits us to provide a precise "portrait" of the diversity of the project manager's roles in relation with the characteristics of the project (Jick, 1979). To illustrate the triangulation used in our research, we present the two following examples:

QUAN	QUAL
The quantitative results of the ANOVA analysis shows that the role of champion is significantly more important in projects with a high technical uncertainty than in the projects with low technical uncertainty, to $P < .05$ (proposition 3).	The qualitative analysis of interviews supports this result. To decrease the high technical uncertainty inherent in projects, the project managers attribute the importance to the promotion and the implementation of technical and organizational innovative solutions. OI Project manager*: "we have more defended the AH project than SD. We fought in order to make the project succeed. It is really my personality which was involved; not the enterprise. At a certain time, it was said that the physical person who wanted to succeed; not the moral one. It was a challenge. I had to make it a success because it was the first dam of its style."*
Tamhane's test carried out in the framework of "post hoc test" shows that the coordination role is significantly more important in the phase of works than in the phase of building site installation and the phase of completion to $p < .01$.	The qualitative analysis of interviews corroborates the quantitative result and explicates it by a high complexity in the phase of works. TY, project manager*: "The coordination is important there (the installation phase of the building site) it goes up more there (works phase) because there are other participants who come into play: the electro-mechanic enterprise with its teams, and at the end it comes down. It's the end of works, the coordination becomes less".*

Table 1: Illustrative examples of the triangulation in the second stage of the research

The triangulation strategy may be schematised as displayed in Figure 2.



Source: according to Creswell W. J., 2003, *Research Design: Qualitative and Quantitative, and Mixed Approaches*, Thousand Oaks, CA: Sage.

Figure 2: Concurrent strategy of triangulation

2.3 Complementarity

The complementarity among the methods permits researchers to clarify, explicate and to apprehend some levels of analysis different from the object of research. Thus, the objective is not to corroborate the results, but to apprehend a supplementary facet of reality. In our research, the complementarity was carried out on a framework of concurrent triangulation and can be observed during the organization of the qualitative and quantitative results. An example of the latter is presented here.

The results of the ANOVA analysis show that the degrees of technical uncertainty, complexity and pace are significantly more important in the works phase than in the other phases to $p < .01$ and that the roles of the project manager are significantly more important in the works phase than in the two other phases to $p < .01$. Thus, it was concluded that the variation of roles follows the variation of the projects characteristics in the three phases. The curve founded on the descriptive statistics also demonstrates this. However, this quantitative analysis does not show the variation of a specific role in relation with the variation of a specific characteristic. It is the qualitative analysis which will permit this to be explored. For example, the innovation is significantly more important in the works phase than the installation phase of the building site and the completion phase (to $p < .01$). The qualitative analysis corroborates the result and explicates it by the variation of the degree of technical uncertainty among the three phases of the project.

> BT, project manager: *"During the phase of the building site installation, we make attempts which we continue throughout the project. But it is a part of the norms. There is nothing new and is not really a part of the innovation. The rules of art say that you should test many formulas of concrete and to choose the best. During the phase of works we innovate because it is there where the technical problems emerge. We innovate in order to focus on these problems".*

The qualitative analysis has permitted a subtle comprehension and the explication of an inferior level of analysis. It thus compliments the results of the quantitative analysis.

2.4 Transformation

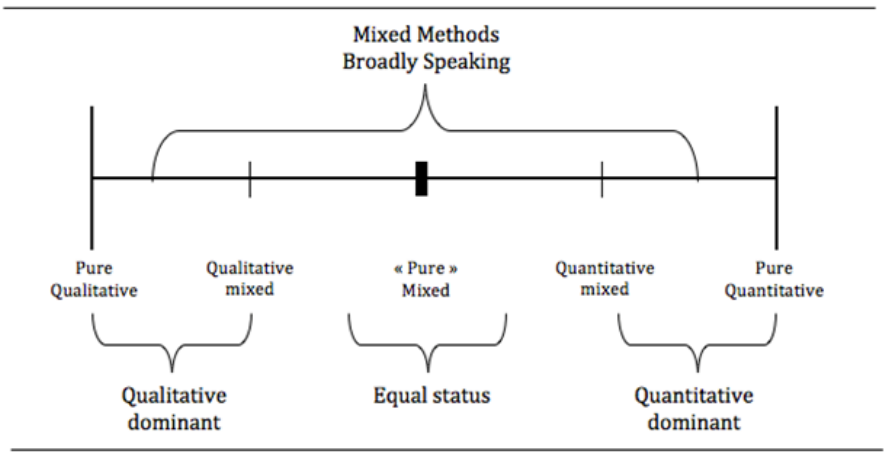
The transformation of data is one of three objectives of mixed methods. It is a matter of converting the qualitative data into numerical codes in order to be statistically analysed or converting the quantitative data into narrative data in order to be quantitatively analysed. The method of comparative analysis (QCA) developed by Ragin (1987) permits the transformation of data thanks to the Boolean algebra. This method remains underutilised in the discipline of management sciences despite its advantages (the best

comprehension of the studied phenomenon and the adequacy to samples of intermediary size). The method of the research is not of the QCA type because, on the one hand, we did not use the Boolean algebra but statistical tests (ANOVA, t of Fisher, t of Welch, "post hoc test") and, on the other hand, the qualitative data were not obtained from the quantitative values, but from semi-directive interviews. However, it remains quite near the QCA method because of the common characteristics: the dichotomization of some variables (0 for example for the projects with low innovative and 1 for the projects with high innovative), the objective of exceeding the incompatibility of qualitative and quantitative methods and the double comprehensive and analytical aim.

3. The classification of our mixed method research design

The typology of the mixed methods research can be established according to four principal dimensions: the status of each method in relation to the other (Morse, 1991; Morgan, 1998), the degree of combination of the methods (Johnson, Onwuegbuzie and Turner, 2007), the order of implementation of the methods (Creswell, 2003; Johnson and Onwuegbuzie, 2004) and the presence or the absence of theoretical framework. The status of each method depends on the weight the researcher gives to each of them (equal status or dominant status) during the process of the research at the data collection level, as well as the diffusion of results. The domination of a method depends on the epistemological positioning adopted by the researcher (positivism, pragmatism, interpretativism and constructivism) and the aim of the researcher (a critical approach or ideological approach).

Yin (2006) and Johnson, Onwuegbuzie and Turner (2007) have called into question the dichotomy between qualitative and quantitative methods integrating them within a continuum. In order, for a study to be considered mixed method research, the data must be integrated during the analysis and the interpretation of results (Greene, Caracelli and Graham, 1989; Johnson and Onwuegbuzie, 2004; Yin, 2006). Johnson, Onwuegbuzie and Turner (2007) have then constructed a typology of mixed methods research according to two dimensions: the degree of combination of the data collection methods and the status (weight) of methods (Figure 3).



Source: according to Johnson R.B., Onwuegbuzie A. J. and Turner L.A., 2007, "Toward a Definition of Mixed Methods research", *Journal of Mixed Methods Research*, vol. 1, n° 2, p. 124.

Figure 3: Typology of mixed methods research based on the degree of combination and the status

Mixed methods research can also be classified according to the order of implementation of the data collection. They can be implemented, for example, in a sequential manner with the objective of exploration or, again, in a concurrent manner with the objective of triangulation. Based on Morse's (1991) notation system, when the methods are sequential, they are represented under the form Qual → Quan or Quan → Qual

and when they are concurrent, they are presented under the form Quan + Qual

The presence and the absence of a theoretical perspective whether it is a conceptual framework, an advocacy or an ideology is another criterion which can be considered in the proposition of mixed methods design

typologies. The aim of the theoretical perspective guides the research study more than the methods. The research design which integrates a theoretical perspective has a transformational value or action-oriented dimensions and is called a transformative design (Greene and Caracelli, 1997; Creswell et al. 2003)

There is a plethora of mixed methods designs. Most of them are complicated or, too simplistic not including the important criteria or an incoherent system (Leech and Onwuegbuzie, 2007). Here, we present three typologies of mixed methods designs which, in our view, integrate the most important dimensions needed by researchers.

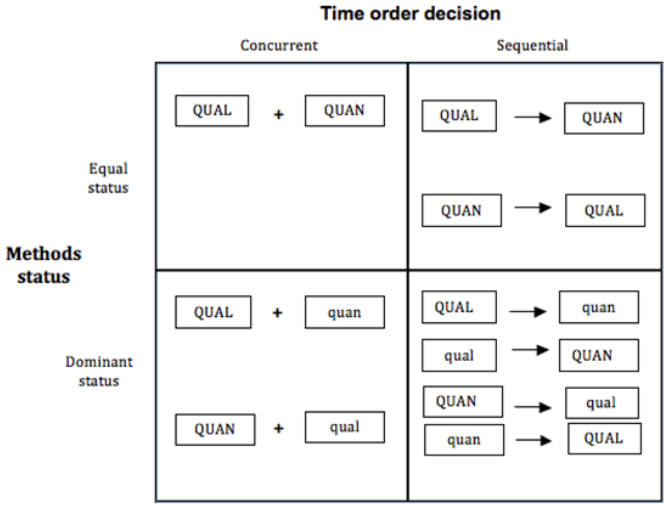
Creswell, Plano Clark, Gutmann and Hanson (2003) provide one of the most relevant typology of mixed methods designs based on four criteria: the implementation order of data collection (sequential or concurrent), the priority given to quantitative or qualitative research, the research stage of integration of qualitative and quantitative methods and the potential use of a transformational value or action-oriented perspective in the study (framework, advocacy, ideology). This typology specifies six mixed methods designs explained in the Table 2.

Design Type	*Implementation*	*Priority*	*Stage of Integration*	*Theoretical Perspective*
Sequential explanatory	Quantitative followed by qualitative	Usually quantitative; can be qualitative or equal	Interpretation phase	May be present
Sequential exploratory	Qualitative followed by quantitative	Usually qualitative; can be quantitative or equal	Interpretation phase	May be present
Sequential transformative	Either quantitative followed by qualitative or qualitative followed by quantitative	Quantitative, qualitative or equal	Interpretation phase	Definitely present (i.e., conceptual framework, advocacy, empowerment)
Concurrent triangulation	Concurrent collection of quantitative and qualitative data	Preferably equal; can be quantitative or qualitative	Interpretation phase or analysis phase	May be present
Concurrent nested	Concurrent collection of quantitative and qualitative data	Quantitative or qualitative	Analysis phase	May be present
Concurrent transformative	Concurrent collection of quantitative and qualitative data	Quantitative, qualitative, or equal	Usually analysis phase; can be during interpretation phase	Definitely present (i.e., conceptual framework advocacy, empowerment)

Table 2: Types of mixed methods research designs

Source: Creswell, J.W., Plano Clark, V.L., Gutmann, M.L., and Hanson, W.E. (2003). Advanced Mixed Methods research designs. In A. Tashakkori & Teddlie (Eds.), *Handbook of Mixed Methods in Social and Behavioral Research*, TO, Sage

Johnson and Onwuegbuzie (2004) constructed a typology of mixed methods research designs based on two dimensions: the implementation strategy and the status of the methods (Figure 4)



Source: according to Johnson R.B. and Onwuegbuzie A. J., 2004, « Mixed Methods Research: A Research Paradigm Whose Time Has Come », *Educational Researcher*, vol. 33, n° 7, p. 22.

Note: « qual » stands for qualitative. « quan » stands for quantitative, + stands for concurrent, → Stands for sequential, capital letters denote high priority or weight and lower case letters denote lower priority or weight.

Figure 4: Mixed-methods design matrix with mixed-methods research design shown in the four cells

Leech and Onwuegbuzie (2007) created a new typology of mixed methods design crossing three criteria: time dimension (the order of the methods), emphasis dimension (dominant or equal methods status) and mixing dimension (partially or fully mixed methods). The latter is divided in two categories: fully mixed methods and partially mixed methods. The first involves the mixing of quantitative and qualitative methods within and/or across one or all the stages of the process of research: research objectives, data collection, analysis and inference. The second involves the mixing of quantitative and qualitative methods in the data interpretation stage and this is regardless of the implementation strategy. This integrated typology represents eight mixed research designs represented in Figure 5.

In our research, we have integrated a theoretical perspective consisting of a contingent and dynamic model, adopted a strategy of a sequential and concurrent implementation of qualitative and quantitative methods, and have given them equal status. Thus, the research represents a sequential and concurrent (in the second stage) transformative mixed method design which can be schematised in Figure 6.

According to Johnson and Onwuegbuzie (2004, p. 20) the researcher must "be creative and not limited by the designs listed (…) and should mindfully create a design that effectively answers the research question". Yin (2006) goes beyond the combination of qualitative and quantitative methods integrating other methods of research to "mix". His difference in comparison with other supporters of mixed methods research lies in the idea that the mixed methods can not only be integrated, but also simply paralleled when the results diverge.

Before the discussion of the findings, it is important to explain the procedure of data collection, analysis and presentation in relation to the design type.

Being a supporter of mixed research methods, our mode of data collecting has been sequential, concurrent and diversified. Even within an only qualitative or quantitative method, the researchers advocate multiplying the sources of the data to avoid errors of analysis and interpretation (Denzin, 1978). Sources of multiple data permit triangulation (Jick, 1979). In our research process we have mobilized many data collection methods: the observation, documents and especially semi-directive interviews and directive interviews (in the form of survey). The manner with which we have alternated and modelled them depends on the evolution of our knowledge of the fieldwork, the confidence the projects actors put in us and the context of the research. Like many researchers in management science, our process of exploration was not linear. It was made up of iteration, recursiveness and constant movement between the theory and fieldwork in order to adjust the theoretical conceptual model and ensure the reliability of its connexion with the empirical data.

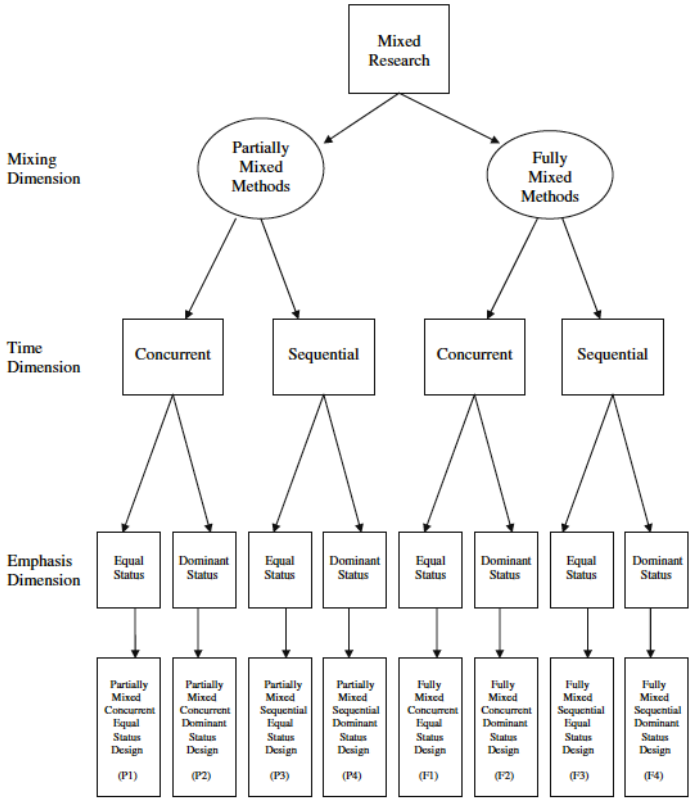


Figure 5: Typology of mixed research

Source: Leech, N.L. and Onwuegbuzie, A.J. (2007), "A Typology of Mixed Methods Research Designs", Quality & Quantity, 43, p. 269.

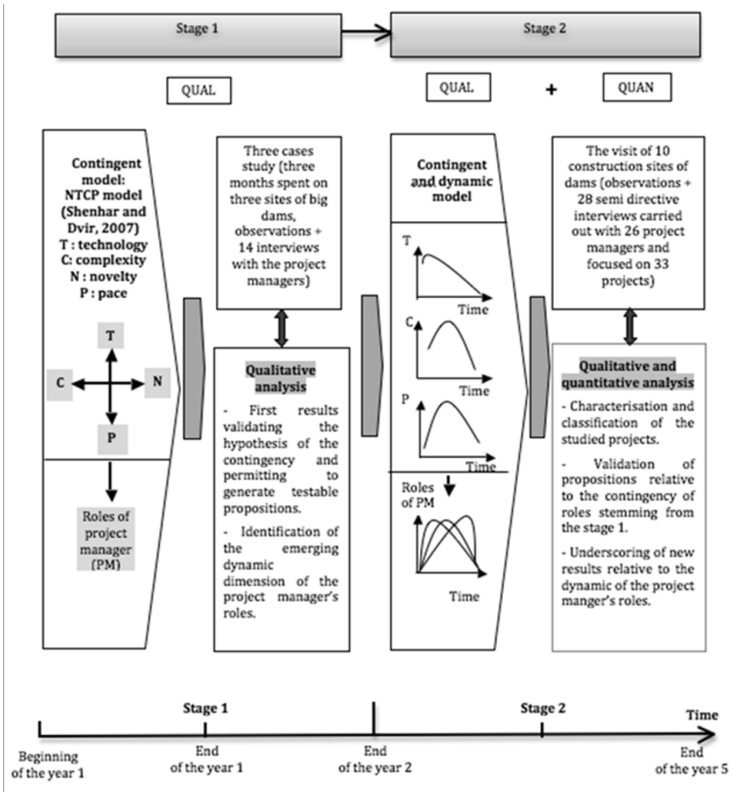


Figure 6: A sequential and concurrent transformative mixed method design in project management

In relation to the analysis of the data, the qualitative analysis required more time and financial resources than the quantitative analysis because the data are rich and traditionally considered (wrongly) as "soft" research and more difficult to achieve (Yin, 1994). The researcher must follow a series of procedures and rules during the course of the empirical stage to increase the reliability and legitimacy of the results. Thus, our process of data analysis was undertaken in three stages: 1) data condensation, 2) data presentation and 3) data elaboration/verification of data (Miles et al., 2013).

In order to obtain a simplified representation of collected data, we have carried out thematic coding which assisted in the research of causalities and replications. The performed coding grid was oriented from the beginning by the problematic and theoretical conception, then, integrated some emerging dimensions from the empirical world. For the quantitative analysis, data was collected with the help of evaluation grids. These were then regrouped in three main Excel tables relative to: the roles of the project manager in the different types of projects; the roles of the project manager in the three stages of the project and; the characteristics of the projects. Finally, each of the three tables was copied into SPSS for the final statistical analyses. This resulted in some statistical calculations of a descriptive nature (e.g., average of the importance of roles, average of the NTCP variables) and statistical tests. These were mainly ANOVA in order to analyse the variance and to evaluate the gaps of the average values of the dependent variable (the project manager's roles) under the influence of the independent variables (NTCP in the contingent conceptual model and the stages in the dynamic conceptual model). ANOVA was used to determine the global differences among the samples. However, when it is three groups and more the ANOVA cannot show the differences among the pairs of averages. To do this a test of multiple comparisons, which is a subordinate test to the ANOVA was undertaken. The test of multiple comparisons is a posteriori test (post hoc test) which comes after an ANOVA or a significative test of Welsh. When the homogeneity hypothesis of the variances is verified, the applied posteriori test can be the LSD or the Tukey. The Tukey was used because it is considered to be more reliable (Montgomery, 2009).

After the collection and the analysis of data, a clear, coherent and integrated presentation of the results is necessary. The presentation of data conveys the image of work provided by the researcher and allows the reader to identify and understand the conclusions. The presentation of data was made in a sequential and concurrent manner, being consistent with the research design. Thus, in the first stage, the qualitative exploratory study was presented in the form of narrative texts. It describes and compares the roles of the project manager in the context of three construction projects and are linked to figures (the NTCP model applied to dams), descriptive tables (description of dams) and some verbatims which support the research's reasoning and facilitate the reader's understanding. Then, in the second stage, the empirical, qualitative and quantitative data was presented in many formats: tables, curves, interpretation and narration. The presentation of the quantitative and the qualitative analyses were sometimes integrated and sometimes sequential in order to facilitate comprehension.

4. Discussion and the perspectives of future researches

We do not claim to have undertaken an exemplar of a mixed methods study but we think that it may help and/or inspire other researchers contemplating using mixed methods in the choice of their research design and the manner of implementing and integrating the qualitative and quantitative methods and data. This echoes the statement from Teddlie and Tashakkori (2003) who emphasize that mixed methods research designs provide guidance and direction for the researchers to conceptualise their mixed methods studies. The choice of research design was motivated by the objectives of exploration, triangulation and complementarity as has been illustrated with some examples, and the manner in which the qualitative and quantitative data has been integrated. Finally, in this study of project management, we put into practice the theory of mixed methods research design.

The thesis of the incommensurability of paradigms advocated by the quantitative purists (Maxwell and Delaney, 2004) and the qualitative purists (Guba and Lincoln, 1989) is more and more called into question (Howe, 1988; Morgan, 2007). For a better comprehension of the social phenomena which are more dynamic and complex, researchers are less confined in their particular epistemological posture (Miles et al., 2013). Even Guba and Lincoln (2005) have evolved toward the acceptation of a degree of permeability between the paradigms when they do not include fundamental ontological postulates. Accordingly, the supporters of the multi-paradigmatic approach, an integration of paradigms, permits us to apprehend a larger perimeter of

reality (Morgan, 2007). The arguments developed by these researchers are, to some extent, in accord with the thought of the classical pragmatism partisans (James, 1907; Dewey, 1920) and neo pragmatism supporters (Murphy, 1990; Rescher, 2000) who emphasize the common senses and actions among researchers (Morgan, 2007) and or the relation between the methodology, the methods and the research questions, than the metaphysical postulates (Patton, 1988). During the first research stage, the objective was to understand the perceptions the project managers had on the diversity of their roles, the characteristics of dams (complexity, technical uncertainty, pace, innovation) and of the process of dam construction. Thus, an empathy combined with an axiological neutrality vis-a-vis the actors was essential (Weber, 1965). The comprehension of the units of analysis and their interactions permitted the conceptual contingent initial model to emerge. This also allowed for the formulation of the propositions in relation to the project manager's roles and the contingent characteristics of the project. During the second stage of the research, the objective was the testing of the proposition formulated on a larger sample and discovering some regularities and explaining them. Thus, we have evolved towards a distanciation relatively more important vis-a-vis the research object and towards a more important control of the double subjectivity of the researcher and the questioned actors. We consider that the epistemological position of the researcher can evolve in an incremental way during the different phases of the research project in function of the evolution of the research questions, the hierarchy of objectives of the knowledge (describe, comprehend or explain) and the kind of relation the researcher has with the object of the research (exteriority or empathy). Like the contingent plans used by the project managers in complex and uncertain projects, an epistemological and flexible position allows the researcher to easily and rapidly adapt to the complexity and the uncertainty inherent to the process of the research: emergence of new variables and/or causalities, difficulty of access to the information, changing the access strategy to the empirical world and the combination of qualitative and quantitative methods.

Mixed methods research has many advantages and it's utilisation in management sciences is essential. As Cameron et al (2015, p. 102) have pointed out "Mixed methods research designs can aide project management researchers in the investigation of multifaceted phenomena in innovative ways. Project management researchers need to be encouraged to explore methodological approaches that may be less traditional". More specifically and in terms of the mixed methods study reported in this paper, some questions must be explored and studied in depth by researchers engaging in mixed methods studies:

- How to interpret the contradictory results? According to Jick (1979), one must reconcile them finding some alternate explications. Must one so far reconcile them in a systematic manner? And how to reconcile them in a concrete manner?

An example in our research shows how to reconcile contradictory results:

The results of the quantitative analysis (ANOVA) show that the project manager innovation's role is significantly more important in the high technology projects than in the low technology projects to $p < .01$.

The qualitative analysis of an interview with a project manager contradicts this quantitative result. The non important role of innovation in a high technology project can be explained by the entrepreneurial culture of the firm which is averse to the risk:

> LM, Project manager*: "we, the directors of projects, have not the financial resources to innovate…when the engineer of the conception gives you a project and you give back to him another project's version, it is frowned upon… believe me it will not happen without friction… there is a self-censorship and a lack of resources to innovate"*

- Are the confirmed quantitative results more important than the results which emerge from the qualitative study? And how to evaluate the legitimacy of the results of mixed methods?

The last question is one of the central questions which has not yet been resolved. One of the proposed answers by Teddlie and Tashakkori (2003) to this question is using a common bilingual nomenclature. Thus they propose "legitimacy" or "inference quality" terms to transcend the qualitative and the quantitative dichotomy. The inference quality is associated by the authors to the design quality of mixed methods and to the rigour of interpretation.

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