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Main challenges during project planning when working with virtual teams

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ABSTRACT

This study confirms the need to correctly plan human resources, risk and communication management when virtual teams are included in a project team, as indicated in the literature review. his study extends the current literature in the field, in a way not previously identified by other authors, by identifying the importance of virtual teams in the requirements collection and scope management processes during project planning. It is demonstrated that project managers should consider the impact of virtual teams on integration and scope planning and not simply on resources, communication and cost planning. In this study, the use of fuzzy set Qualitative Comparative Analysis (fsQCA) is a key methodological contribution to indicate hidden or unknown impacts of virtual teams in certain key project planning processes.

1. Introduction

Globally distributed companies are the most expansive businesses and their coordination has improved through new technologies and communications since the early 1990s (Janssens and Brett, 1994) with the objective of managing project complexity to reduce product development time (Clift and Vandenbosch, 1999). New technologies allow global companies, including small and medium enterprises (SMEs), to satisfy global product demand via new product development (Gallego, 2016; McDonough, Kahnb, and Barczaka, 2001). This increased demand complexity has forced companies to establish multinational locations in order to commercialize their products directly, reducing development and manufacturing costs (locating low-value processes in regions where salaries are low), leading to knowledge acquisition from leading technological countries, and providing on-site services to their customers. Because of this increased complexity, virtual teams (VTs) are more frequently used in all sizes of projects and in many companies; therefore, this research is focused on the identification of knowledge areas when working with VTs in project-oriented organisations during the project planning phase, in order to improve the project management plan (Rolstadås, et al., 2014).

There are many studies related to VT management; they focus mainly on the execution and monitoring phases, which identify problems and the impact of IT communication tools or human resource techniques applied to this kind of team. However, the project planning literature does not provide specific analyses indicating how to identify which project processes and knowledge areas are influenced by VTs when they are part of the project team. In this context, the Project Management Institute (PMI, 2017) introduced the concept of VTs as an environmental factor to be considered as an input in project integration execution and as a tool in project resource management (execution phase) to provide flexibility and advantages like knowledge sharing between remote locations; however, they did not include specific processes to be executed by VTs during project integration planning or planning processes from other knowledge areas which are related to the project management plan. Haywood (1998) also states that the complexity of managing virtual teams relates to communication, knowledge management, and performance data for monitoring and control. In other words, for a global or multinational company (independent of its location), it is imperative to clearly identify the processes and critical success factors (CSFs) to be considered during the planning phase when VTs are involved in the execution of the project. Meanwhile, there are other project management knowledge areas and processes for which the effect that a VT could have during project execution has not been taken into consideration, meaning that the possibility of using VTs during the project planning phase is ignored.

Therefore, the purpose of this research is to identify those project planning processes where VTs influence the project management plan (integration planning process). As indicated in the literature review, there are currently no significant studies on the influence of VTs during the creation of the project plan or on how they can be considered a key element of the plan, adding value to the project as indicated by Afflerbach (2020). In order to fill this gap in the knowledge, we aim to answer two main research questions:

RQ1: What is the impact of VTs in each knowledge area while the

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project plan is being created?

RQ2: Which project planning processes have to be improved to fully consider the impact of VTs in a project plan?

VTs are important in project planning since, as described in the literature review, many companies work in a multi-location environment where remote workers and teams are integrated with collocated ones. Therefore, a deep study of how to plan a project properly, with remote workers as part of the company, is essential from a theoretical and a practical point of view. As indicated by Afflerbach (2020), cooperation in virtual teams must be reinforced and new practices are required to overcome the challenges such cooperation presents. This is the case for project management, which is an essential part of service provision and globally distributed companies.

The structure of the present study is as follows: literature review, methodology, results and discussion, and conclusion. There is a bibliographic study of VTs' influence on project management that is presented in the literature review where the research gaps to focus on are clearly exposed. The methodology for this research is based on a four-step process where fsQCA is used as a qualitative analysis method for small samples where the complex relationship among variables must be assessed. The results and conclusion sections covers the direct results coming from the fsQCA and its interpretation in relation to the two research questions. As a main conclusion, it is identified that VTs must be properly taken into account when creating a project plan, with a focus on requirements collection and scope definition.

2. Literature review

The purpose of this review is to identify the methods, processes, tools, and techniques that have been established for project planning phases to date (PMI, 2017) and the gaps to be filled where VTs are a key part of the project team. A VT can be defined as comprising 'geographically dispersed team members who communicate with each other using some variant mix of information and communication technologies' (Lee-Kelley and Sankey, 2007). Focusing on studies that include a specific analysis of project planning in VTs, we can find research that asserts that detailed planning is a critical step in every project driven by VTs (McMahon, 2016). Therefore, it is necessary to clearly establish the work packages and how to split them in order to avoid delayed work-split decisions that impact on time and cost during the execution of the project. The provided solutions also focus on resource management and ICT. A detailed planning proposal (McMahon, 2016) is based on three steps: *System Build Planning, Requirements Allocation*, and *Integration Planning*. The first must be developed in parallel with the work-split process when taking into account all the elements of the VT; the second is a classical approach to requirements allocation, assigning each requirement to the right team member within the VT; the third step is to integrate the global components, focusing on a single responsibility at one single responsibility level. It is also proposed that an unclear work-split should be considered a risk to be managed and considered if necessary. The previous explanation is aligned with the purpose of this research but the findings need to be examined from a practical point of view, there is a lack of specific solutions to manage requirements allocation and integration only encompasses a general overview of the processes. Therefore, there is a special interest in new research topics related to VTs but not specific solutions for project management (Gilson, Maynard, Jones Young, Vartiainen, and Hakonen, 2015). As an example, a proposed a method is Integrated Process and Project Management (IPPM). It is used to align project processes between multiple locations in multi-site projects that could be regarded as one practical approach to align project management and VTs by studying the improvement of management tools (Bangel, Garrett, and Martin, 2008). The aim of Bangel et al. (2008) study was to provide a system to guarantee live communications and the distribution of information among all locations by process automation. The implementation of IPPM is proposed to properly manage project processes by improving the ICT activities of software development companies (a communication system, connected databases, multi-site task synchronization, etc.) but there is no specific mention of project process integration as CFS for the proper project planning when VTs are part of the project team.

One good approach to the problem of requirements management (Damian and Zowghi, 2002) highlights the complexity of the engineering requirements of global and multi-site corporations (especially in terms of software development). Despite focusing on communication, cultural, and time problems rather than requirements collection, as in the previous studies, one of the important conclusions of that case study is the importance of stakeholder roles and their geographical distribution using maps. In this way, the power of the stakeholders in the organisational structure of the studied company is clearly identified along with its impact on project planning in terms of integration, scope, communication and human resources management. So, they provide a good overview of requirements management as a basis for our research.

One assumption of the study (Bangel et al., 2008) is that communication, leadership and cultural differences, in projects where VTs are key, have been widely studied; therefore, the studies of Haywood (1998), Cascio and Shurygailo (2003), White (2014), Oertig and Buergi (2006), etc. are central to any understanding of the topic.

One of the first studies to focus on VTs (Haywood, 1998) considered the activities carried out by project managers during the implementation and guidance of distributed teams, focusing on communication management both from a theoretical and technological point of view, based on two different perspectives (those of VT leaders and VT members). The concise explanation of distributed team creation and communication technologies can be regarded as referring to general communication and HR project requirements. However, there is no specific mention of project planning or integration processes where VTs have to be taken into account, something usual at that time. Focusing on project execution (Cascio and Shurygailo, 2003) it is necessary to understand the importance of leadership in VTs (e-leadership), teams formed to solve problems stemming from geographical or temporal differences, and to show the leadership style used depending on the VT type (teleworkers or remote teams) and the number of managers (one or multiple, depending on locations). It is shown that VTs have a clear impact during project planning, focusing only on the human resources and communication project planning aspects, but there is no specific mention of integration or scope planning in the areas of interest for this paper. The importance of leadership during project execution can be understood through five success factors (White, 2014): clear objectives, guidelines for virtual meetings, fixed team members inside VTs to generate trust, language training, and local achievement of global goals. Clear objectives and local achievement goals have to be included in the scope of the project via requirements and the scope of work and integrated with other knowledge areas through the project management plan but, again, there is no specific mention of this in the study.

In all the previous studies, one factor is clearly identified: cultural differences. So, finding solutions for cultural differences arising in VTs is one of the main challenges in managing them (Oertig and Buergi, 2006). The solutions cover the communication and language aspects to be considered by PMs and VT leaders during project execution as well as work performance monitoring and control (task management), reflecting the importance of cultural factors during project execution by analysing the virtual factors of communication. Those factors have to be considered during project planning but there are no specific factors impacting on integration, scope, time and cost. So, we need to look into a sector where VTs are growing and part of a company's normal functioning. Software development projects are the archetype of projects requiring VTs due to their technological needs and ICT infrastructure. In this sense, some studies (Guzman, 2010) have addressed the practices to be implemented in software development projects with global teams. Selecting creative VT leaders, face-to-face meetings to discuss important topics, and language training are good practices during the execution of projects in which project teams are formed as VTs. Those specific requirements have to be included in the project management plan and considered inside the specific plans for scope and integration management. But it is difficult to extrapolate this into other service businesses, such as consulting or financial projects, where VTs are an important part of the resources (Afflerbach, 2020).

So, as shown before, it is now clear for this study that VTs can add and create value in the area of project management. In this sense, some early studies (Casey and Richardson, 2006; Lee-Kelley and Sankey, 2007) have evaluated the project management of VTs and their value creation. Rather than focusing on project planning, they investigated the organisational aspects of VTs (resources structure, conflict management, and communication), risk management (risks associated with distance, time, language, and culture), and infrastructure (with information technology as a key enabler). An important outcome of their study is the influence of the VT leader's responsibility, which must be assumed to be self-responsibility in the geographical or virtual areas of the project. In line with these key enablers and with a focus on software development projects, the basic guidance for VT leaders and project managers in the implementation of VTs is summarised in 12 guidelines (Edwards and Wilson, 2004), including general suggestions for project execution, monitoring and control of VTs, and guidance for planning resources management and communication management, but there is no direct indication of how to handle project planning processes including integration or scope management in that study as they focus, again, on project execution (as in White, 2014). Aligned with this organisational point of view, but not elucidating on how to design a proper project plan, there are studies that have identified the main challenges for VTs and their team leaders (Settle-Murphy, 2013; Shachaf, 2008). For VTs, these challenges are: large-complex projects, lack of face-to-face communication, time zone differences, local or vacation schedules, teams closer to the team leader, scope/requirements alignment, different reporting structures for co-located teams, providing/receiving feedback, and on-the-job knowledge acquisition. So, they have identified the problems to be solved during execution but not offered solutions relating to project planning. Therefore, for the VT leader, the main challenges are: establishing trust, creating cooperative team environments, identifying skills and knowledge inside the virtual team, managing/project rules, communication criteria, monitoring team performance, team members' disengagement, and motivating the team during virtual meetings (Barruch et al., 2012). Therefore, the need to align scope within project planning has been identified, meaning that the required alignments are constraints to be included and integrated within the project management plan. As indicated before, information and communication technology (ICT) is a clear enabler of project execution, monitoring, and control when VTs are part of the project team, providing solutions to many challenges. ICT facilitates the process through the use of common and interconnected tools to increase VT communication based on the right mix of selected technologies (Gillard and Johansen, 2004; Padalkar and Gopinath, 2016) and it is used to reduce project risks (Reed and Knight, 2010a, 2010b), but ICT is just an enabler and not the core of project planning (Joe et al., 2014). In addition to this, the most recent studies (Afflerbach, 2020; Tabatabei, 2020; Brockhoff, 2020; Seftyandra, 2020) still focus either on the same project management topics as most cited articles (communication, cultural differences, IT and human resources) or leadership (Nordbäck et al., 2019; Larson et al., 2020). So, designing a good project plan, that takes into account VTs, is an essential part of adding value during execution, and this is an area of research in need of further study, which is the focus of this paper.

3. Methodology

In order to answer the research questions, we have selected a qualitative evaluation of surveys (Thomas, 2006) from highly experienced project stakeholders to structure the study. Knowing that it is difficult to get a high number of respondents with the required knowledge and experience to complete a quantitative statistical analysis (sample size), we decided to use fsQCA (Ragin, 2014). fsQCA is used both in Social Science and Business research (Fiss, 2011; Romero, 2017) to obtain information on complex relationships among the studied variables from a qualitative point of view. This methodology provides the right expert knowledge from a small sample of experts without limiting the analysis of correlations among variables from a qualitative perspective. It is, thus, in line with the aim of this research.

Table 1
Research methodology.

Stage 1 First, an analysis is conducted to indentify the key processes impacted by VTs. Qualitative evaluation (Thomas, 2006) analysing all knowledge areas (PMI, 2017a)	Research prospection
Stage 2 Creation of the corresponding questions in the survey based on the qualitative evaluation (see Table 6). Preselection of potential respondents to answer the survey focusing on one specific profile: Bach./MSc. Education level, English as working language, expereince in Project Management, experience in multinational projects, experience with VTs or remote workers.	Questionnaire creation Respondents selection
Stage 3 Screening of answers: the first part of the survey was created to eliminate professionals without the required profile (see Table 6). Analysis of collected data using fsQCA (Romero 2017; Fiss, 2011; Ragin, 2014)	Screening of answers fsQCA in two steps
Stage 4 Results and discussion	Final results

In order to capture the experience of project managers and project team members in relation to the influence of VTs in each project planning process, we have followed the stages shown in Table 1:

The main questionnaire has been designed to cover all knowledge areas and processes in project planning, according to PMI (2017). We have used fsQCA in this study to analyze the answers of the most experienced and reliable project professionals, with experience of working with or managing VTs, as it is the analysis technique recommended for samples of between 10 and 70 items and to obtain a graduation of results where complex and nonlinear solutions are present (Ragin, 2014), meaning that classical statistical analysis does not generate reliable results with complex non-linear solutions like the ones presented here. In particular, fsQCA 3.0 (Ragin and Davey, 2016) is the software used in this study. As indicated before, the fsQCA analysis in Stage 3 (Table 1) is carried out in two steps to refine the answers and give results at the process level, providing useful information for project managers to fill any gaps in project planning, with a focus on project integration, and setting the next research topics. These two fsQCA analysis results are aligned with the two main research questions in this study (Introduction).

Prior to the survey release, a pilot survey was sent to five project managers from five different companies (Remer, Stokdyk, and Van Driel, 1993; White and Fortune, 2002) to elicit suggestions for reviewing and updating the questionnaire. The survey was then sent to a total of 163 pre-selected professionals, and 42 completed questionnaires were received (response rate of 25.7%).

3.1. Screening of answers

In the first step, a total of 42 professionals completed the survey. Despite being informed in the survey about the experience and knowledge required to answer, only 22 were considered suited for the quantitative analysis, fitting into the optimal sample size for fsQCA. The rest were discarded due to a lack of required experience (answers to questions X11, X13, X14, and X15 were 'No') or the survey was incomplete (see Table 6).

3.2. Questionnaire design

The revised questionnaire comprised a total of 81 questions, including the profile questions used for screening (see Table 6) and questions related to project planning processes (see Table 7) that may be influenced by VTs (PMI, 2017). The first part of the questionnaire is based on respondents' data (personal data, list/choice, and yes/no questions), while the second part involves grade or mark selection using a Likert scale (from 1 to 5), where 1 = *low impact of VTs* and 5 = *high impact of VTs* in the respondent's experience. The identification of extreme results led us to find potential areas for improvement during project planning and/or areas which it would be beneficial to retain and enhance when VTs are involved in a project team.

3.3. fsQCA questionnaire analysis

The survey captured the experience of the pre-screened respondents about the importance or influence of VTs in each of the planning processes; therefore, an fsQCA was conducted to identify project planning gaps, being those processes where VTs have a low impact because they are not fully taken into account during project planning, and to confirm the good practices identified in the literature review, those involving a high impact of VTs, as they are taken into account in the corresponding planning processes. The advantage of using this method is that it allows causal complexity to be analysed through a nonlinear analysis of the relationships between factors called 'conditions' and it results in so-called 'outcomes'.

The five steps in the fsQCA (Ganter and Hecker, 2014; Ragin, 2014) are an extended version (Fig. 2) of the three basic steps indicated by Fiss (2011): Calibration, Analysis of Necessary Conditions and Analysis of Sufficiency.

Calibration is used to transform variables into fuzzy conditions, establishing the grade of membership; in the Analysis of Necessary Conditions, the expected Outcome is compared with conditions (the membership grade of the results is lower than the level specified in the conditions); finally, the Analysis of Sufficiency is used to identify the combination of causal conditions that is present or absent in the Outcome (Legewie, 2013).

This method offers three types of solution: Parsimonious, Intermediate and Complex. To obtain the solutions, it is necessary to make various simplifying assumptions that are based on counterfactuals; independently of the experiments or the theorisation that have been used over an event or phenomenon that is taking place, the method can give as a result any different causal condition depending on the simplifying solutions to be used. In this sense, complex solutions don't include any simplifying assumption, the intermediate solutions includes selected simplifying assumptions to reduce complexity (the assumptions have to be consistent with theoretical or empirical knowledge that is evaluated); finally, the parsimonious solutions reduce the causal recipes to a minimum number of conditions (Legewie, 2013).

The fsQCA applied in this study, following the previous steps, are conducted according to the good practices established by Schneider & Wagemann (2010); thus: the calibration has been discussed in detailed and the data are based on membership scores in sets; the terminology used in the results is appropriate for QCA and different from statistical terminology; the analysis of necessary conditions is undertaken first; contradictory rows are considered configuration conditions; the consistency values are bigger than 0.75 (Ragin, 2008); the generation of the three solution formulas (parsimonious, complex and intermediate) is based on a unique truth table (calibrated results); the outcome and the negation of the outcome are dealt with in two different analyses and the solution formulas are linked to the cases through graphical representation.

4. RESULTS & discussion

4.1. Analysis of respondents

A total of 22 respondents were located in Spain and Germany (Table 8). The mean age of the respondents was 38.4 years and their mean experience in project management was 8.95 years. By occupation, 26% of the respondents were project managers, 43% project engineers or project team members (including scrum masters), and the rest (31%) were project stakeholders. In terms of education, despite their high standing, 60.9% of the respondents did not hold a master's degree or certification in project management.

The distribution of respondents according to company size was balanced; 47.8% worked for big multinational corporations (> 1000 workers), 26.1% for medium-sized corporations (200 < workers < 1000), and 26.1% for small-sized companies (< 200 workers). Moreover, 78.3% of the companies primarily provided services, and the rest provided products. Regarding the formal processes of managing the projects inside their companies, 39.1% are PMP-like (PMI, 2017), 34.8% have no formal project management process, 17.4% are Scrum/Agile-like (Schwaber, 2004), and 8.7% are Systems-Engineering-like (Haskins et al., 2006). Moreover, 43.5% of the companies have not implemented formal project management processes, meaning that the way projects are managed depends on the project manager's decision.

4.2. Questionnaire results

A total of 64 questions are included in the second part of the survey (see Table 7), and as all knowledge areas do not have the same number of processes in the planning phase (Stellingwerf and Zandhuis, 2013), we calibrated each case or respondent's answer (Romero, 2017) among all knowledge areas in light of the results for all planning processes (see Table 6). The calibration is used to evaluate the level of membership of each independent variable studied (Ragin, 2014), in terms of the VT's grade of impact in each knowledge area: VTs not fully considered (0.3), VTs considered (0.6), and VTs properly considered (0.9).

Based on the average results for each knowledge area, three potential outcomes were identified, one of which has been taken as the outcome of this research: *Integration Management*; the other two are the complementary group results *Risk Management* and *Scope Management*. Complementary results (indicated with~) are those where the complementary variables, in Bayesian term, have been chosen. In this research, those are the knowledge areas and processes where VTs are not fully considered during project planning, the ones that need to be identified. The knowledge areas to improve (complementary solutions) are based on the survey analysis, so~*Integration Management* is analysed as an outcome variable in two steps: the first step looks for the most suitable combination of variables using other knowledge areas and the second uses~ *Scope Management* planning processes, as the two knowledge areas are related and to be studied to fill the gap in project planning processes.

4.3. Results analysis

The analysis of the results was performed in two fsQCA steps (Fig. 1), regarding~*Integration Management* as an outcome. The first step used knowledge areas as variables or necessary conditions; after the review of the results, taken from the fsQCA on Knowledge Areas, the

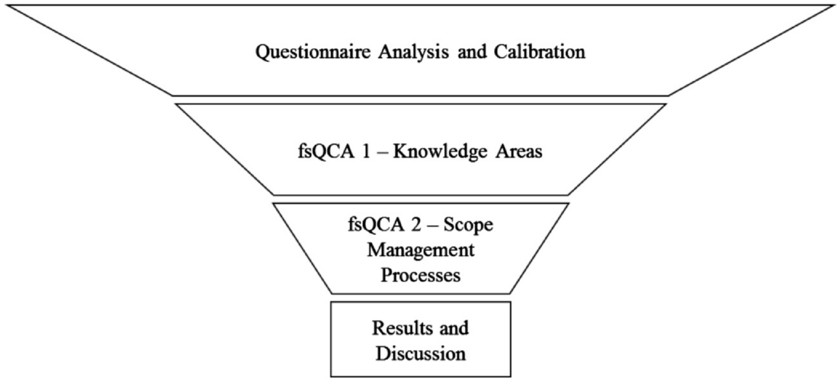

Fig. 1. The two steps of fsQCA.

conditions for ~*Scope Management* and ~*Risk Management* had consistencies closest to 0.9, and therefore they were carefully considered.

The second fsQCA analysed the necessary conditions for *Integration Management* as the outcome variable based on scope management planning processes (SMP: Scope Management Plan, CRQ: Collect Requirements, SDF: Scope Definition, WBS: WBS Creation). It was found that~ Scope Definition was the condition with consistency closest to 0.9.

The two fsQCAs selected the complex solutions with a consistency close to or greater than 0.8, which are known as paths as they are combinations of variables that are sufficient for reaching the outcome.

A graphical representation (Table 4 and Table 5) is used to summarize the analysis of sufficiency results. These results are based on the analysis of the Parsimonious and Intermediate solutions. Two types of conditions are considered: *Core conditions*, those which are presented both in the Parsimonious and Intermediate solutions and *Peripheral conditions*, which are only presented in the Intermediate solution.

In line with Ragin & Fiss (2008), the following notation is used: black circles ("●") indicate the presence of a condition, and empty circles ("o") indicate the presence of a complementary Bayesian condition; our intention is to find complementary solutions (unidentified conditions). Furthermore, large circles indicate core conditions, while small circles refer to peripheral conditions. Blank spaces in a solution indicate a "not relevant" effect on the solution where the causal condition may be either present or absent.

The first fsQCA relates to knowledge areas and seven paths have been identified, two of which have a consistency close to or over 0.8 (Table 4). Meanwhile the second fsQCA, using Scope Management planning processes, identifies three paths (Table 5), all with a consistency close to or over 0.8. These have been identified as core causal conditions and contributing or peripheral causal conditions. As mentioned before, the selected paths are those identified with a consistency close to or over 0.9 (Table 2 and Table 3). The solutions highlighted, to find causal conditions (Table 4 and Table 5), are those that are more relevant due to the value of raw coverage.

Table 2
Analysis of necessary conditions ~INM by Knowledge Areas.

Outcome variable: ~INM Conditions	Consistency	Coverage
SCM	0.68	0.43
~SCM	**0.89**	**0.80**
TIM	0.79	0.48
~TIM	0.82	0.79
COM	0.82	0.52
~COM	0.78	0.70
REM	0.74	0.50
~REM	0.82	0.69
CMM	0.7	0.51
~CMM	0.85	0.66
RKM	0.68	0.48
~RKM	**0.89**	**0.71**
PRM	0.84	0.53
~PRM	0.71	0.66
STM	0.82	0.53
~STM	0.74	0.65

Table 3
Analysis of necessary conditions ~INM by SCM Planning Processes.

Outcome variable: ~INM Conditions	Consistency	Coverage
SMP	0.83	0.48
~SMP	0.70	0.65
CRQ	0.70	0.45
~CRQ	**0.87**	**0.70**
SDF	0.70	0.48
~SDF	**0.91**	**0.68**
WBS	0.83	0.49
~WBS	0.75	0.66

4.4. Discussion

The questionnaire answers demonstrate an expected alignment between those knowledge areas, processes, and actions directly related to IT involving virtual teams, meaning that VTs are considered during the planning phase only in the areas where location or virtual (non-face-to-face) communication is obligatory: where final users or partners are not co-located with the project teams (clearly impacting stakeholder management and communications management) and IT tools are needed to manage communication or project execution. This result is aligned with the identification and management of cultural differences (Hofstede, 1983; Oertig & Buergi 2006) in communication management strategies when VTs are present (Reed and Knight, 2010b; Wende, Alt, and King, 2017) and organisational support (Drouin, Bourgault, and Gervais, 2010) in international companies.

Fig. 2. Steps in the fsQCA (Romero, 2017).

Table 4
Identified knowledge areas as causal conditions.

Path	Causal Conditions: Scope Mgnt	Time Mgnt	Costs Mngt	Resources Mngt	Communication Mngt	Risk Mngt	Purchasing Mngt	Stakeholder Mngt	Raw coverage	Unique coverage	Consistency	Solution coverage	Solution consistency
1		•		∘	∘	○	•	•	0.63	0.06	0.86	0.91	0.70
2	○	•	•	∘	•	●	•	•	0.60	0.07	0.84		

Key
- ● Core causal condition (present)
- • Contributing causal condition (present)
- ○ Core causal condition (complementary)
- ∘ Contributing causal condition (complementary)

There is an important output that can be obtained from the analysis of respondents' answers, namely, the importance of the project management procedures implemented in the companies. Those companies without formal project management processes do not have a Project Management Information System (PMIS) implemented and available to the team (X10 is clearly related with Y0 and Y22, see Table 7). Therefore, it is clear that companies with virtual or remote teams need to establish a formal procedure for project management inside their organisations as a first step towards the implementation of specific actions, processes, and tools related to VT management as identified in the literature review.

In summary, the questionnaire answers (Table 4) demonstrate that VTs are properly considered during project planning in connection with *Risk, Communications*, and *Resources Management*, indicating that not considering VTs in risk, communications and resources management can lead to a bad integration management plan. These results are also aligned with the efforts of the project managers, indicated in the literature review, in terms of communication problems affected by cultural differences (Oertig & Buergi, 2006) or remote locations (Wende et al., 2017).

After the calibration of the results, two fsQCA analyses were performed, focusing on the knowledge area connected with the rest of the project planning, with *Integration Management* regarded as the link between all of them and impacting the project management plan. After the first fsQCA analysis was conducted to examine the impact of knowledge areas, a more detailed fsQCA analysis was conducted focusing on *Scope Management* processes since planning processes for this area are linked to integration management as a causal condition (Table 2), demonstrating the effect on the project management plan when VTs are not taken into account during project planning.

In the analysis of the first fsQCA, the second path or solution (Table 4), with a raw coverage of 0.60, indicates the relationship between extra efforts made in some knowledge areas due to the lack of consideration of VTs in others during the planning phase. This solution demonstrates that the lack of VT consideration in *Scope Management* is a core causal condition during project planning and is compensated for by an extra effort in planning processes with another core causal condition, *Risk Management*, meaning that independently of the extra effort in risk management planning, some risks would not even be considered because of information which is missing in an unclear scope. This situation leads to a failure to consider VTs during the integration

Table 6
Participant data survey.

Code	Information	Type of Data
X0	Name	TEXT
X1	Surname	TEXT
X2	Company	TEXT
X3	Location (country)	TEXT
X4	Age	#
X5	Years of experience in project management (not necessary as PM)	#
X6	Profession	TEXT
X7	Type of business	Services/Goods
X8	How are the projects managed in your company?	PMP-Like Agile/Scrum Systems Engineering No formal process
X9	Do you have a certification in Project Management or a Master's?	Yes/No
X10	Does your company have a formal PM Process implemented?	Yes/No
X11	Do you work or have you ever worked on multinational projects?	Yes/No
X12	Do you work or have you ever worked with co-located teams?	Yes/No
X13	Do you work or have you ever worked with online isolated teams?	Yes/No
X14	Do you work or have you ever worked with online isolated team members?	Yes/No
X15	Are you used to working with virtual teams?	Yes/No
X16	Does your company use common IT and communication systems globally?	Yes/No

Table 5
Identified Scope Management planning processes as causal conditions.

Path	Causal Conditions: SMP	CRQ	SDF	WBS	Raw coverage	Unique coverage	Consistency	Solution coverage	Solution consistency
1		●	○		0.79	0.08	0.79	0.94	0.74
2		●	○	∘	0.68	0.13	0.83		
3	∘	○		•	0.66	0.02	0.83		

Key
- ● Core causal condition (present)
- • Contributing causal condition (present)
- ○ Core causal condition (complementary)
- ∘ Contributing causal condition (complementary)

Table 7
Project planning processes survey.

Project Planning Knowledge Areas	Impacted Process	1 – Low, 5 – High	Code
Integration Management (INM)	Project Plan Development	Use of a Project Management Information System	Y0
		Expert Judgment (use of internal experts for project planning estimations): 1-collocated, 5-virtual	Y1
Scope Management (SCM)	Scope Management Plan	Scope Planning Meetings (online vs live)	Y2
	Collect Requirements	Collection Techniques: Interviews	Y3
		Collection Techniques: Focal Groups	Y4
		Collection Techniques: Facilitated groups	Y5
		Collection Techniques: Workshop	Y6
		Collection Techniques: Group creativity	Y7
		Group Decisions: Delphi Method (an anonymous survey to collect planning data whose results are shared within the team for re-evaluation)	Y8
		Group Decisions: Nominal Group	Y9
		Group Decisions: Dialectic Inquiry	Y10
	Scope Definition	Data Collection: Stakeholders Survey	Y11
		Data Collection: Historical Data	Y12
		Data Collection: Big Data Analysis or Parametric Estimation	Y13
		Acceptance Criteria: International Standards	Y14
		Acceptance Criteria: User/Industry Experience	Y15
		Acceptance Criteria: Cultural Impact	Y16
	WBS Creation	Work Breakdown Structure following the product structure	Y17
		Work Breakdown Structure following team's locations	Y18
		Work Breakdown Structure following specific project structure (product + project)	Y19
Time Management (TIM)	Schedule Management Plan	Schedule planning meetings (1-live vs 5-online)	Y20
		List of organisational differences between locations collected for each project	Y21
	Activities Definition	Project Management System (software) for all stakeholders	Y22
		Costs estimation: 1-global vs 5-each location	Y23
		Legal restriction differences between locations	Y24
	Schedule Development	Global Project Schedule considering local labor schedule	Y25
Cost Management (COM)	Cost Management Plan	Stand-Alone Plan (no specific plans)	Y26
		Local Management Plan or Team Management Plan	Y27
	Cost Estimation	Global Cost Estimation from parametric/historic data (full project)	Y28
		Aggregate of local cost estimation (parametric or historic data)	Y29
		Supplier contracts (1-global, independent from location, 5-according to team locations)	Y30
	Budget Definition	Global Budget: 1 full project estimation, 5 aggregate of all local estimations	Y31
		Contingency Budget: 1 full project estimation, 5 aggregate of all local estimations	Y32
Quality Management (QMN)	Quality Management Plan	Estimation of Cost of Quality influenced by location	Y33
Resources Management (REM)	Human Resources Management Plan	HR Management Plan_ 1-global for all locations, 5 - aligned with the law of each location	Y34
		Resource Breakdown Structure based on locations (1-low, 5-high)	Y35
		Meetings or Virtual Team Management included in the plan (1-not at all, 5-always)	Y36
		Responsibility Matrix: -according to corporate organization, 5-according to local skills	Y37
Communication Management (CMM)	Communication Management Plan	Communication requirements including local time	Y38
		Communication IT tools common in all locations	Y39
		Definition of communication techniques: pull, push (1-not defined, 5-totally defined)	Y40
		Formal Virtual Meetings with MoM	Y41
		Inter-location communication rules (1-not defined, 5-totally defined)	Y42
Risk Management (RKM)	Risk Management Plan	Risk Management Plan covering all locations	Y43
	Risk Identification	Expert Judgment Rooster (co-located)	Y44
		Risk Identification Source: local laws considered (1-low, 5-high)	Y45
		Risk Identification Source: local labor risk considered (1-low, 5-high)	Y46
		Risk Identification Source: final user location (1-low, 5-high)	Y47
		Risk Identification Source: historical data (1-low, 5-high)	Y48
		Risk Identification Source: BI and Big Data (1-low, 5-high)	Y49
		Risk Identification Technique: Process Analysis including all locations (1-low, 5-high)	Y50
		Risk Identification Technique: Brainstorming (1-live, 5-online)	Y51
		Risk Identification Technique: Survey	Y52
		Risk Identification Technique: Workshops and Interviews (live)	Y53
		Risk perception differences (influenced by culture and location): 1-low, 5-high	Y54
	Risk Qualitative Analysis	Risk categorisation Analysis (influenced by culture/location): 1-low, 5-high	Y55
		Influenced by qualitative analysis factors (culture/location): 1-low, 5-high	Y56
		Influenced by team members (culture/location): 1-low, 5-high	Y57
Procurement Management (PRM)	Procurement Management Plan	Influence on INCOTERMS (if needed to ship goods and materials)	Y58
		INCOTERMS are the International Commercial Terms, conditions of international transportation of goods	Y59
		Variable contractor criteria depending on location (1-low, 5-high)	Y60
		Supplier selection driven by price (1-low, 5-high)	Y61
		Supplier selection driven by confidence (1-low, 5-high)	Y62
Stakeholder Management (STM)	Stakeholder Management Plan	Stakeholder impact analysis by location/culture: 1-low, 5-high	Y63

management planning phase so the project manager has to identify this project planning gap, highlighting the extra effort in risk management planning as a trigger of lack of scope management when VTs are present. This impacts on the integration of the project and therefore the project management plan. The first path or solution (Table 4), with a raw coverage of 0.63, despite having higher raw coverage, does not include the necessary conditions previously identified (Table 2), but does indicate an important topic discussed by Reed et al. (2010) relating to the risk management of VTs and their impact on risks associated with project development. This is aligned with the literature

Table 8
Respondents' analysis.

Age	Country	Profession	Years of experience in Project Management (as Team Member or Project Manager)	Type of Business	How are the projects managed in your company	Do you have a certification or master in Project Management	Does your company have a formal PM process implemented?
32	Spain	Consultant	5	Services	PMP-like (classic project management)	No	Yes
37	Spain	Architect	5	Services	No formal Project Management framework established in my company	Yes	No
54	spain	program manager space engineer	21	Services	PMP-like (classic project management)	No	Yes
41	Spain	Economist	10	Services	Agile/Scrum	No	Yes
33	Germany	Chemist	2	Services	PMP-like (classic project management)	No	No
43	Spain	Project Engineer	8	Services	PMP-like (classic project management)	Yes	No
34	Spain	Project Manager	5	Services	No formal Project Management framework established in my company	Yes	No
57	Spain	Project Manager	25	Services	PMP-like (classic project management)	Yes	Yes
35	Spain	Project Engineer	12	Services	No formal Project Management framework established in my company	No	Yes
48	Spain	Project Engineer	15	Services	PMP-like (classic project management)	Yes	Yes
33	Spain	Project Manager	3	Services	No formal Project Management framework established in my company	No	No
29	Germany	Project Engineer	5	Goods	PMP-like (classic project management)	No	No
43	Spain	Office Manager	6	Goods	No formal Project Management framework established in my company	No	No
24	Spain	Project Engineer	1	Goods	Systems Engineering (INCOSE or similar)	No	Yes
42	Spain	Entrepreneur	5	Goods	Systems Engineering (INCOSE or similar)	No	Yes
35	Spain	Project Engineer	10	Services	PMP-like (classic project management)	No	Yes
38	Spain	Project Manager	16	Services	No formal Project Management framework established in my company	Yes	No
34	Spain	Project Engineer	11	Goods	PMP-like (classic project management)	No	Yes
38	Spain	Project Engineer	6	Services	Agile/Scrum	Yes	Yes
34	Spain	Scrum Master	11	Services	Agile/Scrum	Yes	No
43	Spain	Project Engineer	8	Services	No formal Project Management framework established in my company	Yes	No
38	Spain	Project Manager	7	Services	No formal Project Management framework established in my company	No	Yes

review advice on risk identification when VTs are part of the project team.

As shown before, the lack of VT consideration in integration management is mainly affected by scope management planning processes (Table 3). The results of the second fsQCA indicate two processes where VTs are not fully considered: *Scope Definition* and *Collection of Requirements*. This indicates that these planning processes must be properly adapted to the existence of VTs inside the project team; therefore, tools or techniques to inform the project manager of the possible impact of ignoring VTs in scope management in project integration planning are needed and must be included in the project management plan. Thus, the greater the participation of the project team in project planning, the better the results during project execution (Damian and Zowghi, 2002). Failure to consider VTs during scope definition is compensated for by an extra effort in the collection of requirements processes and it is also affected by a lack of work packages in the WBS; therefore, an improvement in the collection of requirements involving VTs and the right effort allocation in the corresponding work packages will enhance scope management planning and processes affecting integration management.

5. Conclusions

Our analysis of the questionnaire answers confirms that communications and human resource management are highly influenced by cultural differences (Huemann, Keegan, and Turner, 2007; Zwikael, Shimizu, and Globerson, 2005) which are managed by the project manager and locally managed by the VT leader. Thus, it is clear that virtual meetings and the use of ICT tools and collaborative electronic frameworks have enhanced those processes and are enablers of requirements collection when VTs are present (McDonough et al., 2001).

The results of the present research reveal that integration management is a knowledge area where the influence of VTs has not being properly studied, demonstrating that there are elements of the project plan that can be used by the project manager to identify any respective problems. Some parameters can serve as triggers for planning improvements; one of these is an excess of effort during risk management planning accompanied by a lack of effort in scope management planning. In particular, when considering VTs, the project manager should (with the support of IT tools and expert judgement) identify an extra effort in risk management planning processes and in the associated collection of requirements, together with a lack of accuracy in scope definition in those working packages where VTs have not been properly taken into account. This will lead to the detection of unknown risks and an opportunity to integrate them in the corresponding project plans. Thus, scope definition processes must be improved to properly take into account VTs, so new data collection techniques and acceptance criteria can be established for remote or changing scope by location or new methods can be devised to define project scope when VTs are present. Therefore, we propose, as good practice for project managers, that they fill the identified gap: the definition of specific VT management work packages in order to clarify affected requirements and risks, limiting the need for additional effort down the line during requirements collection and risk identification processes. Those specific work packages have to be included in the WBS of the project and integrated into the project management plan affecting all the other knowledge areas.

Cultural differences within VTs and different locations are properly considered during project planning; despite this, the impact of this factor during project planning is not fully considered or remains unknown.

In summary, brief answers to the two main questions in this research are:

RQ1: Focusing on knowledge areas during the project planning phase, as indicated in Table 4, VTs are clearly identified as a key factor in terms of risk, communication and resources management, impacting the project plan as indicated in the literature review. The main knowledge area impacting the project plan, where VTs are part of the project team, which is not fully considered, is scope management.

RQ2: The scope planning processes, impacting the project plan (project integration knowledge area), that have to be improved and where research effort has to be invested are: collection of requirements and scope definition.

In conclusion, the identified gap in project integration planning (project plan) when VTs are present, as discussed in this research, demonstrates the importance of proper project management procedures in companies as key enablers of successful project planning including VTs (Globerson and Zwikael, 2002), and highlights the need for deep research in areas focused on project planning, taking into account capabilities, leadership and materials, in practice (Clegg, Killen, Biesenthal, and Sankaran, 2018). This will be even more important in the post-COVID19 period (Jouzdani, 2020), when most service and engineering companies will fully integrate Global Virtual Teams into their project teams. in terms of ongoing research directions, it is necessary to create an adaptable and hybrid project management methodology that could fit all sizes of companies (from SMEs to large corporations) and global teams (both collocated and virtual ones), providing a common framework or standard, thereby avoiding the current divergence in project management (Agile vs. Waterfall).

The main limitations of this study are the small sample size that limits the research to qualitative analysis and the small number of countries of the respondents (Spain and Germany) that may limit the extrapolation of results outside Europe and even within Europe in countries where industry practice is dissimilar to that in Spain and Germany. These limitations could be the basis for further analysis of public databases and extended surveys in order to expand the geographical area of the study and implement quantitative analysis of results with a bigger sample of data.

Thus, we have proposed a number of topics related to VTs for further research based on existing studies and the results of this research, which may improve requirements collection and scope definition processes: the *influence of VTs in PMOs and virtual PMO* (Hermano and Martín-Cruz, 2016; Lee-Kelley and Turner, 2017; Müller, Glückler, and Aubry, 2013), *Transition Processes and Planning in SMEs* (Gilson et al., 2015), *Using agile or hybrid techniques and the effect of VTs in exploratory projects* (Rolstadås et al., 2014), and the *Impact of VTs in project interdependencies* (Killen and Kjaer, 2012; McKenna and Walker, 2008; Stettina and Hörz, 2015).

ANNEX

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