



Empirical Research Paper

Main competencies to manage complex defence projects

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ABSTRACT

This research adds a comprehensive way of assessing competencies, contrasting with the usual reductionist approach that uses off-the-shelf instruments. The study reveals 27 competencies to manage complex projects based upon a comprehensive analysis of 22 interviews with senior practitioners associated with the most strategic projects from the Brazilian Army. These competencies were divided into 10 groups, namely influencing, communication, team working, cognitive, management, contextual skills, professionalism, project management knowledge, and personal skills and attributes. Surprisingly, both emotional skills and social competencies were not prominent. The results contribute to advance our knowledge by revealing that practitioners involved in complex defence projects value more technical and individual competencies. This study analyses competencies across several complex projects in the defence sector, providing insights to practitioners and expanding the academic debate focused on other industries and single cases. Organisations might use the competencies to recruit, select, and develop human resources involved in complex defence initiatives.

1. Introduction

Over the last years, academics and professional associations have been interested in the human aspects of project management, particularly the role of competencies in managing projects and programmes (Zhang et al., 2020). As a result, the topic had been researched from the firm, project, and individual levels in project studies (Geraldini and Söderlund, 2018). Academics, for instance, have almost doubled the number of publications in this topic over the last years (de Rezende and Blackwell, 2019a), while professional associations such as the Association for Project Management (APM), the International Project Management Association (IPMA), and the Project Management Institute (PMI) have all published project management competency frameworks (APM, 2015; IPMA, 2015; PMI, 2017).

Throughout the years, the term competency has been developed and associated in the general management literature to other ideas as emotional and interpersonal competency (Bar-On et al., 2000; Riggio and Lee, 2007); communication competency (Griffith, 2002; Cook, 2003; Pitsis et al., 2004; Peltokorpi, 2010; Hynes, 2012); cross-cultural

competency (Dean, 2001; Johnson et al., 2006; Matsumoto and Hwang, 2013); leadership competency (Sydänmaanlakka, 2003; Jokinen, 2005; Kowske and Anthony, 2007; Müller et al., 2012; Drouin et al., 2018); and emotional, social and cognitive intelligence competencies (Boyatzis, 2008). This set of concepts has been recontextualised over time within management studies, where competency has gained prominent importance, especially related to emotional skills, social skills, and performance measures in different approaches (Hong and Stahle, 2005; Salman et al., 2020).

Whilst the exploration of competencies in the general management field is wide and diverse, the project management literature often emphasises a debate about capability at the organisational, rather than competencies at the individual level (Davies and Brady, 2016). Moreover, the project management competency literature is often focused on only some dimensions of project management competencies, such as emotional intelligence, leadership, and project management knowledge. Besides, it is usually contextualised in simple projects and common industries such as construction (Dainty et al., 2005; Shahhosseini and Sebt, 2011; Zhang et al., 2013; Ahadzie et al., 2014; Kwofie et al., 2015;

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Hanna et al., 2016; Maqbool et al., 2017; Hwang et al., 2007; Uhm et al., 2017), information technology (Napier et al., 2009; Skulmoski and Hartman, 2010; Stevenson and Starkweather, 2010; Parolia et al., 2013), public services (Yasin et al., 2009; Blixt and Kirytopoulos, 2017), non-governmental organisations (Brière et al., 2015; Aga et al., 2016; Nanthagopan et al., 2016), among a few others industries (Brill et al., 2006; Geoghegan and Dulewicz, 2008; Ingason and Jónasson, 2009; Krog and Govender, 2015; Medina and Francis, 2015; Miterev et al., 2016). Scholars have already highlighted that the lack of emphasis on competencies might affect the appropriate knowledge to deliver the project and lead to performance problems (Denicol et al., 2020).

Despite the recent interest in the topic, the focus on capabilities and competencies for regular projects in traditional industries has led to a research gap regarding project management competencies in complex projects and programmes in certain industries, such as the defence industry. Practitioners involved in defence projects have to deliver very complex and technological products through projects and programmes with long development timeframes, subject to strong political influences, and under a unique environment shaped by hierarchy, discipline, power, and authority. This scenario pushes the boundaries of which competencies are required from people involved in these initiatives, making it different from regular projects and other industries. Thus, the research question raised is: what are the main competencies used by individuals to manage complex defence projects and programmes?

This research adds an innovative perspective to the current debate about the management of complex projects and programmes, drawing upon cases and insights from the defence sector, which is underexplored in the project management literature. The originality and novelty lie on the presentation of a comprehensive and integrated way of assessing project management competencies used to manage complex projects and programmes, including the ones correlated with them. This approach allows managers to identify which competencies are needed as one moves from simple to complex project management environments, helping to optimise the project management recruitment and development efforts according to the project's context. Moreover, this study not only identifies the main project management competencies needed in complex defence projects, but also highlights their mutual relationship, showcasing the importance of having a comprehensive and integrated effort regarding competency development. Additionally, it visually and clearly demonstrates the distance between the importance given to some competencies in the literature and their real significance in the complex defence project context.

In order to answer the research question, this article is structured in the following sections: First, a theoretical framework is presented to position in the theory, highlighting the integrated view of competency management. Then, the methods used to collect and analyse the data are presented, highlighting the most mentioned competencies and its interdependencies. Next, the results and discussions are presented. Finally, some conclusions, implications, and limitations are presented.

2. Theoretical framework

In order to clearly position the debate proposed in this paper within the management competencies theoretical context, it is necessary to outline the concept of competency and how it has evolved over time, passing from the psychology field to the management field and moving from a functionalist and reductionist view to an integrated and critical view. Thus, this study summarises the different theoretical perspectives regarding the study of competencies and highlights the characteristics of the integrated and critical perspective, which will be used to interpret the results found.

The concept of competency has systematically been studied in the social and behavioural psychology (McClelland, 1973; Boyatzis, 1982), being afterwards added to the field of management in its multiple facets, diffuse, contextualised, and constantly changing nature (Le Boterf,

1995; Hager and Beckett, 1995; Burrell and Morgan, 2017; Morgan, 1999). Competency was firstly described by the constructs of knowledge, skills, and attitudes, shaping a concept widely used for its easy operationalisation in organisational planning (Hong and Stahle, 2005; Salman et al., 2020). For instance, McClelland (1973) was one of the first authors to differentiate competency from skills, abilities, and knowledge. Competency is a characteristic of a person who would relate to superior results in performing a task in a given situation (McClelland, 1973; Boyatzis, 1982). As a result, the concept of competency is thought as a set of characteristics described through knowledge, attitudes, and abilities that justify high performance, and are based on the personality and intelligence of a person. Additionally, competencies are resources available to individuals, mobilised by them to relate to specific situations delimited by their positions and organisational context (McClelland, 1973). Thus, a competency is defined as an ability and "it is a set of related but different sets of behaviour organised around an underlying construct, which we call the intent" (Boyatzis, 2008).

Based on the idea that competencies relate to superior results, a comprehensive literature has been developed over the years to understand the relationship between competencies and organisational results and success. For instance, the seminal works from Boyatzis (1982), Spencer and Spencer (1993) and Lucia and Lepsinger (1999) early argued that competencies are characteristics related to effective or superior performance in a job. Moreover, among the authors that researched the effect of competencies on project's success, the most discussed aspects were the effect of leadership (Müller et al., 2012; Maqbool et al., 2017; Aga et al., 2016; Raziq et al., 2018; Shao, 2018; Ahmed and Anantamula, 2017), emotional competencies (Müller et al., 2012; Maqbool et al., 2017; Shao, 2018; Lee et al., 2013), teamworking competencies (Lee et al., 2013; Chan et al., 2008; Yang et al., 2011), and project management knowledge (Maqbool et al., 2017; Zwickel, 2009; Chou and Yang, 2012, 2013; Hahn et al., 2012) on project success.

However, Le Boterf (1995) and Zarifian (1999) sought to go beyond the concept of personal characteristics described by McClelland (1973), Boyatzis (1982), Spencer and Spencer (1993), and Lucia and Lepsinger (1999), describing competencies as elements of the educational, professional, and personal formation of an individual that guide practices, enabling them to act responsibly in different situations, exceeding one's professional life. Moreover, Le Boterf (1995) added that competency development is an individual responsibility, but also a process of learning with and from others, which implies knowing how to mobilise, integrate, and transfer knowledge, resources, and skills in specific contexts (Ni et al., 2018). Thus, competencies are always contextualised and associated with verbs such as: knowing how to act, mobilizing resources, integrating multiple and complex knowledge, learning to learn, engaging, assuming responsibilities, having a strategic vision (Le Boterf, 1995), adding social value to individuals and to the organisation (Salman et al., 2020).

Despite some of these authors (Salman et al., 2020; Le Boterf, 1995; Zarifian, 1999) had managed to capture the importance of the organisational context to the development of individual competencies, they did not surpass its functionalist view based on causes and consequences relationships such as the influence of competencies on performance or success in projects. This reductionist approach simplifies the complex relations between developing competencies and one's personal trajectory in the organisation given that the presence of competencies do not always create positive results since they are subjective to exogenous factors. Moreover, competencies are not exclusively developed in the organisation and for the organisation.

To overcome functionalist perspectives, Hager and Beckett (1995) propose an integrated and comprehensive conception of competency. It bonds attributes and key tasks, people, and objects. For them, "competency is inferred from performance, rather than being directly observed. While task performance is directly observable, abilities [...] that underlie the performance are necessarily inferred" (Hager and Beckett, 1995; Lum, 2004). For instance, Hyland (1997) states that

competency-based training and education models do not overcome the functional analysis. Thus, the author suggests that competency strategies should be based on experiential traditions.

Therefore, building upon this stream, it is possible to argue that competencies are knowledge, skills and attributes (McClelland, 1973; Boyatzis, 1982) that are elements of the educational, professional and personal formation of a person (Le Boterf, 1995; Zarifian, 1999). Moreover, their assessment needs to be examined in an integrated and comprehensive way (Hager and Beckett, 1995) and consider the context in which they are used (Le Boterf, 1995). For that reason, standard assessment tools focused on few aspects of individuals' competencies (functionalist and reductionist perspective) such as the leadership dimensions questionnaire (Dulewicz and Higgs, 2004), IPMA's individual competence baseline (IPMA, 2015), McBer job competency assessment process [51], Mayer-Salovey-Caruso-Emotional Intelligence Ability Test (Mayer et al., 2002), Multifactor Leadership Questionnaire (Bass and Avolio, 2000), Individual Perceptions Inventory (Goldberg, 1999), among others, was replaced by a comprehensive and integrated assessment tool in this article, the Project Management Competency Framework (PMCF). Based on the project management competency literature (Müller et al., 2012; Dainty et al., 2005; Shahhosseini and Sebt, 2011; Zhang et al., 2013; Ahadzie et al., 2014; Kwofie et al., 2015; Hanna et al., 2016; Maqbool et al., 2017; Uhm et al., 2017; Napier et al., 2009;

Skulmoski and Hartman, 2010; Stevenson and Starkweather, 2010; Parolia et al., 2013; Yasin et al., 2009; Blixt and Kirytopoulos, 2017; Brière et al., 2015; Aga et al., 2016; Nanthagopan et al., 2016; Brill et al., 2006; Geoghegan and Dulewicz, 2008; Ingason and Jónasson, 2009; Krog and Govender, 2015; Medina and Francis, 2015; Miterov et al., 2016; Raziq et al., 2018; Shao, 2018; Ahmed and Anantatmula, 2017; Lee et al., 2013; Chan et al., 2008; Yang et al., 2011; Chou and Yang, 2012; Hahn et al., 2012; Chipulu et al., 2013; Starkweather and Stevenson, 2011; Hwang and Ng, 2013; Ahsan et al., 2013; Fisher, 2011; Zhao et al., 2016; Müller and Turner, 2010a; Müller and Turner, 2010b; Isik et al., 2009; Meng and Boyd, 2017; Chou et al., 2013; Davis, 2011; Creasy and Anantatmula, 2013; Gray and Ulbrich, 2017; Robinson et al., 2005; Clarke, 2010; Andersen et al., 2007; Young and Conboy, 2013; PMI, 2017), the PMCF was developed by de Rezende and Blackwell (2019a), resulting in the identification of 82 competencies organised within 11 groups, namely influencing skills, communication skills, team working skills, emotional skills, contextual skills, management skills, cognitive skills, professionalism, knowledge and experience, project management knowledge, and personal skills and attributes. Fig. 1 illustrates the project management competencies identified by de Rezende and Blackwell (2019a) and highlight in blue the competencies correlated to project success in the project management competency literature (Müller et al., 2012; Maqbool et al., 2017; Aga et al., 2016;

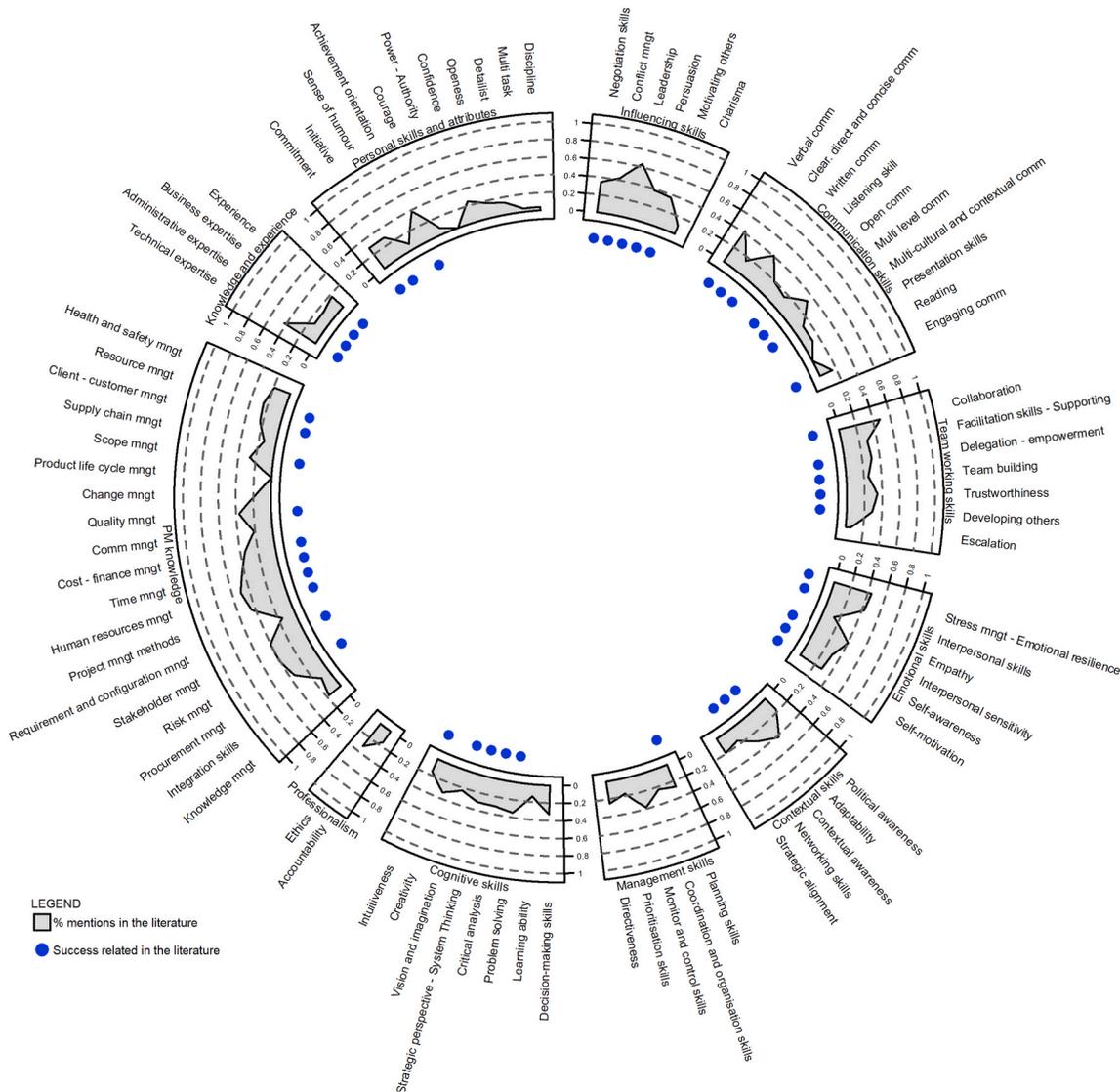


Fig. 1. Project management competency framework (PMCF).

Geoghegan and Dulewicz, 2008; Raziq et al., 2018; Shao, 2018; Ahmed and Anantatmula, 2017; Lee et al., 2013; Chan et al., 2008; Yang et al., 2011; Zwikael, 2009; Chou and Yang, 2012, 2013; Hahn et al., 2012; Müller and Turner, 2010b; Meng and Boyd, 2017):

Therefore, this article uses the integrated view of competency studies to allow the possibility of capturing all characteristics described by the many authors, avoiding reducing the nuances and complexities of project and programme managers' characteristics to a few attributes or perspectives 'a priori'.

3. Methods

The purpose of this article is to develop a greater understanding of the main competencies used to manage complex projects and programmes. Thus, interviews were considered the most appropriate method (Kumar, 2014; Saunders et al., 2016), while a semi-structured interview was designed following a seven-stage process described by Kvale (2008), as illustrated in Fig. 2.

As illustrated in Fig. 2, the first step of Kvale's (2008) process is the thematising stage, which defines the theme to be investigated before the interview, answering why and what will be investigated. The purpose of the interviews (why) was to understand the role of competencies in the management of complex projects and programmes, given that it was identified in a recent bibliometric analysis (de Rezende et al., 2018a) as an important aspect related to complex projects. The focus of the interviews (what) was outlined based on the findings of a systematic review (de Rezende and Blackwell, 2019a) which aimed at developing a comprehensive project management competency framework (PMCF) covering all competencies discussed in the literature so far. Therefore, the interviews focused on identifying which of these competencies found in the literature are regarded as important to manage complex projects and programmes.

Following the research method (Fig. 2), the next stage, protocol design, was focused on developing the interview script, and defining the interview sample. The interview protocol was elaborated following specific steps to guarantee its reliability (Kvale, 2008). First, the interview's questions and its prompts were designed based on the literature, using a project complexity framework (de Rezende and Blackwell, 2019b) and a project management competency framework (de Rezende and Blackwell, 2019a) as foundations. Additionally, warm up and wrap-up questions were included to make the interviewees more comfortable and willing to answer the questions. Before applying the

interviews, research risks and ethics assessments were performed. Moreover, pre-piloting and piloting stages were performed to receive critical feedback (Gillham, 2005) and improve the interview script (Appendix A).

The sample focus was complex projects and programmes. Project complexity is an aspect of projects created by many interdependent parts that can learn (e.g. people, stakeholders) or not (e.g. product, documents) over time and that interact with themselves and the environment (e.g. organisations, governments, laws) through feedback loops that create adaptation and non-linear emergent behaviours that can only be explained by principles and patterns (de Rezende and Blackwell, 2019b). Based on that assertion, it is clear that industries and sectors such as aerospace, construction, information technology, electronic, among other industries and projects can exhibit many factors described in most project complexity frameworks. However, the choice over defence projects occurred because they usually involve an additional layer of complexity. While typical complex projects involve large number of activities and investment, defence projects tend to not only exhibit these factors, but also be highly uncertain (the industry is very secretive and few people have knowledge and experience on developing complex defence systems), be time critical in order to have a strategic advantage over potential threats, involve the development of high technology, many times, new to the world, be subject to strong internal and external political interference and interests, among many other aspects that position defence projects as clearly complex endeavours. Thus, in order to understand the role of project management competencies in complex projects, the defence sector was considered an interesting source of complex projects.

Thus, the choice of sampling method considered characteristics of the defence sector. Some defence projects and programmes were not accessible to interview given their national security issues, sensitive technologies, or being bound by non-disclosure agreements; consequently, quota, volunteer, and haphazard sampling methods were discarded. In this case, a critical case sampling technique was considered appropriate to provide an illustrative profile based on crucial and critical cases from the Brazilian defence industry (Saunders et al., 2016). Then, Brazilian Army's defence projects and programmes (Table 1) were judged to be representative and critical enough to address the research question. They cover several industries within the defence industry (e.g. aerospace, automotive, weapon systems, telecommunication, information technology, research and development, construction), are geographically distributed, involve several countries, and are relevant

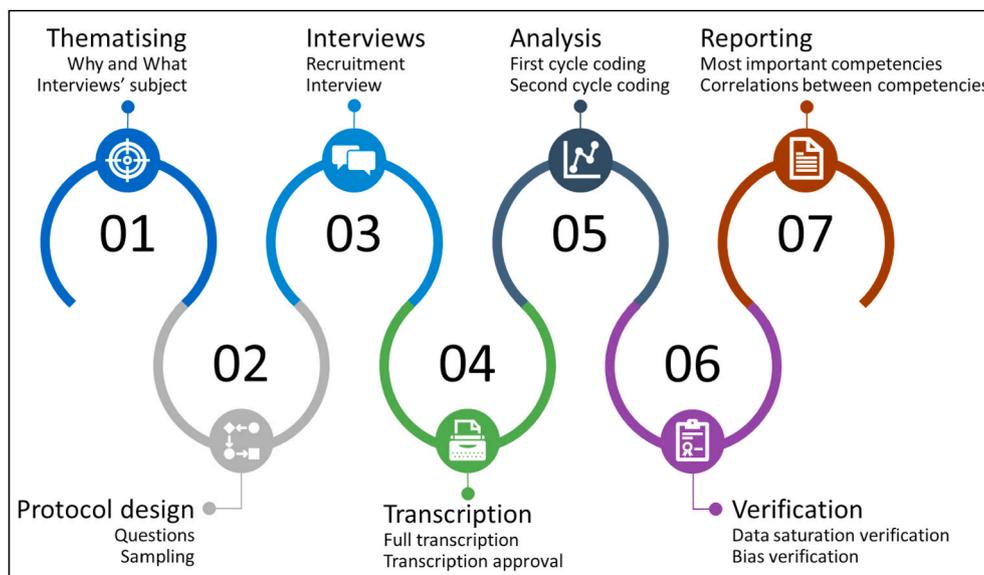


Fig. 2. Research method.

Table 1
Brazilian Army's defence projects and programmes sample.

Defence initiatives	Industry	Estimated budget (US dollars) 1 USD = 3.191 R\$	Estimated duration (years)	Current life-cycle stage
P1	Telecommunications	\$3,760,576,621.75	12	Development
P2	Weapon systems	\$6,267,627,702.91	30	Development
P3	Information technology	\$1,253,525.54	10	Development
P4	Weapon systems	\$1,284,863,679.10	27	Development
P5	Weapon systems	\$567,533,688.50	11	Development
P6	Weapon systems	\$9,401,441.55	10	Concept design
P7	Telecommunications	\$2,036,979.00	4	Concept design

from the executive power (President and ministers), military and industrial agendas in Brazil.

After the protocol design, stage three (Fig. 2) focused on the interviews itself. First, people were recruited from prime contractors, the Brazilian Army's Project Management Office, and the projects and programmes teams to explore the theme from different perspectives. People from these organisations received a participant information sheet (appendix B) and a consent form (appendix C) to understand the interview goal and protocol and decide about their participation in the research. After the contact, 22 people (Table 2) accepted to participate in the research. These interviewees were senior practitioners connected with some of the most strategic projects and programmes from the Brazilian Army (Table 1). The interviewees were asked to pick a date and place of their choosing. The interviews were conducted and recorded for later analysis. As a result, almost 17 hours of interviews were recorded.

Following the research method defined, stage four (Fig. 2), focused on transcription. The recorded interviews were fully transcribed to retain the maximum information in its original form (Gillham, 2005). After receiving an audio file synced with its respective transcription, interviewees approved both of them.

The fifth stage of the research method was the analysis (Fig. 2). In this stage, the approved transcriptions were then uploaded to NVivo for coding (Bazerley and Jackson, 2013). The analysis stage used structural, descriptive, concept, and provisional coding during first cycle coding

Table 2
Interviewee list.

Interviewees	Job position	Professional experience (years)	Age (years)
A	Project Manager	17	35
B	Project Manager	17	35
C	Programme Manager	26	47
D	Project Specialist	34	51
E	Project Manager	49	65
F	Project Manager	29	49
G	Project Specialist	35	54
H	Programme Specialist	39	56
I	Programme Director	25	48
J	Programme Manager	32	48
K	Project Specialist	7	30
L	Programme Director	43	65
M	Programme Director	42	64
N	Project Manager	18	49
O	Programme Manager	21	40
P	Project Specialist	24	42
Q	Project Manager	10	32
R	Project Specialist	28	43
S	Programme Director	27	43
T	Project Specialist	29	45
U	Programme Specialist	38	57
V	Programme Specialist	29	46

(Saldaña, 2016). Structural coding was used as the foundation for analysis, creating context-based or conceptual phrases to express the meaning of what was described. The descriptive coding was used simultaneously as a refinement of the structural codes, assigning basic labels, usually words, to express an idea. Concept coding was used to express big picture ideas related to the interviews. Provisional coding used a comprehensive list of competencies identified by de Rezende and Blackwell (2019a) systematic review on project management competencies. After several coding iterations using the previously described techniques, a second coding cycle reorganised and reanalysed the codes. During this stage, the pattern coding technique was used to develop categories from similar coded data and develop meaning (Saldaña, 2016). As a result, the groups and competencies identified in the literature by de Rezende and Blackwell (2019a) were validated and new competencies were identified.

Following the analysis, stage six (Fig. 2) focused on verifying the interview data. The data were assessed regarding their validity and reliability and to determine whether the responses were sufficient (data saturation) to answer the research question, whether there was any bias in the data, and if the coding methods used created unambiguous codes and coherence (Kvale, 2008). Data saturation was found after 15 interviews, as presented in Fig. 3. No type of bias was found in the interviewees' responses; the codes were considered unambiguous and coherent to interviewees responses.

Finally, stage seven (Fig. 2) focused on reporting the findings. Since this article seeks to identify the main competencies used to manage complex projects and programmes, based on the law of the vital few, only those competencies that were mentioned by at least one-third of the respondents were reported in the results and discussion section. Moreover, since this article also seeks to present an integrated view of project management competencies, when multiple competencies were coded from the same sentence of the interview transcription, they were considered correlated. Thus, the main competencies and its correlations were reported and discussed in the following section.

4. Results and discussion

The analysis of the interviews revealed 67 competencies organised into eleven dimensions of the project management competency framework (de Rezende and Blackwell, 2019a), and those highlighted by at least one-third of the interviewees were regarded as main competencies.

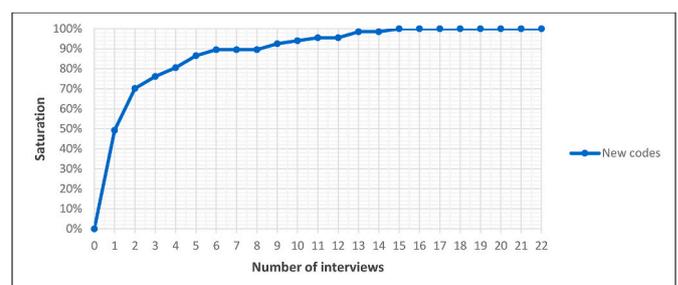


Fig. 3. Data saturation.

As a result, it was found that 27 core competencies to manage complex defence projects and programmes. Fig. 4 illustrates the results from the interviews plotted over the project management competencies described in the literature (de Rezende and Blackwell, 2019a). The number of articles and interviewees mentioning the project management competencies was converted to percentages for comparison. Core competencies mentioned by interviewees were highlighted in blue and the less mentioned competencies were plotted in red. The percentages of mentions in the literature (de Rezende and Blackwell, 2019a) were plotted in grey to allow the comparison between the focus on the literature and the focus given by practitioners in complex projects and programmes. The distance between literature and practice in each of the different competencies dimensions is a first contribution of this study. Finally, when multiple competencies were mentioned by interviewees in the same context, they were considered correlated and were plotted in the inner circle, a second important contribution of the study.

As one may observe, project and programme managers in the defence industry have a competency profile more focused on individuals (left side of Fig. 4) rather than social competencies (right side of Fig. 4). Based on the PMCF, 17 of the 27 core competencies were considered individual competencies, and ten were considered social competencies. On average, individual competencies accounted for 26.03% of the mentions, and social competencies for 21.41%. Conversely, in the

literature, individual competencies are, on average, discussed in 23.63% of the cases, while social competencies are discussed in 28.64% of the cases (de Rezende and Blackwell, 2019a). Therefore, one of the key findings and contributions of this article was that the general profile of project and programme managers present in the literature and focused more on social competencies do not hold in complex defence projects and programmes, where the focus relies more on the individual competencies. For instance, the emotional skills group had few mentions, most of them unrelated to other competencies, and with no competency above the one-third threshold, despite stress management (Müller et al., 2012; Shao, 2018; Lee et al., 2013), interpersonal skills (Müller et al., 2012; Maqbool et al., 2017; Geoghegan and Dulewicz, 2008; Shao, 2018; Müller and Turner, 2010b), interpersonal sensitivity (Maqbool et al., 2017), self-awareness (Müller et al., 2012; Maqbool et al., 2017; Geoghegan and Dulewicz, 2008; Shao, 2018; Müller and Turner, 2010b) and self-motivation (Geoghegan and Dulewicz, 2008; Shao, 2018; Müller and Turner, 2010b; Gray and Ulbrich, 2017) being all competencies related to project success in the literature. Similarly, the analysis of Fig. 4 demonstrates how competencies such as collaboration, political awareness, planning skills, coordination and organisation skills, learning ability, accountability, knowledge management, integration skills, technical, administrative, and business expertise, and experience are underrepresented in the project management competency literature

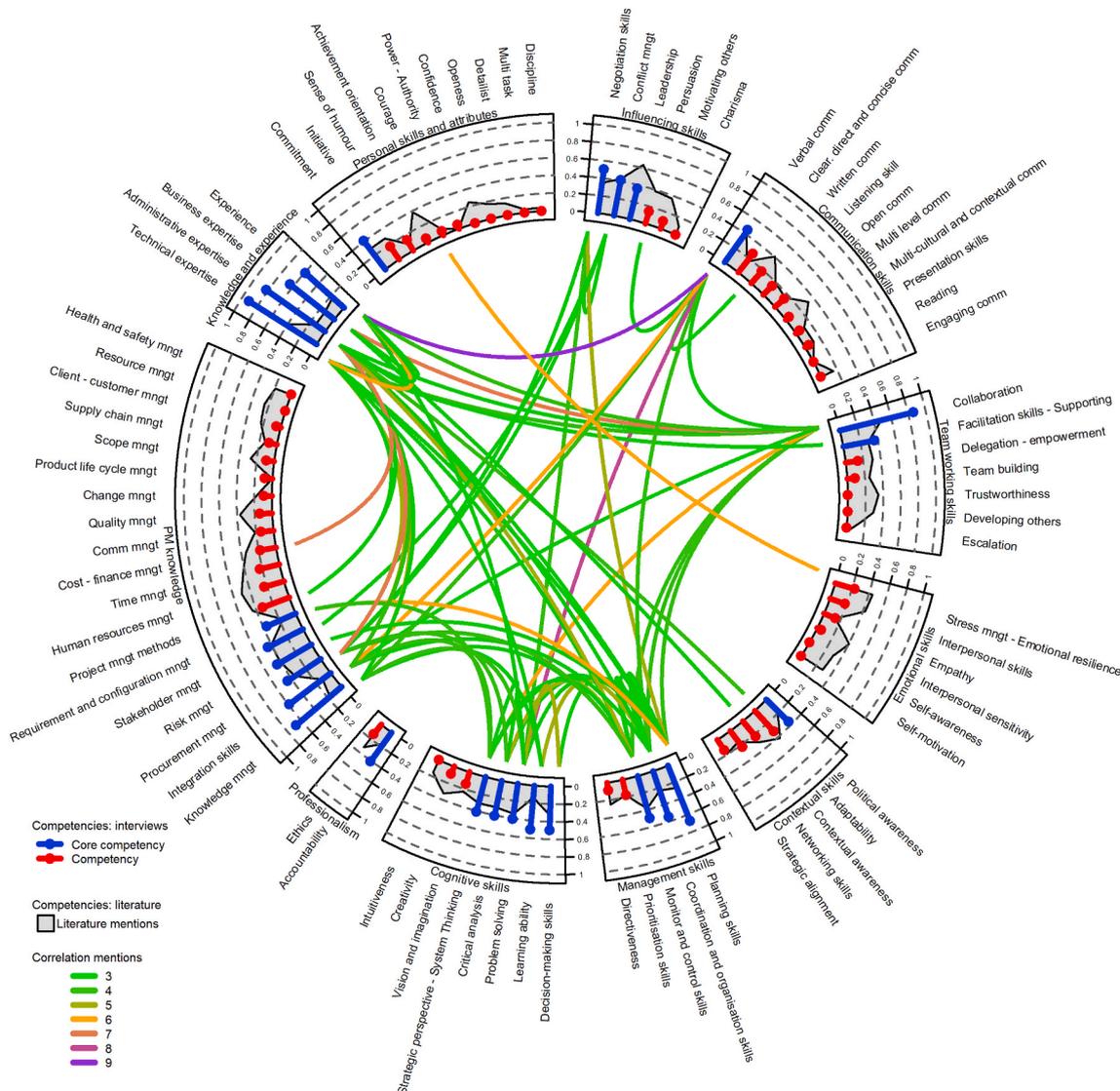


Fig. 4. Main competencies used to manage complex defence projects and programmes.

when compared to interviewees mentions. These gaps in the literature are a fruitful avenue for researchers.

Additionally, the analysis of the interviews also revealed two aspects not described in the PMCF, but despite being important in complex defence projects and programmes, namely product life cycle management knowledge and power and authority. These two aspects were mentioned by few interviewees, although they highlight important characteristics of the defence industry, namely the long lifecycle of defence projects and programmes, and the role of power and authority in the relationship between individuals and organisations involved in this kind of initiatives.

Another important contribution refers to surpassing the functionalist view predominant in competency management studies. The links illustrated in the inner part of Fig. 4 highlight that the main project management competencies are not used in isolation, but, conversely, they mobilise other competencies to manage the project. All this highlights the importance of the integrated and comprehensive view to discuss the main project management competencies in the context of complex projects and programmes.

In the following sections, the 27 main competencies identified, and the ones correlated to them are discussed according to their group.

4.1. Project management knowledge

The project management knowledge group was the group with the highest number of competencies above the one-third threshold, totalling six competencies. Among them were knowledge management (68.18% - 15 sources), integration skills (59.09% - 13 sources), procurement management (45.45% - 10 sources), risk management (45.45% - 10 sources), stakeholder management (45.45% - 10 sources), and requirement and configuration management (36.36% - 8 sources). Despite that, most competencies in this group were below the threshold, including some competencies related to project success in other industries, such as project management methods, quality management (Chan et al., 2008), human resource management (Ahmed and Anantamula, 2017), time management, scope management, cost and finance management (Hahn et al., 2012), client management (Parolia et al., 2013; Chen et al., 2019) and resource management (Müller et al., 2012; Geoghegan and Dulewicz, 2008; Shao, 2018).

Knowledge management describes the processes of creating, sharing, using, and managing knowledge and information in projects and programmes, and it was the most mentioned competency in this group. Knowledge management was correlated with competencies such as learning, problem-solving, verbal communication, administrative expertise, and technical expertise. By analysing the speeches and correlations, it was clear that, despite the importance given to knowledge management, most teams used it informally, focusing on learning and verbally sharing technical and administrative information and knowledge regarding the project or programme, rather than having a systematic approach to it, using knowledge management systems, for instance (Hartono et al., 2019).

The second most mentioned project management knowledge competency was integration management, which describes the “processes and activities to identify, define, combine, unify, and coordinate the various processes and project management activities” (PMI, 2017). Because of the size and complexity of defence initiatives, integration focus was on having people with different technical and administrative expertise working together to get a better understanding of the whole project or programme and the impact that each decision can make on the initiative. Complementing integration management, interviewees also described requirement and configuration management as an important competency to manage defence projects and programmes. Thus, despite not clearly state or know it, what interviewees described was that they use system engineering and requirement management practices alongside project management processes as considered in the literature (Varajão et al., 2019).

Procurement management in defence projects and programmes (Scott Stanford and Molenaar, 2020) incorporates not only the processes and knowledge to purchase products and services, but also legal and contract management processes and knowledge. Moreover, it was correlated to competencies such as critical analysis, conflict management, negotiation, technical expertise, and administrative expertise. The analysis of the speeches and correlations highlighted two contrasting and complementing aspects regarding how procurement management is used in defence initiatives. On one hand, procurement processes in the defence sector tend to be overly complex, therefore managers usually address these issues based on solid technical expertise, administrative expertise, and critical analysis. On the other hand, it also describes the need for soft skills such as negotiation and conflict management. Therefore, teams in defence projects and programmes need to have a balanced composition between technical and people-oriented managers.

Risk management was highlighted by interviewees as an important competency to manage defence initiatives, and it was strongly correlated with planning skills, similar to Cha and Maytorena-Sanchez (2019) findings regarding project managers in software projects. The interviewees' narratives suggested a strong focus on planning, rather than monitoring and controlling the risks. Consequently, competencies such as problem-solving and conflict management that are usually used to deal with issues were also highlighted as important competencies, demonstrating a reactive, rather than proactive approach towards risks.

This analysis contributes to understanding that defence initiatives usually involve many stakeholders, ranging from local communities and companies to foreign governments and organisations. For that reason, stakeholder management was highlighted as an important competency. Despite having many high-profile stakeholders, interviewees described standard approaches to manage them such as face-to-face communication, meetings, reports, among others, demonstrating that, regardless of the complexity of the initiative, managing stakeholders does not need to use sophisticated techniques and tools.

4.2. Cognitive skills

Cognitive skills describe the abilities related to mental processes of perception, memory, judgment, and reasoning, contrasting with emotional and volitional processes. This group had five competencies highly regarded by interviewees, namely decision-making (50% - 11 sources), learning ability (50% - 11 sources), problem-solving (40.91% - 9 sources), critical analysis (40.91% - 9 sources), and strategic perspective and system thinking (40.91% - 9 sources). Conversely, emotional skills had few mentions during interviews, reinforcing the argument that in defence projects and programmes, individual competencies such as cognitive skills play a more predominant role when compared to social competencies, such as emotional skills.

Decision-making was the most mentioned competency in the cognitive skills group, despite not being related to project success in the literature. Moreover, it was correlated with problem-solving and planning in defence initiatives, similar to Cha and Maytorena-Sanchez (2019) findings regarding the importance of planning and decision making during the planning stage of software projects. On one hand, team members used decision-making and problem-solving skills to make decisions regarding contract related issues and risks. On the other hand, they used decision-making and planning to decide the procurement process. All in all, interviewees focused on the importance of leaders' decision-making skills rather than on the autonomy to make decisions, which reinforces the argument that high levels of authority and hierarchy shape how and who employ decision-making skills in defence projects and programmes.

Learning ability was the second most mentioned competency in the cognitive group and describes the ability to acquire and absorb knowledge and other skills. Bjorvatn and Wald (2018) found that it has a mediating effect between project complexity and project performance (unscheduled delays and overspending). In our findings, learning ability

was mainly correlated with technical expertise and knowledge management. Most defence projects and programmes are highly technological and have long development cycles. Therefore, people involved in these initiatives need to rapidly absorb many technical aspects accumulated over the years, usually using knowledge management tools and techniques.

Problem-solving is a competency associated with project success (Hahn et al., 2012) and it was correlated to competencies such as verbal communication, negotiation, experience, planning and knowledge management, revealing that managers involved in defence initiatives prefer to negotiate face-to-face solutions after careful planning and grounded on prior experience and knowledge regarding the issue. This systematic approach to problem-solving resembles military planning for battles, demonstrating that some military ways of working can be easily used in management environments such as projects and programmes. This also reinforces the argument that the environment shapes which and how the competencies are used.

Critical analysis, strategic perspective and system thinking were also highlighted by interviewees as important competencies to manage complex defence initiatives (40.91% - 9 sources). Critical analysis and strategic perspective, for instance, were both correlated to other competencies such as planning, and monitor and control skills, indicating managers usually plan and oversee defence projects and programmes based on logical reasoning and analysis considering the implications, the broader picture and the connections between elements that constitute the initiative. Moreover, strategic perspective and system thinking were also correlated to integration skills, collaboration, and requirement and configuration management, given that developing complex defence systems usually requires a diverse team in terms of skill, knowledge, and experience. Similar results were found by Chen et al. (2019), highlighting the importance of critical analysis (analytical thinking) and strategic perspective (conceptual thinking) in projects and programmes in general.

In summary, managers and specialists in defence projects and programmes privilege the technical and analytical side of cognitive competencies, rather than the more creative side of it. For instance, competencies such as intuitiveness were not mentioned and creativity (9.09% - 2 sources), and vision and imagination (13.64% - 3 sources) were mentioned a few times despite being correlated to project success (Shao, 2018). Moreover, the focus on management skills (planning, organisation, coordination, monitor and control) and cognitive skills (decision-making and learning) in contrast with directiveness, intuitiveness and creativity highlights the influence of the military rationale and pragmatic cultural context shaping the project management competency profile in this context. The contribution of these findings is that success in a specific context shapes the importance given to a set of competencies (as the integrated comprehensive literature states). Competencies need to be inferred from success, rather than being developed from a general understanding of importance aiming for an idealised condition of success. Another contribution is that most cognitive skills regarded as important by interviewees are not usually taught in university courses, revealing a gap between practice and academy.

4.3. Knowledge and experience

The competencies in the knowledge and experience group were highly mentioned by interviewees. For instance, technical expertise (90.91% - 20 sources) was the most mentioned competency of all groups. Administrative expertise (81.82% - 18 sources), business expertise (63.64% - 14 sources), and experience (59.09% - 13 sources) were also highly regarded by interviewees as important competencies to manage defence projects and programmes. All these competencies were highly correlated with each other and with collaboration, demonstrating the interdisciplinary nature of defence initiatives.

Technical expertise describes one's knowledge and skills necessary

for managing technical tasks, technologies, products, and systems. It is the engineering domain of the initiative and people involved in these activities are usually required to use their technical expertise alongside other competencies such as learning, planning, monitoring, controlling, integration, knowledge management, procurement management, project management methods, and facilitation.

Administrative expertise is related to the logistics, managerial activities, and workflow within the organisation and the initiative. In defence projects and programmes, people with administrative expertise are also required to have adaptation skills, coordination and organisation skills, planning, monitoring, controlling, cost and finance management, integration skills, knowledge management, procurement management, and project management methods.

Business expertise describes the ability to understand and identify patterns and common behaviours in the defence industry, but also the knowledge regarding the usage and deployment of the military systems under development by the initiative. Unlike other competencies in this group, business expertise was mainly correlated with only one external competency, namely contextual awareness.

Complementing knowledge expertise, experience was regarded as an important aspect to manage defence projects and programmes. Experienced people involved in defence initiatives are also required to have problem-solving and verbal-communication skills.

In summary, people with technical expertise focus on the micro-level of the initiative, dealing with technologies and technical tasks. Conversely, business expertise focuses on the macro-level, dealing with external and contextual issues. Administrative expertise concerns the meso-level, supporting the activities carried out by the previous levels within organisational boundaries. Regardless of one's expertise, experienced people are required to engage in solving problems and voice their concerns whenever necessary. The results from the knowledge and experience competency group highlights the experiential nature of the competency development strategies that organisations can develop to overcome functionalists, hierarchical and reductionists models (Hyland, 1997). Even in a structured and hierarchical organisational context such as the Armed Forces, experience is one of the most correlated competencies and a key component to manage projects and its complex and dynamic characteristics. Therefore, it becomes clear that the idea of project success is not only related to the sum of existing competencies, but also to the integration of the individual and social competencies mobilised simultaneously in the project.

4.4. Influencing skills

The influencing skills describe the ability to produce effects on the actions, behaviours, and opinions of others. Only three competencies in this group were regarded as very important to manage defence projects and programmes, namely negotiation skills (50% - 11 sources), conflict management (40.91% - 9 sources), and leadership (36.36% - 8 sources).

Defence initiatives usually involve large budgets (Table 1), and multiple types of contracts, such as offset, technology transfer, research and development, and off-the-shelf purchases, which increases the probability of conflicts and the need to negotiate terms. These aspects explain why managers mentioned negotiation skills and conflict management as core competencies, highlighting the need for building consensus and finding common ground on issues regarding legal and contractual aspects of the projects and programmes. Moreover, these competencies were also correlated to procurement management, stakeholder management and planning skills, suggesting an integrated approach in which multiple competencies need to be used together to deliver better results (Hager and Beckett, 1995; Hyland, 1997).

Leadership was another aspect raised by interviewees as important to manage defence projects, however, not as important as described in the literature (de Rezende and Blackwell, 2019a). To an extent, it is because of the nature of military organisations, which in peaceful environments such as projects and programmes, hierarchy and discipline partially

replace the need for strong leadership given the legit exercise of power and authority coming from the rank of military managers. Despite that, leadership continues to be a core competency to managing defence projects and programmes and it is traditionally correlated with project success (Müller et al., 2012; Maqbool et al., 2017; Aga et al., 2016; Raziq et al., 2018; Shao, 2018; Ahmed and Anantatmula, 2017; Podgórska and Pichlak, 2019; Zaman et al., 2019a). In addition, leadership was occasionally mentioned alongside other competencies such as interpersonal skills, political awareness, open communication, and decision-making skills. This correlation contributes to the argument that the functional separation of competencies has its value as a research instrument, however, in the organisation reality, competencies are perceived in an integrated way. In other words, a set of competencies are simultaneously identified while inferring the performance in the management of defence projects (Lum, 2004; Hyland, 1997).

4.5. Management skills

The management skills group had three competencies regarded as important to manage defence initiatives, namely planning (68.18% - 15 sources), coordination and organisation (54.55% - 12 sources), and monitor and control (50% - 11 sources). Defence projects and programmes are generally large and long-lasting organisational initiatives. Therefore, competent individuals able to plan, coordinate, organise, monitor, and control aspects and teams are crucial to success in a defence initiative.

These competencies were strongly correlated with each other, demonstrating that managers usually are involved from planning to execution. Moreover, these competencies were also strongly correlated to other competency groups such as cognitive skills (critical analysis, decision-making, problem-solving, strategic perspective), knowledge and experience (administrative and technical expertise), and project management knowledge (integration, knowledge management, procurement management, requirement and configuration management, and risk management). By analysing the correlations, it is possible to argue that defence projects and programmes are extremely technical and rely heavily on the classical view of project management, not only because of the existing correlations but also because of the missing correlations and few mentions of competencies such as adaptation and intuitiveness, which could imply a more flexible and agile management environment. Besides, it is important to highlight that the classical view of project management, focusing on objectivity, reductionism, control and predictability have been challenged by approaches based on subjectivity, systemic thinking, adaptability, among others (de Rezende et al., 2018a; Pollack, 2007), demanding organisations to reassess their assumptions and adapt to keep being successful. The defence sector is not different.

4.6. Team working skills

The team working skills group focus on the way people work together to deliver projects and programmes. Interviewees focused almost entirely on the role of collaboration (86.36% - 19 sources), and facilitation and support skills (36.36% - 8 sources), occasionally mentioning delegation (13.64% - 3 sources) and team building (9.09% - 2 sources), and ignoring trustworthiness, developing others, and escalation.

Defence projects and programmes usually involve very diversified teams and organisations, requiring intense collaboration. In a matter of fact, collaboration was the most correlated competency, co-occurring alongside 39 other competencies (Fig. 4). However, the strongest correlations were mentioned with knowledge and experience skills (technical expertise, administrative expertise, business expertise, and experience), management skills (monitor and control, planning, and coordination and organisation skills), integration skills, and strategic perspective. Collaboration is the competency that better represents the

integrated perspective for inferring project management performance (Hager and Beckett, 1995; Lum, 2004; Hyland, 1997) given its position as a social competency and its co-occurrence alongside 39 other competencies, most of them individual competencies. Thus, collaboration is the social competency that most attracts individual competencies to create project results.

On the other hand, facilitation and support skills were mainly correlated with technical expertise and interviewees described that the main strategy regarding facilitation and support skills was related to contracting technical experts to facilitate planning, monitoring and control of the project or programme. Therefore, these team members had the role of supporting and facilitating the team with their knowledge and experience.

The less mentioned competencies such as delegation, team building, trustworthiness and developing others are usually related to project success (Parolia et al., 2013; Geoghegan and Dulewicz, 2008; Krog and Govender, 2015; Shao, 2018), although their application in a military environment is not straightforward. For instance, delegation is usually related to empowerment in the literature. However, in a military environment, power comes from the rank one holds. Therefore, it is not easy to transfer power between people with different ranks. This is another example of how the environment shapes specific competencies and how they are mobilised.

4.7. Communication skills

The communication skills group encompasses ten competencies used by competent communicators (Thomas et al., 1998, 1999). Surprisingly, only verbal communication (45.45% - 10 sources) was regarded as a core competency to manage defence projects and programmes. Verbal communication was also correlated with written communication and other competencies that highlighted the context in which it was used, namely persuasion, experience, integration, knowledge management, collaboration, coordination, and organisation skills.

Communication skills are well known for its correlation with project success (Maqbool et al., 2017; Aga et al., 2016; Shao, 2018; Ahmed and Anantatmula, 2017; Hahn et al., 2012). However, in the defence context, they seem to play a secondary role, given that few interviewees mentioned clear, direct and concise communication (27.27% - 6 sources), open communication (13.64% - 3 sources), multi-level communication (4.55% - 1 source), and multi-cultural and contextual communication (4.55% - 1 source) as core competencies. Again, this can be explained by the strong role of hierarchy, discipline, and the consequent use of power and authority. In an environment in which power and authority are key aspects, communications tend to be top-down and not always open to debate (it is an order!). Therefore, competencies such as open communication, multi-level communication, multi-cultural and contextual communication, and engaging communication may not be exercised, despite being developed in people involved in these initiatives. In summary, the presence or absence of some competencies reflects the context of military organisations focused on command-based communication, in contrast with an engaging communication style existing in many firms and often described in the literature. This highlights the importance of not only examining competencies in an integrated way, but also considering the context in which they are exercised.

4.8. Contextual skills

Contextual skills focus on the understanding and management of circumstances or facts that surround an event, situation, or environment. Major defence initiatives usually involve public hearings in the House of Representatives and the Senate, and political articulation with State authorities, the Presidency, Vice-Presidency, and Ministers of State, not only because of their large investment but also because of their geopolitical, economical, technological and security implications (de Rezende et al., 2018b). In that scenario, interviewees mentioned that

political awareness (36.36% - 8 sources) was an important competency to manage complex defence projects and programmes. This is similar to Zaman et al. (2019b) findings. According to them, political skills have a strong impact on the relationship between project complexity and project performance.

However, other contextual skills, usually related to project success (Lee et al., 2013; Chan et al., 2008; Hahn et al., 2012) such as adaptability, contextual awareness, networking, and strategic alignment were not highlighted as core competencies by interviewees. That suggests that defence project and programme managers need to understand, manage and respond more to the external (political awareness), rather than to the internal environment of their initiative. Despite that, competencies such as adaptability and contextual awareness were correlated to other competencies, namely administrative and business expertise, respectively. This demonstrates that managers use their business expertise to be aware of the organisational environment, and their administrative expertise to easily adapt to new situations.

The contextual skills are an interesting example that can benefit from teaching cases that highlight the role of context in project management, especially extreme contexts such as the defence industry.

4.9. Professionalism

Professionalism is a small group with only two competencies, namely accountability and ethics. These competencies are usually noticed when present, but much more perceived when they are absent. Interviewees described only accountability (40.91% - 9 sources) as a core competency to manage defence initiatives.

As described previously, managers in defence projects and programmes are expected to make many decisions and, as such, they should be accountable for their actions and decisions (Yasin et al., 2009; Blixt and Kirytopoulos, 2017; Mac Donald et al., 2020). Moreover, most defence initiatives are funded by the public sector and governmental control and audit organisations enforce accountability upon individuals involved in these projects and programmes. Therefore, accountability is an expected competency in initiatives with large budgets like the ones in the defence industry. Similarly, ethics is another important aspect when managing projects and programmes, however, few interviewees mentioned it as a core competency to manage defence initiatives (13.64% - 3 sources). As argued in this section, professionalism is noticed especially when absent, therefore, the few mentions to ethics are explained because a few unethical issues happened during these initiatives, what usually occurs when ethical people are involved in these teams.

Considering that accountability is already a competency expected from practitioners, military and audit organisations could use the comprehensive and integrated way of assessing the practitioner readiness to work on a complex project based on the findings and contributions reported in this article.

4.10. Personal skills and attributes

Despite the most mentioned competencies to manage a defence initiative being, on average, focused on individual competencies, the personal skills and attributes group had only commitment (40.91% - 9 sources) mentioned as an important competency to manage defence projects and programmes. Even competencies such as initiative, and achievement orientation that are usually related to project success (Müller et al., 2012; Lee et al., 2013; Chan et al., 2008) had few interviewees mentioning it as important, remaining below the one-third threshold.

Commitment is also described as engagement or conscientiousness in the literature and explains the ability to define a course of action and stick to a plan, despite adversities (Müller et al., 2012; Blixt and Kirytopoulos, 2017; Brière et al., 2015; Krog and Govender, 2015; Shao, 2018; Müller and Turner, 2010a; Müller and Turner, 2010b; Gray and

Ulbrich, 2017; Varajão et al., 2019). Because of the many adversities faced in a complex defence initiative, interviewees described that commitment usually comes with the need to also have stress management skills and emotional resilience, similar to the findings in information technology projects (Varajão et al., 2019).

5. Conclusion

Scholars have highlighted that the lack of emphasis on competencies might affect the appropriate knowledge to deliver the project and lead to performance problems (Denicol et al., 2020). Moreover, the current focus on capabilities and competencies for regular projects in traditional industries led to a research gap regarding project management competencies in complex projects and programmes in certain industries, such as the defence industry.

In order to contribute with that issue, this article raised the research question of what the main competencies are used to manage complex defence projects and programmes. Addressing this question, a series of semi-structured interviews were conducted with senior practitioners connected with some of the most strategic and complex projects and programmes in the Brazilian Army.

The results highlight that 27 competencies are considered important to manage complex defence projects and programmes. These 27 competencies are divided into 10 groups, namely influencing, communication, team working, contextual, management, cognitive skills, professionalism, project management knowledge, and personal skills and attributes. Surprisingly, emotional skills had few mentions and most of them were unrelated to other competencies. Moreover, contrary to the general literature on the topic (de Rezende and Blackwell, 2019a), interviewees valued more individual competencies than social competencies, what, in addition to the few mentions to emotional skills, reinforces the argument that people involved in complex defence initiatives value more technical and individual competencies. Although there are private partners to defence projects that may not necessarily have the same organisational culture and values, some of them were founded by military egress, or it is possible that a similar organisational culture has facilitated the partnership and belonging to the same organisational network. In that sense, they replicate the same pattern of valuing more technical and individual competencies. Future research that addresses organisational culture would help to further clarify this reflection.

Based on the findings, it is possible to conclude that managers in complex defence projects and programmes have a competency profile mostly focused on individual competencies, reflecting some characteristics of the defence industry and its culture. For instance, extraordinarily complex and technological defence products, projects and programmes, and their long periods of development require people with deep knowledge and strong cognitive skills. Moreover, the unique defence environment shaped by hierarchy, discipline, power, and authority reinforces the focus on individual competencies, since managers are empowered by their ranks with the authority to make team members comply with their orders. All this highlights the role of the context (hierarchy, discipline, power, authority, technology) in shaping the importance and focus on project and programme management competencies. Therefore, there is no one-size-fits-all regarding competencies. Managers need to understand and tailor these competency frameworks to their industries and initiatives, an argument aligned with the integrated perspectives of competency studies.

Analysing the individual and social competencies that were identified in complex defence initiatives settings, it was possible to capture and understand the fluid, changeable and interconnected nature of the competencies, strengthening arguments against reductionist perspectives based on stereotypes and evidence how a set of competencies can be inferred from project successes. These findings also point towards the understanding that behaviours and competencies can be developed by individuals to adapt to specific labour environments.

The original value of this article lies on the identification of the main competencies to manage complex defence projects and programmes and on its differences and similarities with the literature, adding a different perspective on the discussion regarding competencies. Moreover, it adds a comprehensive way of assessing competencies, contrasting with the usual functionalist approach that uses off-the-shelf instruments and discusses isolated competencies. Besides, it adds a framework tailored to complex defence projects and programmes, which incorporates all competencies identified in the literature and the context, allowing a complete and integrated assessment of people working in these settings.

5.1. Implications for practice, teaching, society, and research

The implications for practice are twofold. On one hand, organisations can benefit from this research by focusing on the main competencies and the ones associated with them to recruit, select, and develop human resources involved in complex defence initiatives. The proper fitness within the set of competencies available in the organisation can contribute to reduce the overall project portfolio risk, improve organisational performance (Denicol et al., 2020), and help to successfully deliver business results. On the other hand, practitioners can use the findings to understand which competencies are needed as one moves from a regular to a complex project or programme, or from other industries to the defence industry. Focusing on the development of the right competencies can help managers to improve their performance and lead to a successful career development. In both cases, practitioners and organisations can find a comprehensive list of project management competencies derived from the literature and practice illustrated in Fig. 4. Moreover, the main competencies are highlighted in blue to easily identify the most important competencies. Special attention must be given to the inner circle links connecting the competencies because they illustrate which competencies are used together to respond to the challenges in delivering complex projects and programmes.

This article has also implications for teaching. For instance, the article can be used as an interesting teaching case that illustrates how the project's environment can shape which, how, and when competencies are regarded as important, stimulating a rich discussion able to prepare future project managers to be critical and attentive to the needs of the projects, recognising that one size does not fit all. Additionally, scholars can use the identified competencies to develop teaching programmes aiming to develop project management competencies beyond the traditional technical competencies, focusing also in the development of social competencies.

Most defence projects and programmes are funded by the public sector, so this article has also some societal implications. For instance, the Armed Forces and the Ministry of Defence can develop internal policies to ensure that the project teams have the right set of competencies to work in complex defence projects. This type of assessment can be done by the military or audit organisations based on the complete list of competencies illustrated in Fig. 4, with special attention to those regarded as most important. Working to ensure that projects teams are prepared to manage complex defence projects can contribute to better investment of taxpayers' money and to the successful development of defence systems, which, ultimately, can implicate in protecting soldiers and citizens.

The implications for research illustrate some of the limitations of the current debate regarding project management competencies and open the opportunity to further develop the subject. For instance, the comparison made in Fig. 4 regarding the importance given to project management competencies in the literature (grey area of the chart) and in complex defence projects (chart bars) points several research opportunities to academics, showcasing the need for going beyond the traditional functionalist and reductionist perspectives which are often adopted. Additionally, researchers can get a better understanding of the several competencies needed to manage projects by using the comprehensive and integrated perspective based on the Project Management

Competency Framework (de Rezende and Blackwell, 2019a), as illustrated in this article.

This research is limited to the context of exploration, therefore generalisations need to be carefully treated, given the nature of competencies in the defence industry. Further research is needed to assess the weight of each competency, the development level required and existent in each type of initiative or phase, among many other routes of enquiry. Researchers could also explore the question on whether it is possible to sustain these contextualised developed competencies along time, and if they would lead to outstanding performance in terms of delivering defence capabilities. This could form initial paths for future research related to defence project management offices, alongside with proving the success of delivering economic growth and technology innovation.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.plas.2021.100014>.

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