Impact of proactive behaviour antecedents on construction project managers' performance

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Abstract

Purpose – Many aspects of social behaviour are manifested in project managers in interaction with team members in the construction sector. Proactive behaviour as a social behaviour impacts on project and organizational effectiveness. This research intends to explore and explain how project managers' proactive behaviour could be enhanced in a project by the use of integrated collaborative environments. The paper aims to discuss these issues.

Design/methodology/approach – In order to investigate this interrelationship, researchers used a survey methodology involving gathering both quantitative and qualitative data, and used regression analysis to assess the strength of impact of proactive behavior antecedents on project manages' performance on a construction project when using integrated collaborative technologies. For the qualitative data researchers content analysis used.

Findings – The research showed that by developing a proactive personality, the construction project manager is more likely to pre–identify "accurately" project time and costs, and to identify project culture, collaboration strategy and project risks. Moreover, co–worker trust as a proactive behaviour antecedent has been shown to impact on raising quality issues in a project. Furthermore, project managers' flexibility could assist them in designing procurement strategies as well as designing a project business plan and avoiding conflict. Nevertheless, flexibility, including self–efficacy, control appraisal, change orientation, job autonomy and supportive supervision, plays a significant role in the development of proactive behaviour in construction project managers and enhances project performance.

Originality/value – The value of this paper is to contribute understanding of the impact of the use of integrated collaborative technologies on developing project managers' proactive behavior and thus impacting project performance.

Keywords Integration, BIM, Construction management, Collaboration, Project management, Information systems

1. Introduction

The social behaviour of employees has a great impact on an organisation's effectiveness within the construction sector (Tsai, 2011). Many aspects of social behaviour are manifested in project managers in interaction with team members (Kozlowski, 2001). Moreover, working in teams magnifies and intensifies behavioural characteristics because of the close encounters that members have with each other, in terms of both formal and informal attitudes, where rapid responses/decisions are required for problem resolution. Proactive behaviour as a social behaviour impacts on project and organizational effectiveness (Bindl, 2011) but this research intends to explore and explain how project managers' proactive behaviour could be enhanced in a project. However, the use of integrated collaborative environment and its technologies, such as Building Information Modelling (BIM) that is the state of the art in the Architecture, Engineering and Construction sectors (Kapogiannis et al,2018) demonstrated the added value to integrated collaborative environment in developing a collaborative culture that complies with the need of HM UK Government (2013) where team members have to enhance proactive behavior.

In 2002 Wainhouse Research & First Virtual Communication Inc stated that, 'integrated collaboration environments allow enterprises to realise a number of competitive advantages by using their existing

computers and network infrastructure for group and personal collaboration. These new fully-featured environments take the best features of both traditional videoconferencing and web collaboration and combine them to enable teams to work together interactively through a browser-based interface'. Rummler et al (2009), Voivklis et al.(2009), and Abuelmaatti et al (2014) mentioned that integrated collaborative technologies are consisted from collaborative software, workflow systems, documentation management systems, peer – to – peer software, knowledge management systems, social network systems and collaborative design. More recently location (Jin et al, 2017) is taken into consideration helping the positioning of the buildings and its coordinates too. Considerably, collaborative tools help facilitate action-oriented teams working together over geographic distances by providing tools that aid communication, collaboration and the process of problem solving. Collaboration requires individuals working together in a coordinated fashion, towards a common goal Kiviniemi (2010). Arguably integrated collaborative technologies are those tools that can help stakeholders work collectively towards problem solving without considering geographical distance and improving technical skills too. These technologies could work either in a synchronous (real time) or asynchronous (not real time) manner, so allowing the stakeholders or the team members to share documents or files. Therefore, BIM paradigm and its implementation should be more applied into the industry for the shake of developing collaborative culture in projects and however to develop proactive behaviour project managers (PMI, 2019).

Crant (2000, p.436) referred to proactive behaviour as, "taking initiative in improving current circumstances; it involves challenging the status quo rather than passively adapting present conditions." Parker, Williams & Turner (2006, p. 636) defined proactive behaviour as, "self-initiated and future-oriented action that aims to change and improve the situation or oneself." As it is a relatively new field, there is no precise definition of proactive behaviour and current definitions are somewhat unclear and even contentious. Nevertheless, in recent times, a consensus appears to be emerging as to the definition of proactive behaviour, as suggested in Parker & Collins (2010). Grant & Ashford (2008, p. 13) defined proactive behaviour as, "anticipatory action that employees take to impact on themselves and/or their environments." Parker et al. (2006) captured and analysed the proactive cognitive model. It consists of proactive personality, job autonomy, co-worker trust, supportive supervision, self-efficacy, flexible role orientation (organisational commitment) and control appraisal. However, Liu et el. (2019) show the importance of team proactive behavior at organizational level, but still no research has been conducted at project level and how it supports decision making. It should be noted that proactive model antecedents will be used to support the design of the survey and the structured interviews.

The dynamic view of managing projects successfully is through enhancing the skills of the project manager in the manner of controlling and making more accurate decisions (Kerzner,1999; Morris, 2006; Pinto, 2007; Fewing et al, 2019). What is mainly needed to advance the project manager's skills is the capability to interact with the other participants or members of the organisation or project. This interaction enhances communication and collaboration and develops the building of trust among the project manager and the participants. What is more, in enhancing and developing the above key elements, the outcome will efficiently and effectively capture partnerships. The result of this attempt is to assist in reducing the degree of complexity in projects. Specifically, regarding trust, Estrin (2008:272) stated that, "innovators must trust themselves, trust the people with whom they work, and trust the people with whom they partner, balancing their progress in an environment that demands both self-doubt and self-confidence." Communication constitutes conceptualising the processes by which people navigate and assign meaning. Communication is also understood as the exchanging of understanding. Montiel-Overall (2005) defined collaboration as, "a trusting relationship between two or more equal participants involved in sharing thinking, shared planning and shared creation."

Latham (1994) and The Construction Industry Board (1998) introduced the following key performance indicators: project delivery on time, on budget, free from defects, efficiently, right first time, safely, by profitable companies. Moreover, regular clients expect continuous improvement from their construction team to achieve year-on-year reductions in project costs and reductions in project times. The Department of the Environment, Transport and the Regions (2000), the Construction Industry Board, and the Movement for Innovation, through the Construction Best Practice Programme, presents the construction industry's range of performance using seven groups, but omits the more detailed elements of performance. However, a survey in 2012 by The Minister of the Department of Business, Innovation and Skills shows that 79% of contractors' turnover was attributable to repeat clients. Therefore, the message disseminated within the construction environment is the need to strengthen ties with existing clients and secure profitable repeat business. Similarly, clients had a higher level of satisfaction on projects where KPIs have been deployed to monitor their project. The same applied later in 2018 KPI Report. In 2019 the Project Management Institute highlighted the importance of improving proactive behavior as well as reactive behavior to sustain project managers' interest on how to maintain their project performance at high levels. Hence it is clear that the use of integrated collaborative technologies in construction projects could potentially benefit all project stakeholders in encouraging sharing and trust by being collaborative and consequently proactive.

Due to the complexity of evaluating all the above KPIs, the researchers focused on testing the following four sub-objectives: Time (accurate time prediction for design and construction), cost (accurate cost prediction for design and construction), quality (raise quality issue) and business performance (return on investment for the client). These 4 sub-objectives were used in the research to design the interface of the conceptual framework and to design the survey and the structured interviews.

2. Research Method

The research question is focused on whether and how the proactive behaviour antecedents of construction project managers can have an impact on project performance. since this research investigates 'soft' and 'hard' aspects (tasks, people and decisions) in the management of construction projects, the researcher's worldview is pragmatism. Therefore, the mixed method will be used for the data collection and analysis (Creswell, 2018) provided that the data are validated true by both quantitative and qualitative research. Within the project management research area an indication of the adequacy of a particular foundation is usually provided (Koskela, 2002), and thus the results of this research will provide adequate outcomes. Adequate does not mean that the results will be weak but that they will be valid and measurable (Creswell, 2018).

The success of this research will be derived when there is a continuous dialogue between the scientific and practitioner community; being in the scientific community, the researcher is seeking answers from the practitioner community (construction project managers). However, since the research requires the testing of the strength/credibility of the relationship: Proactive Behaviour to Projects' Performance - a Survey Approach has been followed. Moreover, to understand in depth the relationships structured interviews applied too.

In total the purposive sample was from 24 construction project managers operating in the United Kingdom (UK). Contact was made via several events organized by the Chartered Institute of Building North West, mainly at the University of Salford. The 24 project managers worked for a total of 18 different large organisations: 29% worked for contractors, 33% for consultants, 21% for clients, 8.5% for suppliers and

8.5%. The average work experience of the interviewees was 16.5 years in the architecture, engineering and construction (AEC) industry.

Quantitative data were collected from the construction project managers using a Likert scale questionnaire to assess the strength of the impact of the factors as set in the Appendix. A 0-10 Likert scale was used to provide the interviewees with flexibility with their answers. The scale ranged from "No Impact at all" (i.e. "0") to "Very High Impact" (10). Qualitative data were collected through interviews, the average length of which was 60 minutes, which were recorded and subsequently transcribed. Content analysis was then applied to the transcripts mobilising a coding process. The first step involved a coding schedule using predefined coding themes, and from this, a coding manual was generated to accompany the coding schedule (listing the codes). Consequently, elements of the content are described and organised according to these categories, where categories are used to explain the information as is occurred from this data. These data are analysed and findings are reported in Table 1 alongside the qualitative data.

<< Table 1>>

3. Comparative data analysis

Due to constraints of space within this paper, the statistical analysis carried out for the assessment of one of the factors, specifically that pf "proactive behaviour antecedents of construction project managers can have an impact on project performance", has been presented here as an exempla.

3.1. Quantitative data analysis

Time (H1a)

According to the descriptive statistical analysis it has been found that the degree of influence of flexible role orientation on accurate prediction of the **time H1a** for planning, design and construction is equal to the mean value, that is, $\mu = 6.6$. Moreover for this sample n=24, the minimum value was 2 and the maximum was 9, and values between 7 and 8 were quite frequent. There is a range of low values between 2 and 4, which makes sense because one group of project managers did not have a very good understanding of the question. Moreover, another group of project managers provided answers with a frequency between 5 and 6. Finally, due to the atypical large value, the histogram is slightly skewed to the left, or negatively skewed (-1.086). Without this value, the histogram would be reasonably symmetrical. Moreover the Standard Deviation (SD) between the data and the mean is SD=2.098. The confidence interval for the underlying population mean for flexible role leading to 'accurate time' equals $\mu = 6.6 \pm 0.88$ minutes, or $\mu = 5.72$ to $\mu = 7.48$. So, at a significance level of 0.05 and probability 95% the accepted range is: $5.72 < 6.6 < 7.48$. Furthermore, by accessing the coefficient of determination where R^2 (Actual Frequency) = 0.96 and R^2 (Normal Distribution) = 0.83, the regression line from both models and their data tend to match and both their values are close to 1. As a result the sub hypothesis H1a is accepted.

Cost (H1b)

According to the descriptive statistical analysis it has been found that the degree of influence of the flexible role lead to accurately predict the **cost (H1b)** for planning, design and construction is equal to the mean value, that is, $\mu = 6.29$. Moreover for this sample n=24, the minimum value was 2 and the maximum was 8, and the values between 7 and 8 were quite frequent. It is clear the frequency is between the ranges 6-7 in the second most popular area. That makes sense because one group of project managers had a very good

understanding of the question. Moreover a smaller group of project managers provided answers with frequency between 4 and 5. Finally, due to the atypical large value, the histogram is slightly skewed to the left, or negatively skewed (-1.081). Without this value, the histogram would be reasonably symmetrical. Moreover the Standard Deviation (SD) between the data and the mean is SD=1.899. The confidence interval for the underlying population mean for flexible role lead to 'accurate time' equals $\mu=6.29 \pm 0.80$ minutes, or $\mu=5.48$ to $\mu=7.09$. So at a significance level 0.05 and probability 95% the accepted range is: $5.48<6.29<7.09$. Furthermore by accessing the coefficient of determination where R^2 (Actual Frequency) = 0.84 and R^2 (Normal Distribution) = 0.95 the regression line from both models and their data tend to match and both their values are close to 1. As a result the sub hypothesis H1b is accepted.

Quality (H1c)

According to the descriptive statistical analysis it has been found that the degree of influence of flexible role leading to **raising the quality issues** (H1c) of the final output is equal to the mean value, that is, $\mu=7.29$. Moreover for this sample n=24, the minimum value was 2 and the maximum was 9. Values 7 and 8 were the most frequent, although 9 was also indicated. That makes sense because one group of project managers had a very good understanding of the question. Moreover a smaller group of project managers provided answers with frequency between 6 and 7 as well as between 4 and 5. Finally, due to the atypical large value, the histogram is slightly skewed to the left, or negatively skewed (-1.53). Without this value, the histogram would be reasonably symmetric. Moreover the Standard Deviation (SD) between the data and the mean is SD=1.78. The confidence interval for the underlying population mean for flexible role leading to 'accurate time' equals $\mu=7.29 \pm 0.75$ minutes, or $\mu=6.53$ to $\mu=8.04$. So at a significance level 0.05 and probability 95% the accepted range is: $6.53<7.29<8.04$. Furthermore, by accessing the coefficient of determination where R^2 (Actual Frequency) = 0.74 and R^2 (Normal Distribution) = 0.92, the regression line from both models and their data tend to match and both their values are close to 1. As a result, the sub hypothesis H1c is accepted.

Return on Investment (H1d)

According to the descriptive statistical analysis it has been found that the degree of influence of flexible role leading to 'accurate' comparison of the estimated **return on investment (H1d)** for the client is equal to the mean value, that is, $\mu=6$. Moreover, for this sample n=24, the minimum value was 0 and the maximum was 9, and the values between 8 and 9 were quite frequent compared to the others. In contrast, the range between 6 and 7 in terms of the frequency was the second most popular. That makes sense since one group of project managers had a very good understanding of the question. Moreover a smaller group of project managers provided answers with frequency between 4 and 5. In addition a smaller group of project managers provided answers with frequency between 0 and 1, and between 2 and 3. Finally, due to the atypically large value, the histogram is slightly skewed to the left, or negatively skewed (-1.29). Without this value, the histogram would be reasonably symmetrical.

Moreover, the Standard Deviation (SD) between the data and the mean is SD=2.14. The confidence interval for the underlying population mean for flexible role leading to 'accurate time' equals $\mu=6 \pm 0.90$ minutes, or $\mu=6.53$ to $\mu=8.04$. So, at a significance level 0.05 and probability 95% the accepted range is: $5.09<6<6.90$. Furthermore, by accessing the coefficient of determination where R^2 (Actual Frequency) = 0.81 and R^2 (Normal Distribution) = 0.94 the regression line from both models and their data tend to match and both their values are close to 1. As a result, the sub hypothesis H1d is accepted. All the above can be found in Table 1 including further details.

3.2. Qualitative data analysis

By applying the content analysis technique on the feedback received from the subjects from H1a,b,cd the researchers identified the effects of how flexible role could impact on project performance, which are presented below:

Design of the procurement strategy: it has been presented as a major impact of flexible role orientation. Interviewees have stated that "procurement strategy identifies alternatives and is the optimum way of achieving project objectives, taking account of the risks and constraints." In addition, it has been said that "procurement strategy helps to control and fund a particular project". Therefore, it is essential to know and understand who is involved and what activities have to be executed before, during and post construction procurement process. Interviewees stated that the selection process criteria differ but are based 50% on price and 50% on quality. So, by being flexible the project manager can orient the right people to the right project. *Note: the contractor can play the role of the client for selecting suppliers, and the city council can play the role of the client in selecting the right contractor.* As a result, by knowing who is involved during the design of the procurement strategy, the project manager, a) can define clearly what the client wants, b) based on team skill can negotiate deals that are justified on whole life value, c) ensure that the team members involved are in a competitive position to express how the industry works and to conduct market research, d) can select specialist suppliers and, e) can be more effective in building up and sharing knowledge about the suppliers' performance so as to make an efficient decision. As a result, by being flexible, a project manager is in a position to be most effective in design of the procurement strategy. The principal of spending more time and money in the design of a construction procurement strategy to identify the most suitable partners reduces project risks at the planning and construction stages of a project. Henceforth, project managers felt that "by pre-identifying who will be involved and what activities will need to be implemented, it is more possible to pre identify 'accurate' project time and costs, to raise quality issues in advance (using criteria/benchmarking) and also to predict 'accurately' the return on investment for the client."

Design of the construction project business plan: the project business plan is a formal statement of a set of business goals, including the plan for reaching those goals. The principle of completing a construction business plan is the quality and accuracy of the information provided to the project manager, while in the design of the project business plan there is a reflection/impact on the project life cycle. At the stage where the project manager is preparing to design the project plan he must "consider the construction business plan as well as who is involved at a senior level." The project manager has to be flexible and to search and select capable team members that are "leaders, who understand and raise project constraints, who are team players and share information." As a result a "flexible role orientation" antecedent of a project manager provides an added value to the project due to his capability to pre–identify key people that will help stakeholders - including the client - to predict 'accurate' project time and costs, to raise quality issues in advance (using criteria/benchmarking) and also to predict 'accurately' the return on investment for the client.

Conflict Avoidance: Interviewees mentioned that in a project it is, "common for stakeholders to have arguments." Henceforth, it is possible for this to impact on project progress and often, it is project time and costs that are the first two indicators to be directly affected. Moreover, a project manager being flexible so as to resolve disagreements concerned with the project or programme in order to arrive at a mutually satisfactory solution, was found to be an interesting point. However, their biggest challenge is at the stage where a project manager has to be flexible so as to avoid conflict rather than resolving it. Therefore, by being flexible at an early stage the project manager can clarify who is who and who is doing what.

Throughout this process he can identify possible project concerns at different project stages and thus will be more efficient in predicting 'accurate' project time and costs, raising quality issues in advance (using criteria/benchmarking) and in predicting 'accurately' the return on investment for the client. Henceforth, the flexible role orientation antecedent can impact on project performance design procurement strategy; design project business plan and conflict avoidance.

3.3. Data Comparison Analysis

The above quantitative analysis shows that the maximum mean is μ=8.13 and this is the degree of influence between proactive personality and time. The second highest is μ=8 and represents the degree of influence between cost and proactive personality. Moreover, the degree of influence is overlapped/matched between job autonomy and quality as well as job autonomy and cost with μ=5.95. Very close to this value is the degree of influence between job autonomy and time. As a result, there is a need to enhance project managers' proactive behavior antecedents. This can be visualized in Figure 1 that shows how close is the relationship between KPIs within different proactive behaviour antecedents by using integrated collaborative technologies.

<< figure 1>>

In fact, according to Parker (2006), **flexible role** affects the extent to which various problems affect the longer-term goals of projects. This statement is, in effect, saying that a project manager has to understand the problems that affect the long-term goals of a project. This has been agreed according to respondents 1, 2, 3, 4, 5, 6, 8, 10, 14, 15, 16, 20, 22, 23 and 24. In addition, he/she has to be confident about the staff involved in the project, including confidence in their skills (knowledge and experience). Moreover, in the project management world, as Pinto (2007) states, it is essential that team members (not just the project manager) are aware, according to their allocated tasks, of "what problems can occur and who the owner of the problem is." Therefore, it would be advantageous for project managers to know how, and what, problems can affect the longer term project and to be in a flexible position to foresee these problems, to report them and to act in advance of them occurring. In addition, Takim and Akintoye (2002), Kerzner (2006), Pinto (2007), and Koskela at al (2002) have stated that time, cost and quality issues must be pre-identified. In addition, Takim and Akintoye (2002) mentioned the importance of construction project ROI identification to secure a new project or recommendation to a new client. Thus, this research shows that when a project manager is flexible there is a high degree of influence between construction KPIs: the sub–hypothesis on predicting the time and cost to raise quality issues but a lower influence on pre-identifying project ROI for the client (μ=5.91). Therefore, a project manager has to be flexible since, by predicting project times, costs, quality issues and client ROI he/she will be in a competitive position to design dynamic procurement strategies, to design dynamic project plans and to avoid conflicts.

Walker (2014) stated that **trust** among team members can influence the degree of collaboration and vice versa. Moreover, it is crucial for a project manager and his/her team to develop a culture where trust is a major principle that affects both organisational and project performance. The reason is that trust engages and enables people when they are in business with each other. This has been agreed according to respondents 1, 2, 3, 4, 5, 6, 7,8, 9,10, 11,12, 13, 14, 15, 16, 17,18, 20, 22, 23 and 24. In addition, trust helps communication and sharing information and is a major factor in efficient collaboration. Collaboration, according to Koskela at al (2002), is a principle of lean management which aims to optimise project performance. This optimisation is in pre-identifying the time a project will take and the costs of a project, to raise a project's quality. Akintonye (1999) mentioned the importance of construction project ROI identification to secure a new project or recommendation for a new client. Therefore, a project manager has to establish trust among project partners so that he/she can predict project times and costs, raise quality

issues and help identify client's ROI. This will give him/her the opportunity to share correct data & information, organise and have effective project meetings, ensure that projects run efficiently and allow him/her to make efficient project decisions.

A project manager has to design, control and execute project tasks, according to PMBoK (2018). In addition according to PMI (2019) a project manager, amongst other things, has to be self-efficant in order to be able to design, control and execute a task. Respondents 1, 2, 3, 5, 6, 8, 10, 11,14, 15, 16, 20, 22, and 23 agreed on the need to be self - efficant. Furthermore, it is expected that the more **self-efficant** a project manager is, the less problems will occur because he/she has the skills to pre-identify and control project indicators. In addition to these skills, he/she is required to foresee problems and to integrate task processes (Parker, 2006). Furthermore, this research shows that, by a project manager being self-efficant, he/she is in a more competitive position to predict project times and costs, raise quality issues and is more likely to help identify clients' ROI (μ=5.60) and thus to identify project risks and political factors, to clarify project requirements, to efficiently design the project's process and to clarify the project business model.

A project manager can control and have an impact on project outcomes according to Cleland (1999). Moreover, a project manager must be able to identify the key project stages (gates) when decisions will be made from time to time during the project process (Cooper et al, 2008). The biggest challenges for the design and execution of the control appraisal process are to identify these key points and to propose changes (Cooper et al, 2008). **Changes** during the design of the control appraisal process can reflect on the project indicators' performance. This research shows that there is a high degree of influence on predicting project time (μ=7.30), cost (μ=7.0), raising problems (μ=6.86) and pre-identifying client ROI (μ=5.86). This has been agreed according to respondents 1, 4, 5, 6, 8, 10, 12, 14, 15, 16, 20 and 22.Therefore, the more critically oriented belief a project manager has, the more likely it is that he/she will pre-identify "accurately" time and costs, raise quality problems and identify client ROI. The impact of a project manager having such ability is to efficiently set up a project control process, eliminate project risks and optimise project process.

Kotter (2011) stated that change management is an "approach to transitioning individuals, teams and organisations to a desired future state." In the construction industry changes are taking place on a regular basis, e.g. regulations, engineering techniques, new technologies (Cooper et al, 2008). Therefore, if problems cannot be dealt with, change cannot occur. According to the KPI (2012), time, cost, quality, and ROI are still cited as problems in the construction industry. The industry is deficient in making changes in a period when the economic environment is not growing fast. According to the findings of this research, it has been shown that there is high degree of influence on strength of developing a project manager's mind-set so as to **predict** time (μ=6.69) and cost (μ=6.30). However, the most important impact of this is the capability of raising project quality problems (μ=6.82) and pre-identifying client ROI (μ=6.04). Having a project manager who can pre-identify any possible type of changes in a project will impact on the design of the project and on the process of change management, as efficient change management decisions will be made and he/she will have an understanding of how to make changes. Moreover, it should be noted that most of the respondents of the research also agreed as regards the added value of developing proactive behavior, as stated by Parker (2006).

For a project manager it is vital to understand under which circumstances he/she must make a **decision** as well as realising if he/she can make decisions (Cooper et al, 2008). If he/she is not in a position of understanding how a problem has occurred (Kerzner,1999), why (Pinto, 2007) and by whom (Morris, 2006), then this person causes project deficiencies to progress. According to this research, it has been found that the strength to make a decision does not impact on "accurately" predicting time (μ=5.69) and cost (μ=5.95), "raising quality (μ=5.95)" and on predicting "client ROI (μ=5.13)." In particular, the degree of influence is the lowest when compared to any other sub-hypothesis in this research. This validates what Foucault

(1980:154) said in terms of the power in the project management process. Therefore, there is no need to ensure that a project manager has the power to make changes in a project, rather that he/she is in a position to have the ability to justify his/her decisions without affecting project progress. Otherwise, the impact will be inefficient project decisions and difficulties in generating and managing project knowledge.

Parker (2006) stated that a **proactive** personality has the relatively stable tendency to identify problems in advance. RIBA (2013) stated that a modern project manager has to predict project problems in advance in order to eliminate project risks at different project stages, even where technology exists to support the proactive process. Lack of proactivity in a project manager is not helpful in improving project progress and reducing the relevant risks. Moreover, in this research it has been found that the degree of strength of a proactive personality is the most important factor compared to the other sub-hypotheses. Therefore, it is vital to develop proactive awareness within construction project managers which will help in the pre-identification of a project culture, and assist in promoting collaboration and in pre-identifying project risks respectively. It has to be noted that proactivity caught the attention of most of the interviewees (agreed by respondents 1, 2, 3, 4, 5, 6, 7, 8, 10, 11,12,14, 15, 16, 20, 22, 23 and 24) also by stating the importance on decision making also beyond raising problems. In addition, it was mentioned the capacity of reacting wherever and whenever is required in order to provide as "accurate" data possible related to time, costs and identify certain problems e.g. clash detection, accidents, environmental behavior etc. Though according to the research is less likely to identify ROI; noted only 60% of the sample agreed that these technologies could add value to improve proactive personality.

Egbu (1999) stated that a project manager must be a **leader**. A leader must be effective to ensure that his/her team will allow him/her to develop their skills (Eye of Competence, 2017). By developing project management skills there is a strong possibility of developing efficient, effective, and productive team members who can manage project knowledge and develop future leaders' characteristics, e.g., passion, motivation, confidence, etc. In this research, the degree of influence of the impact of supportive supervision on project performance is high in terms of identifying "accurately" time (μ=6.91) and cost (μ=6.73), in raising project quality problems (μ=6.82) and in pre-identifying client ROI (μ= 6.21) compared to other sub-hypotheses.

Furthermore, the influencing factors of the impact of proactive behaviour on project performance using digital collaborative technologies are listed in the following table 2:

<<table 2>>

Sum up it has been shown that by developing a proactive personality in construction project managers they are more likely to pre–identify "accurately" project time and costs and to identify project culture, collaboration strategy and pre – identification of project risks. Moreover, co – worker trust as a proactive behaviour antecedent has been shown to impact on raising quality issues in a project. Furthermore, project managers' flexibility and their access to right information at the right time by using integrated collaborative environment, could assist them in designing procurement strategies and project business plans, and in avoiding conflict. Information sharing could be the way forward to develop a such as collaborative culture, beyond the use of CDE, that could improve projects' performance on the basis of reviewing 3D BIM models using the right software in the right environment and provide instant and constructive feedback. Retrospectively according to PMI (2019) this approach could impact on "accurately" project time and costs. Nevertheless, flexibility including self – efficacy, control appraisal, change orientation, job autonomy and supportive supervision, play a significant role in the development of proactive behaviour in construction project managers and thus in enhanced project performance. This is achieved due to the advance use of Visualisation and Information Modeling technologies that allow the project manager and project

stakeholders to review the 3D model over a meetings (hybrid) layout and also the capacity of running simulations based on different scenarios. With the help of 5G network technologies this could happen also in real stream (Gionis, 2020). As a result the development of self -confidence can give them capacity to build self -esteem that could inspire other members and however to develop improved projects' performance.

In essence, it was found that the correct use of integrated collaborative technologies within a collaborative culture of construction projects could aid the development of proactive behavior in project managers and thus impact on project performance.

Conclusions

Despite 24 the sample size is relatively small, credible findings were enabled bases on interviewees experiences. Moreover, this study was conducted by using mixed method approach. In summary, the research shows that the impact of developing proactive behaviour to projects managers to improve project performance based on the use of integrated collaborative based on the development of a collaborative culture in all stages of project management life cycle. In fact the use of integrated collaborative technologies will allow the proactive antecedents to be developed on the basis of sharing data and information on a CDE, where stakeholders could have access to and thus discuss and exchange opinion by providing constructive and (a)synchronously feedback. Moreover, the development of trust between team members (co–worker trust) could be achieved and thus leadership skills to be improved. The mobile working environment (laptop, mobile) allow project managers to be flexible and however to pre–identify and undertake issues (flexible role) promptly and avoid any conflicts. As a result the leading person has to take initiative to make changes (change orientation and simultaneously to control the whole process in order to secure project performance). Hence, the collaborative environment enhances the possibilities of developing proactive behaviour in construction project managers. Furthermore, the requirement of having proactive personality is something that has to be developed more because this could be the pre-requisite for the project manager require power to influence the project process (job autonomy). As a result, the proactive culture that is generated within the collaborative culture by using the state of the art digital and integrated collaborative technologies during the project management life cycle allow the project manager to be more efficient and thus allow the project to have improved performance. The future of this research is to develop integrated collaborative environments that can improve proactive behavior antecedents that could impact construction project managers' performance.

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References

Aisha Abuelmaatti, Vian Ahmed (2014), "Collaborative technologies for small and medium-sized architecture, engineering and construction enterprises: implementation survey", *Journal of Information Technology in Construction (ITcon)*, Vol. 19, pg. 210-224, http://www.itcon.org/2014/12

Bindl, U. K., & Parker, S. K. (2011), "Proactive work behavior: Forward-thinking and change-oriented action in organizations." In S. Zedeck (Ed.), APA Handbooks in Psychology. APA handbook of industrial and organizational psychology, Vol. 2. Selecting and developing members for the organization (pp. 567-598). Washington, DC, US: American Psychological Association. http://dx.doi.org/10.1037/12170-019

Cleland, David I., (1999), *Project management: strategic design and implementation* / David I. Cleland. - 3rd ed.. - New York; London: McGraw-Hill

Construction Industry Board (1998), "Strategic Review of Construction Training Skills", Telford Publishing, pp35-62

Cooper, R., Aouad, Ghassan Lee, A., Wu, S., Fleming, A., Kagioglou, M. (2008), "Process Management in Design and Construction", Blackwell Publishing

Crant, J. M. (2000), "Proactive Behavior in Organizations". *Journal of Management*, 26(3), 435–462. https://doi.org/10.1177/014920630002600304

Creswell, John W. (1994), "Research Design : Qualitative & Quantitative Approaches". Thousand Oaks, Calif. :Sage Publications

Egbu, C.O. (1999), "Skills, Knowledge and Competencies for Managing Construction Refurbishment Works", *Journal Construction Management and Economics*, Vol. 17, No. 1, pp. 29 – 43.

Estrin, Judy, (2008), Closing the Innovation Gap: Reigniting the Spark of Creativity in a Global Economy (New York: McGraw Hill, 272 pp.)

Eye of Competence (2018), IPMA, International Project Management Association, ICB Version 4.0, June 2018.

Department of Business, Innovation and Skills (2012), UK Construction Industry Performance Report, London, United Kingdom

Fewings, P. and Henjewele, C. (2019), Construction Project Management: An Integrated Approach, Taylor and Francis, Oxon.

Foucault (1980:154): Foucault, M. (1980), "Power/knowledge: selected interviews and other writings 1972-1977", edited by Colin Gordon. London: Harvester. (See in particular 'The confession of the flesh' [interview, 1977]).

Gkonis, P., Trakadas, P., and Kaklamani D. (2020), "A Comprehensive Study on Simulation Techniques for 5G Networks: State of the Art Results, Analysis, and Future Challenges". *Electronics. 9. 468. 10.3390/electronics9030468*.

Golman (2012), "What Makes a Leader", in Harvard Business Review, Best of HBR 1998

Grant, A. M. (2007), “Relational job design and the motivation to make a prosocial difference”, *The Academy of Management Review*, 32(2), 393–417.

Grant, A. M., & Ashford, S. J. (2008), “The dynamics of proactivity at work. In B. M. Staw, & A. P. Brief (Vol. Eds.), Research in organizational behavior: An annual series of analytical essays and critical reviews”, vol. 28, (pp. 3–34). New York: Elsevier https://doi.org/10.1016/j.riob.2008.04.002

HM UK Government (2013), Construction 2025, URN BIS/13/955, Retrieved from https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/210099/bis-13-955-construction-2025-industrial-strategy.pdf, United Kingdom

Jin Ruoyu, Hancock Craig, Tang Llewellyn, Chen Chao, Wanatowski Dariusz & Yang Lin. (2017), “An empirical study of BIM-implementation-based perceptions among Chinese practitioners”, *Journal of Management in Engineering*. 33. 10.1061/(ASCE)ME.1943-5479.0000538.

ISO19650-1 (2018), Organization and digitization of information about buildings and civil engineering works, including building information modelling (BIM), Retrieved from https://www.iso.org/standard/68078.html, Switzerland

Kapogiannis, G. and Sherratt, F. (2018), "Impact of integrated collaborative technologies to form a collaborative culture in construction projects", Built Environment Project and Asset Management, Vol. 8 No. 1, pp. 24-38. https://doi.org/10.1108/BEPAM-07-2017-0043

Kerzner, H. (2006), “Project Management Logic Puzzles”, ISBN: 978-0-471-79346-5

Kerzner, H. (1989), “Project management: a systems approach to planning, scheduling, and controlling”. New York: Van Nostrand Reinhold.

Kiviniemi, A. (2010), “How Design Change Through BIM? - BIM Guidelines and Impacts of Integrated BIM in Design Process”, Salford, United Kingdom

Koskela, LJ and Howell, G. (2002), “The underlying theory of project management is obsolete”, in: *The PMI Research Conference*, June 2002, Seattle, Washington.

Koskela, L., (2000) An exploration towards a production theory and its application to construction. Espoo, VTT Building Technology. 296 p. VTT Publications; 408. http://www.inf.vtt.fi/pdf/publications/2000/P408.pdf

Kotter, J. (July 12, 2011), “Change Management vs. Change Leadership — What’s the Difference?” Forbes online.

Kozlowski, S. W. J. & Bell, B. S. (2003). Work groups and teams in organizations. In W. C. Borman, D. R. Ilgen & R. J. Klimoski (Eds.), Handbook of psychology (Vol. 12): Industrial and Organizational Psychology (333-375). New York: Wiley-Blackwell. Reprinted with permission.

Latham, M. (1994), “Constructing the Team”, London: HMSO. ISBN 978-0-11-752994-6

Liu, W., S. Tangirala, C. Lee, and S. K. Parker. (2019), “New Directions for Exploring the Consequences of Proactive Behaviors: Introduction to the Special Issue”. *Journal of Organizational Behavior* 40 (1): 1–4. doi:10.1002/job.2334.

Montiel-Overall, P., (2005), "Toward a theory of collaboration for teachers and librarians". School Library Media Research [online], 8. Volume 8, ISSN: 1523-4320, *Research Journal of the American Association of School Librarians*

Morris, Peter. (1994), "The Management of Projects". Thomas Telford, London. 358 p. doi:10.1680/mop.16934

Morris, P., (2005), "Making the management of projects critical". In D. Hodgson, S. Cicmil (Eds.), Making Projects Critical. London: Palgrave.

Morris, P., Jamieson, H. A., & Shepherd, M. M. (2006), "Research updating the APM Body of Knowledge" 4th edition. *International Journal of Project Management*, 24 (6), 461-473. doi:10.1016/j.ijproman.2006.02.002

Parker, S. K., Williams, H. M., & Turner, N. (2006), "Modelling the antecedents of proactive behavior at work". *Journal of Applied Psychology*, 91(3), 636-652.

Parker, S, Collins, C., (2010), "Taking Stock: Integrating and Differentiating Multiple Proactive Behaviors Institute of Work Psychology", University of Sheffield, *Journal of Management*

Pinto, Jeffrey K. (2007), "Project management: achieving competitive advantage" Upper Saddle River, N.J.: Pearson Prentice Hall, 2007.

Project Management Institute - PMI (2017), "A Guide to the Project Management Body of Knowledge", 7th Edition USA

Rummler, S. & Ng, K.B.. (2009). Collaborative technologies and applications for interactive information design: Emerging trends in user experiences. 10.4018/978-1-60566-727-0

Takim, R and Akintoye, A. (2002), "Performance indicators for successful construction project performance. In: Greenwood, D (Ed.), *18th Annual ARCOM Conference*, 2-4 September 2002, University of Northumbria. Association of Researchers in Construction Management, Vol. 2, 545-55.

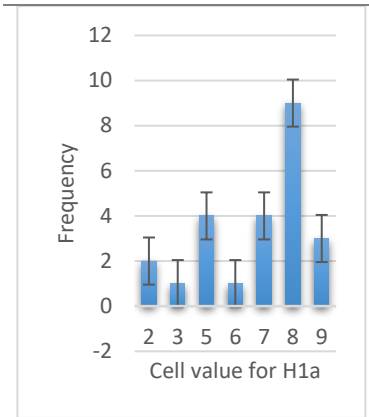
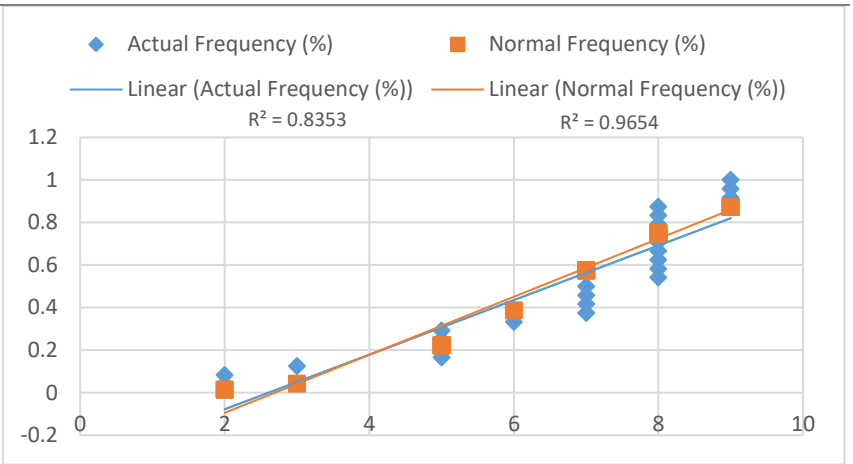
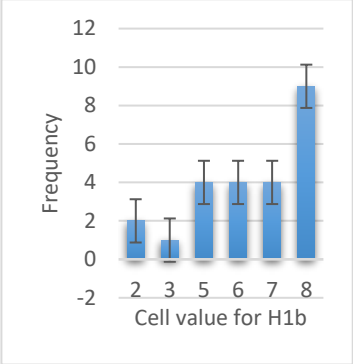
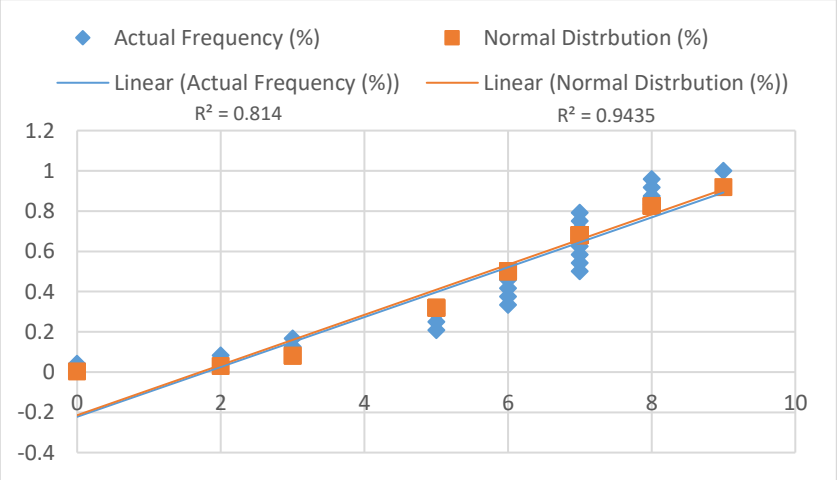
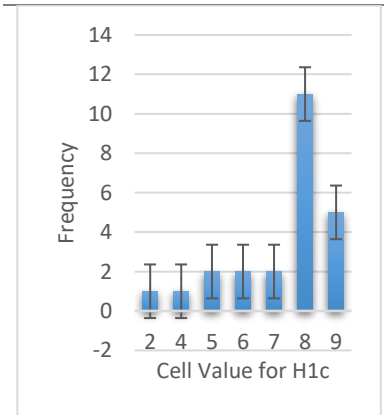
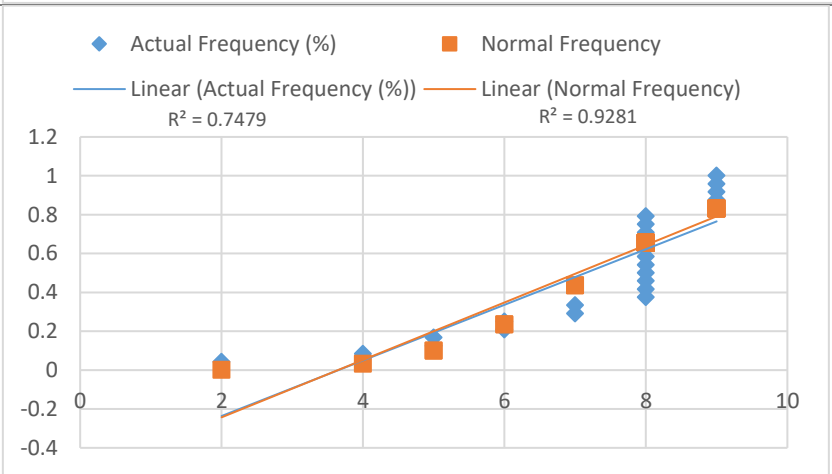
The KPI Working Group (2000), "KPI Report for The Minister for Construction", Department of the Environment, Transport and the Regions, United Kingdom

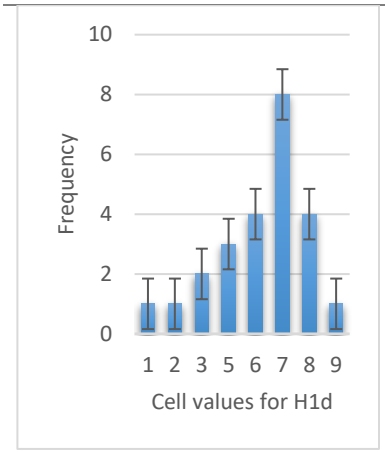
Tsai Y. (2011), "Relationship between organizational culture, leadership behavior and job satisfaction". BMC health services research, 11, 98. doi:10.1186/1472-6963-11-98

Voiklis, J. and Nickerson, J.V. (2009). Collaborative decision-making for coastal and port security (Report to sponsor CSR.Y2.2009). Hoboken, NJ: Center for Decision Technologies, Stevens Institute of Technology

Walker, D. H. T. & Lloyd-Walker, B. (2014), "Understanding relationship based procurement in the construction sector: summary of research findings". Paper presented at *Project Management Institute Research and Education Conference*, Phoenix, AZ. Newtown Square, PA: Project Management Institute.

Table 1: Normal Descriptive Statistical Analysis and Coefficient of Determination for H1a,b,c,d

Descriptive Statistical Analysis for sub hypothesis H1a,b,c,d	Coefficient of Determination for sub-hypothesis H1a,b,c,d
	
	
	


10
8
6
4
2
0
Frequency
1 2 3 5 6 7 8 9
Cell values for H1d

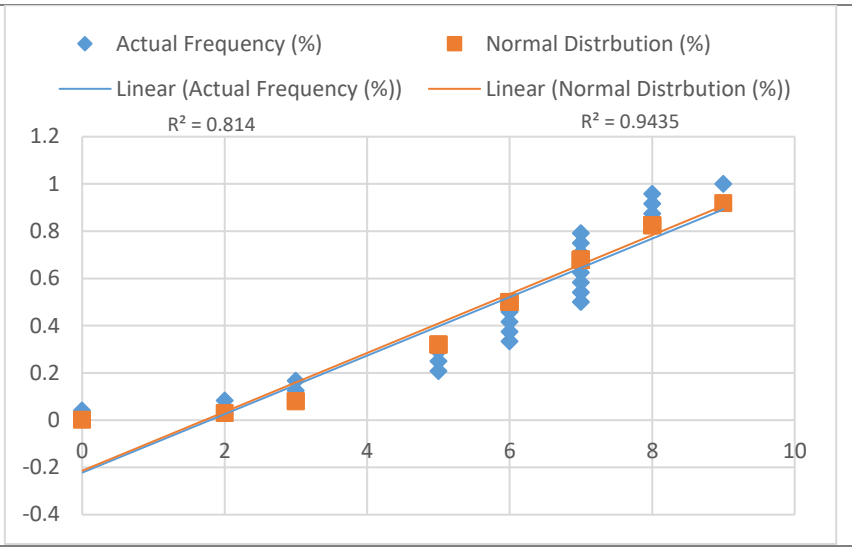
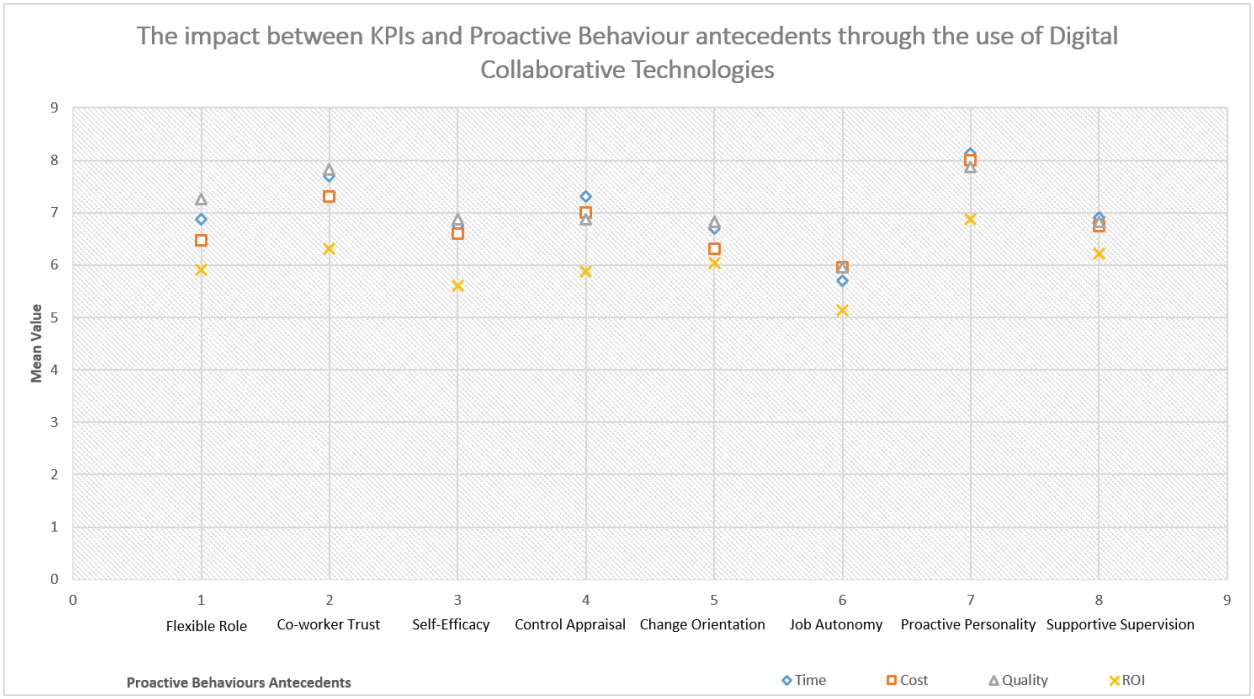

Actual Frequency (%)
Normal Distrbution (%)
Linear (Actual Frequency (%))
Linear (Normal Distrbution (%))
R² = 0.814
R² = 0.9435
1.2
1
0.8
0.6
0.4
0.2
0
-0.2
-0.4
0
2
4
6
8
10

Table 2: Impact of Proactive Behavior On Project Performance

	Proactive Antecedents	**KPI**	**Strength of Influence**	**Impact on Project Performance**
H1	Flexible Role Orientation	Time Cost Quality ROI	μ=*6.87* μ=6.48 μ=7.26 μ=5.9	• Design procurement strategy • Design project business plan • Conflict avoidance
H2	Co-Worker Trust	Time Cost Quality ROI	μ= 7.70 μ=7.30 μ=7.82 μ=6.30	• Data & Information Sharing • Effective project meetings • Project Efficiency • Efficient project decisions
H3	Self–Efficacy	Time Cost Quality ROI	μ=6.73 μ=6.60 μ=6.87 μ=5.60	• Project risk identification • Identify project's political factors • Clarify project requirements • Efficient design of the project process • Clarify project business model
H4	Control Appraisal	Time Cost Quality ROI	μ=7.30 μ=7 μ=6.87 μ=5.87	• Efficient project control process • Eliminate project risks • Project optimisation process
H5	Change Orientation	Time Cost Quality ROI	μ=6.70 μ=6.30 μ=6.82 μ=6.04	• Project and process change management • Efficient project change decisions • Knowledge for making changes
H6	Job autonomy	Time Cost Quality ROI	μ=5.70 μ=5.96 μ=5.94 μ=5.13	• Efficient project decisions • Management of project knowledge
H7	Proactive Personality	Time Cost Quality ROI	μ=8.13 μ=8 μ=7.87 μ=6.87	• Pre–identify project culture • Pre–identify how to collaborate • Pre–identify project risks
H8	Supportive Supervision	Time Cost Quality ROI	μ=6.91 μ=6.74 μ=6.82 μ=6.21	• Develop efficient and effective productive team members • Management of project knowledge • Develop future leaders

Figure 1:


The impact between KPIs and Proactive Behaviour antecedents through the use of Digital Collaborative Technologies
Mean Value
0
1
2
3
4
5
6
7
8
9
Flexible Role
Co-worker Trust
Self-Efficacy
Control Appraisal
Change Orientation
Job Autonomy
Proactive Personality
Supportive Supervision
Proactive Behaviours Antecedents
Time
Cost
Quality
ROI