(Draft – before final print)

The Impact of Perceived Work Complexity and Shared Leadership on Team Performance of IT Employees of South African Firms

Christiaan Philippus Storm, Gordon Institute of Business Science (GIBS), University of Pretoria, South Africa

*Caren Brenda Scheepers, Gordon Institute of Business Science (GIBS), University of Pretoria, South Africa

*corresponding author scheepersc@gibs.co.za

Abstract:

This article investigates how work complexity, as perceived by Information Technology (IT) employees, influences team performance, and examines the role played by shared leadership. The findings of this study that collected data from 204 IT employees in South Africa show that perceived work complexity negatively predicts team performance while shared leadership negatively predicts perceived work complexity and positively predicts team performance.

Keywords:

Perceived work complexity; shared leadership; team performance; software development

Introduction

More than 60% of Information Technology (IT) projects fail (The Standish Group, 2013) and the cost of IT failures worldwide is estimated to be $3 trillion (Krigsman, 2012). In 2013, the reliability, efficiency and availability of information systems (IS) was ranked the sixth most important management issue globally (Luftman, Zadeh, Derksen, Santana, Rigoni, & Huang, 2013). Despite this, the failure rate of complex software development projects remains high (Chen, Bharadwaj, & Goh, 2017). Anderson and Dekker (2005) state that increases in software development project costs are caused by changes to the agreed-upon requirements as well as uncertainties about performance and quality specifications.

The software development project environment is thus riddled with difficulties, rendering it complex. It is complex in the sense that IT projects involve multiple interactions among elements, multiple actors, multiple actor roles, various degrees of freedom, and multiple settings for distribution (Leonardi, Bailey, Diniz, Sholler, & Nardi, 2016; Geraldi, Maylor, & Williams, 2011). In addition, individual software developers have their own perceptions of the degree of complexity of their work within this project environment. Jaques (1996) notes that work complexity is determined by the number of factors involved, the rate of change of those factors and the ease of identification of the factors in a situation (e.g. the software developer's perception about the degree of work complexity). These form the developer's reality. In other words, if the work feels — and/or is perceived as — less complex, there is reduced cognitive interference affecting throughput. This is because less cognitive energy is spent trying to create illusory patterns and create order in a seemingly random world (Floricel, Michela, & Piperca, 2016; Whitson & Galinsky, 2008). This article focuses on this **perceived work complexity** construct, defined as the cognitive appreciation of the complexity of the work itself.

The following story highlights the application of work complexity in practice: One of the authors manages software development projects for a global company. He observed that the traditional way of developing code, in which each individual software developer codes in isolation, increased perceived work complexity. He therefore experimented with different approaches to reduce the silo mentality of the software developers reporting to him. He noticed that the industry believes a good developer produces high quality software code and a weak developer is bad at software development. To challenge these stereotypes he designed the work environment to ensure developers became interdependent; to achieve a common goal, the team had to collaborate and each member had to take turns to lead projects. When these changes were implemented this team interaction improved the performance of individual developers .

From this anecdotal evidence the authors developed several hypotheses about performance improvement. This article investigates one of the hypotheses tested during their subsequent study: perceived work complexity is reduced by the way that exchanges happen in the team. An extensive literature review revealed the concept of **shared leadership** as a type of team exchange. Shared leadership occurs when work is interdependent and knowledge-based and promotes mutual learning and knowledge-sharing (Roepke, Agarwal, & Ferratt, 2000; Wang, Waldman, & Zhang, 2014). Shared leadership is the "serial emergence of multiple leaders over the life of a team" (Pearce & Sims, 2002, p.176). It involves the leadership role being shared by a series of different people who take on the leadership role at different times in the lifecycle of a project or team. This kind of leadership involves connecting individuals, who assist each other with problem-solving in the work environment, which then increases team performance. Supporting the authors' hypothesis, previous research indicates that learning increases for those providing as well as those receiving problem-solving assistance, which contributes to **team performance** improvement (Shah, Cross, & Levin, 2015). We therefore propose that these supportive exchanges in the team decrease (or negatively affect) perceived work complexity, which improves team performance.

We could only find four research studies that referenced the exact term "perceived work complexity" (Schwarz, Barros, Behnke, Chang, Christiansen, Faber, Kwon, Johnson-Mehta, Beal, MacDermid, & Weiss, 2004; Kemp, Wall, Clegg, & Cordery, 1983; Tian, 2013; Mattsson, Li, Fast-Berglund, & Gong, 2017). Of these, those of Kemp et al. (1983), Tian (2013) and Mattsson et al. (2017) measure work complexity but not perceived work complexity, use the degree of variety between constructs and do not ask respondents direct questions about how they perceive work complexity. Schwarz et al. (2004) makes a search term reference to the phrase. The authors developed a measurement scale for perceived work complexity as we could not find one in the existing literature.

This study focuses on these understudied constructs and contributes to the literature by increasing understanding of the relationship between **perceived work complexity** and the **shared leadership** and **team performance** constructs.

By understanding the interrelationships, managers of software development projects can increase team performance by managing employees' perceived work complexity. This has practical application value in three ways. First, if perceived work complexity influences team performance, managers can focus team efforts on reducing this perception, rather than on reducing the actual complexity of the work; in other words, they can reduce the intensity of information-sharing and creative thinking required, which has been shown to reduce work complexity (Wang, Waldman et al., 2014). Second, managers can use aspects of shared leadership, using concepts like mutual learning and knowledge-sharing, to further reduce perceived work complexity. Lastly, managers can embed mutual learning and knowledge-sharing techniques into the team's culture, enabling its members to leverage more knowledge from each other. Using shared leadership, leaders could link individuals in a team and reduce perceived work complexity, ultimately leading to increased team performance.

The research problem gives rise to the following questions:

- To what extent do the dimensions of perceived work complexity influence team performance?
- To what extent does shared leadership influence perceived work complexity?
- To what extent does shared leadership influence perceived team performance?

Literature review

Perceived work complexity

Different disciplines have significantly varying views of complexity and complex systems. It is useful to differentiate the notions of complex system and system (Rouse, 2003). A system is a combination or group of interacting, interrelated or interdependent elements that together form a collective entity. Elements may include behavioral, symbolic or physical entities. Elements may interact computationally, by exchange of information, and/or physically. Systems tend to have purposes/goals which in some cases are ascribed from the outside by observers.

A complex system, on the other hand, is a system whose behaviors can be attributed to one or more of the following perceived complicated characteristics: there are a large number of relationships among elements, discontinuous and nonlinear relationships, uncertain characteristics of relationships and elements, and large numbers of elements. A system may be judged to be complex from a functional perspective if the underlying structural features are independent and complicated behaviors are present (Snowden & Boone, 2007).

This research draws on the classic work of Snowden and Boone (2007). They observe that complexity is more a "way of thinking about the world than a new way of working with mathematical models" (Snowden & Boone, 2007, p. 3). Snowden and Boone (2007, p.3) show that a complex system has the following characteristics: it involves large numbers of interacting elements; the interactions are nonlinear, and minor changes can produce disproportionately major consequences; the system is dynamic, the whole is greater than the sum of its parts; the system has a history, and the past is integrated with the present; the elements evolve with one another and with the environment; this evolution is irreversible; though a complex system may, in retrospect, appear to be ordered and predictable, hindsight does not lead to foresight because the external conditions and systems constantly change; and in a complex system the agents and the system constrain one another, especially over time.

The researchers found that the development of IS systems adheres to all eight criteria of a complex system. According to Snowden and Boone (2007), systems adhering to these criteria can be classified as either complex or complicated. Systems that can be understood using experts, data and relationship are not complex systems but complicated systems. This research investigated whether complicated or complex systems have a relationship with team performance.

A recent meta-analysis of the work complexity literature shows it can be measured using scale-based measurement, and using levels of knowledge-sharing and interdependence among team members (Wang, Waldman et al., 2014). Wang, Tsai and Tsai (2014) postulate that work complexity can be measured by the intensity of the information-sharing and creative thinking required. This can be seen as aligning with aspects of the Snowden and Boone (2007) postulation of complexity, particularly their statements, “It involves large numbers of interacting elements” and “The elements evolve with one another and with the environment” (Snowden & Boone, 2007, p. 3). Most other research into complexity of systems focuses on the mathematical model of complexity rather than the consciousness, or perception, of complexity (Geraldi et al., 2011).

Our review of the literature did not reveal any existing scales that measure perceived work complexity aligned to Snowden and Boone’s (2007) complexity theory and the researchers therefore developed such a scale. Aligned with Snowden and Boone (2007), lower ratings in the scale indicate complicated systems and higher ratings indicate that the system is more complex.

Team performance

Team performance is the dependent variable in this study. It is an important construct and has received much academic attention. A recent meta-analysis by D’Innocenzo, Mathieu, and Kukenberger (2016) shows that team performance can be measured in multiple ways and that it still deserves attention.

The extent of a team's ability to meet established quality, time and cost objectives can be defined as team performance (Hoegl & Gemuenden, 2001). A key issue in studying team performance is the perspective of the evaluator, as “project success depends, in part, on the perspective of the evaluator” (Hoegl & Gemuenden, 2001, p. 438). Therefore, when studying subjective ratings of team performance, it is important to include the views of multiple sources, e.g. of the customer, the team and the company (Hoegl & Gemuenden 2001). Research also shows that subjective ratings of performance do not represent the entire performance domain and that objective measures should be used, but also that this is only a significant problem if the performance ratings are given by the same source that rated other dependent and independent variables (D'Innocenzo et al., 2016).

For the purpose of this study, efficiency and effectiveness variables were used to describe team performance (Hoegl & Gemuenden, 2001). While effectiveness refers to the outcome quality and the degree to which expectations are met by the team, efficiency refers to adherence to schedules.

Work complexity has been found to have a negative correlation with team performance (Espinosa, Slaughter, Kraut, & Herbsleb, 2007). This study investigates whether perceived work complexity is also negatively associated with team performance in this sample group. Hence:

> *Hypotheses H1-h0* - Perceived work complexity does not have an effect on team performance.
>
> *Hypotheses H1-h1* - Perceived work complexity has a negative effect on team performance.

Shared leadership

It is evident that the long-established definitions of leadership are vague or inconsistent (Bass & Bass, 2009). In addition to the definition, the dynamics of "who is a leader?", as well as "what is a leader?" in any given social context are subjective and ambiguous. Furthermore, the proposition that members of a team somehow share leadership (called shared leadership) complicates an already ambiguous scenario (D'Innocenzo et al., 2016).

The leadership literature can thus be viewed as quite disjointed with a rapid increase of models and conceptualizations. The researchers listed below conceptualized and advanced ways of understanding different styles of leadership, for example: Shared Leadership (D'Innocenzo et al., 2016); Collective Leadership (Friedrich, Vessey, Schuelke, Mumford, Yammarino, & Ruark, 2014); Complexity Leadership (Uhl-Bien, Marion, & McKelvey, 2007); Distributed Leadership (Bolden, 2011); and Team Leadership (Morgeson, DeRue, & Karam, 2010).

A recent meta-analysis by Tal and Gordon (2016) and Lord, Day, Zaccaro, Avolio, and Eagly (2017) shows that transformational, shared, complex and collective leadership theories are still important today. Though researchers have struggled with a clear definition of shared leadership, and, more importantly, to articulate a theory of what it is, shared leadership ultimately stems from the traditional leadership theories (D'Innocenzo et al., 2016). These state there is a downward influence between the leader and his/her followers, based on formal authority and power inherently possessed by the leader (Pearce, 2004). However, leadership is multifaceted and there is more to it than a simple downward line towards subordinates. For example, reference is made to the leader-member exchange, as discussed by Graen and Uhl-Bien (1995). Despite this, many authors, academics and researchers still perceive leadership in terms of theories based on hierarchy, individualization and unilateral direction.

The current study focuses on shared leadership because of its association with a decrease in work complexity (Shah et al., 2015). Shared leadership focuses on three types of leadership that members in a team might share – transformational, transactional, and directive (Pearce & Sims, 2002). Shared transformational leadership, for example, could be achieved through the inspiration of one another and a shared strategic vision, or by challenging existing norms and industry standards to create breakthrough services or products. Similarly, teams might engage in shared directive leadership. This type of leadership might be expressed as directive give-and-take testing of, for example, the engagement of key stakeholders, how to create or implement internal structures and systems, or how to develop strategic initiatives. Shared transactional leadership might also be expressed by distributing rewards based on established key performance metrics, or through collegial recognition of contributions and efforts.

Leaders that understand complexity are able to shift complexity from the environment itself to the interactions between members, which reduces perceived work complexity. These leaders can predict and see through complexity, engage groups in dynamic organizational change, think through complex problems, and adaptively engage complex problem-solving with emotional intelligence of their own (Metcalf & Benn, 2012; Metcalf & Benn, 2013). When work is more interdependent, and knowledge-based, shared leadership promotes mutual learning and knowledge-sharing, which affects work complexity (Shah et al., 2015). Thus, the more shared leadership in teams, the less the perceived work complexity. Hence:

> *Hypotheses H2-h0* - Shared leadership does not have an effect on perceived work complexity.
>
> *Hypotheses H2-h1* - Shared leadership has a negative effect on perceived work complexity.

Empirical studies have revealed several moderators in the relationship between shared leadership and performance including work function, levels of work autonomy (Fausing, Jeppesen, & Jønsson, Lewandowski, & Bligh, 2013), and task complexity (Hoch 2014; Wang, Waldman et al. 2014). Shared leadership has a positive relationship with team performance for knowledge-intensive teams but has a negative relationship for manufacturing teams (Fausing et al., 2013). Similarly, team autonomy is identified as a moderator by Fausing et al. (2013) who conclude that sharing leadership is a performance disadvantage in teams with low levels of autonomy. An earlier study by Hoch, Pearce, and Welzel (2010) concludes that where tasks are routine, shared leadership does not impact team performance. Others agree that the effects of shared leadership are stronger when work is more complex (Wang, Waldman et al., 2014). These findings are significant and imply that the likely success of shared leadership is contingent on the nature of the work and the level of work complexity. More complex work thus necessitates a higher degree of shared leadership (Wang, Waldman et al., 2014). In the absence of shared leadership, complex work is even more complex and can lead to negative team performance.

Hypotheses H3-h0 - Shared leadership does not have an effect on team performance.

Hypotheses H3-h1 - Shared leadership has a positive effect on team performance.

Figure 1 illustrates the relationships investigated by this study.

(Insert figure 1 here)

Figure 1. Conceptual model

Method

A realist paradigm informed this study (Saunders & Lewis, 2012) as it drew from existing theory on complexity, leadership and team performance to create a predefined set of variables, based on formal propositions and relationships between the constructs. Also, the propositions and relationships were tested using quantifiable measures of the variables. Finally, this study did not contain any controllable conditions; the research strategy used to answer the question was not an experiment but a survey (Saunders & Lewis, 2012).

A relational study/descriptive design was followed, and a cross-sectional survey questionnaire was used. Hypotheses were tested using quantitative methods. The unit of analysis, or population, was IT employees. IT software development projects offer a knowledge-based environment with adequate levels of complexity and in which individuals interact to deliver to clients. As Anderson and Dekker (2005) report, these clients regularly change specifications which creates uncertainty and increases perceived complexity. IT employees were therefore appropriate as a sample as the study endeavored to investigate perceived work complexity. IT employees were defined as employees with any of the following roles: MIS engineer, programmer, developer, information system professional, systems analyst, software architect, systems designer, data processing professional, and software engineer.

Survey methods, and web-based questionnaires in particular, are ideal when limited resources are available and allow for data collection from a larger sample. A non-probability sampling approach, specifically convenience and snowball sampling, was used to sample the population.

Measurement instrument

Most of the research variables in this study were measured using existing scales, which ensured greater content validity (DeVellis, 2016). Content validity is important to assess if items measuring a construct are appropriate and valid (Bhattacherjee, 2012). To optimize reliability, a seven-point Likert scale was used, which allowed for more variation in the data by preventing neutral responses (DeVellis, 2016). For all variables, the respondents were asked to rate construct items ranging from:

1: Strongly Disagree 2: Disagree 3: Disagree Somewhat 4: Neither Agree nor Disagree 5: Agree Somewhat 6: Agree 7: Strongly Agree

For the purpose of this study, efficiency and effectiveness variables were used to describe team performance (Hoegl & Gemuenden, 2001). Effectiveness refers to the outcome quality and the degree to which expectations are met by the team. For projects such as those commonly found in IS, team members must regularly adhere to predefined properties of the process, services, or products under development (e.g. reliability, functionality, performance and robustness). Team efficiency refers to adherence to schedules (e.g. starting the project on the target date and completing it on time and within budget). Thus, efficiency ratings are based on the comparison of the inputs, actual versus intended, whereas effectiveness reflects a comparison of the outcomes, actual versus intended (Hoegl & Gemuenden, 2001).

This research therefore measured perceptions of IT employees about two dimensions of team performance, efficiency and effectiveness (Hoch & Kozlowski, 2014). Scale items included ten on effectiveness, “Going by the results, this project can be regarded as successful”; “All demands of the customers have been satisfied”, and five items for efficiency, “From the company’s perspective one could be satisfied with how the project progressed”; “Overall, the project was done in a cost-efficient way”.

An existing scale was found to measure the shared leadership construct. Based on the work of Pearce and Sims (2002), shared leadership was measured using 12 items measuring dimensions of transformational leadership, including, “My team members show enthusiasm for my efforts”; “My team members approach a new project or task in an enthusiastic way”. Directive shared leadership was measured using nine questions retrieved from Pearce and Sims (2002), including, “My team members give me instructions about how to do my work”; “My team members provide commands in regard to my work”. Transactional shared leadership was measured by six questions retrieved from Pearce and Sims (2002), including, “My team members give me positive feedback when I perform well”; “My team members commend me when I do a better-than-average job”.

This study draws on Snowden and Boone’s (2007) postulation of complexity. They emphasize that complexity is more a “way of thinking about the world than a new way of working with mathematical models” (Snowden & Boone, 2007, p. 3). Because no existing scale could be found to measure perceived work complexity, items were created based on Snowden and Boone’s (2007) complexity construct. The 11 items included, “The elements in the project evolve with the external environment"; "External environmental influences are difficult to reverse in the project."

Pilot testing the instrument

The data gathering process involved three phases. The first phase ensured face validity which is important to ensure that items are meaningful and reasonable to measure the underlying constructs (Bhattacherjee, 2012). This study drew on the expertise of academics to ensure face validity. The second phase employed a pilot test within a preselected division within an organization. The questionnaire was sent to the selected division and respondents was asked to comment on the clarity and their understanding of instructions provided. Statistical tests were conducted on the data collected from the pilot test to ensure the distribution and reliability of the existing and new scales. The final phase involved a non-probability sampling approach, using convenience and snowball sampling methods, to sample the population.

This study followed the well-known recommendation for performing SEM analysis as a two-step process (Anderson & Gerbing, 1988). Construct validity was measured first through exploratory factor analysis (EFA). Adopting methodology from Hair, Wolfinbarger Celsi, Money, Samouel and Page (2015), EFA was conducted to test validity for the constructs of perceived work complexity, shared leadership and team performance. The EFA demonstrated convergent validity if item loadings were above 0.6 and discriminant validity if cross-loadings were below 0.3. The average variance extracted (AVE) demonstrated convergent validity if the variance of each construct was above 0.5, and discriminant validity if the shared variance between the constructs was larger than the average variance (Hair et al., 2015). Discriminant and convergent validity statistical methods were used to show the direct (convergent) effect of an item on the construct and to prove that the item was unrelated (discriminant) to other constructs (Kang, Zhang, Cai, & Small, 2016).

Sample characteristics

Of the 217 who responded to the distributed questionnaire, seven had job roles that did not meet the definition of an "IT employee" and were eliminated. 47 (22.4%) responses had missing item data. One case was missing three responses, four (2%) had two missing items and 34 (16.2%) had one missing item. Hair, Black, Babin and Anderson (2010) suggest as a rule of thumb that cases are candidates for deletion if they are missing more than 15% of the data and may be retained if they are only missing 10% of the required data. Five cases were thus deleted. One case was excluded in further analysis as a number of responses had standard scores above 4. The final sample size was therefore 204.

39% of the respondents had bachelor's degrees and 16% had college diplomas. 81% were male. This is not surprising given that information technology has been stereotyped as a male-dominated profession. 48% of employees were between the ages of 20 and 30, 40% were between 30 and 40, 9% between 40 and 50, and only 3% above the age of 50. Approximately 57% of respondents had between zero and three years' work experience at their respective organizations, 22% between three and five years, and only 7% had worked for more than 10 years in their organizations. Approximately 62% of respondents were four or more levels below the CEO at their respective organizations, 19% were three levels below the CEO, and only 9% one level below the CEO. Most IT employees thought of themselves as software developers or MIS engineers. Most IT employees either worked 100% on site or 0% on site, accounting for 34% and 32% of the sample respectively.

Validity and reliability

We used factor analysis to analyze correlations among factors that were highly correlated (Hair et al., 2015), while Oblimin Rotation was used to estimate parameters to facilitate SEM model generation. The first factor analysis was run on the items measuring the variables of transformational shared leadership (SLTF), transactional shared leadership (SLTX), directive shared leadership (SLDR), perceived work complexity (PC), team performance effectiveness (TPEF), and team performance efficiency (TPEC). Several items were subsequently removed because the items loaded with factors they were not intended to measure (e.g. only four items were retained for perceived work complexity). The KMO and Bartlett's test results are shown in Table 1 below. Table 2 shows the use of factor rotations was appropriate and the items were factorable. All non-significant loadings for the factor analyses of less than 0.3 were suppressed.

(Insert table 1 here)

The pattern matrix of the retained items follows.

(Insert table 2 here)

Tests on skewness indicated statistics ranging from (-1.309 to -0.138) which are within the recommended range of (-2 to +2) implying that the study variables are fairly normally distributed. Kurtosis values ranged from (-0.977 to 1.704) which are within the range of (-2 to +2) implying fairly normal distribution of the study variables. According to George and Mallery (2010), when the skewness statistics range within (-2 to +2), the variables are said to be in normal distribution.

A separate confirmatory factor analysis on the combined sample (N = 204) using AMOS 24.0 maximum likelihood procedure was conducted. As Hu and Bentler (1999) propose, good fitting models should have a root mean square error of approximation (RMSEA) of less than or equal to .06 and a comparative fit index (CFI) of .95 or greater. Using 204, the researchers compared the fit of two different factor structures. The first was a four first-order factor model of transformational shared leadership, transactional shared leadership, directive shared leadership, perceived work complexity (PC), team performance efficiency and team performance effectiveness. The second was a second-order factor model in which items of team performance efficiency and effectiveness were loaded onto their respective factors and the two factors then loaded on a second-order latent team performance (TP) factor. Then items of shared leadership (SL), that is, transformational, transactional and directive, loaded onto their respective factors and the three factors loading on a second-order latent shared leadership factor. The fit statistics for the two models are shown in Table 3.

(Insert table 3 here)

The two models (first-order and second-order) are mathematically equivalent (Bollen, 1989). However, because a second-order factor model accounts for corrected errors amongst the covariation of first-order factors, which is very common in first-order CFA, if justifiable, the second-order latent factor model is preferable (Gerbing and Anderson, 1984).
The six-factor first-order factor model of transformational shared leadership, transactional shared leadership, directive shared leadership, perceived work complexity, team performance efficiency and team performance effectiveness, was entered into a SEM measurement model, see Figure 2. The fit statistics are as follows: $\chi 2 = 372.748$, df =237, $\chi 2/df = 1.573$, CFI = 0.956, and RMSEA = 0.053, and PCLOSE = 0.301. All factor loadings are significant at $p<0.001$. The second order factor model fit statistics are as follows: $\chi 2 = 393.213$, df =244, $\chi 2/df = 1.612$, CFI = 0.951, and RMSEA = .055, and PCLOSE = 0.206. It was decided to use the second order latent factor model to create the composite variables.

Additionally, the AVE was above 0.5, and composite reliability (CR) was above 0.7 for all constructs. Also, the MSV was greater than the AVE for all constructs adding additional support for discriminate validity (Hair et al., 2010, 2014). The Curve estimation and a multicollinearity test was also checked. All variance inflation factor (VIF) loadings were below 3 and all estimations were linear (Grewal, Cote, & Baumgartner, 2004). For each of the measures the internal consistency alphas (Cronbach's alpha) was also above 0.7, see Table 4 below.

(Insert table 4 here)

A one-way analysis of variance (ANOVA) was used to check if categorical nominal variables of role and gender differed across perceived work complexity, shared leadership and team performance. All other ordinal control variables were also checked for differences including working on site, age, education and tenure.

Only age and working on site were significant between the dependent and independent variables. Working on site was coded into "not working at different locations" (0) and "working at different locations" (1). IT employees who worked at different locations reported significantly different ratings in perceived work complexity ($p < 0.05$). In addition, respondent age was statistically significantly different ($p < 0.05$) when reporting shared leadership. A control was added for the effects of working on site and age because of these differences across the independent and dependent variables.

The structural model was constructed to evaluate shared leadership, perceived work complexity and team performance; additionally, control variables of age and working at different locations were added. In the structural model below, shared leadership is a latent factor of transformational shared leadership, transactional shared leadership and directive shared leadership, while team performance is a latent factor of team performance efficiency and team performance effectiveness. The model fits the data perfectly with fit statistics at: $\chi 2 = .852$, df = 5, $\chi 2/df = .170$, RMSEA = .000, PCLOSE = 0.991, GFI = 1.

(Insert figure 2 here)

Note: ** $p < 0.001$, * $p < 0.05$

Figure 2. Structural model

Regression weights for all paths were significant (all $p < .05$) in the model. Table 5 shows the regression weights results. The results confirm perceived work complexity negatively predicts team performance ($\beta = -0.097$, $p<0.05$), supporting H1. Shared leadership negatively predicts perceived work complexity ($\beta = -0.293$, $p<0.001$), supporting H2. Shared leadership also positively predicts team performance ($\beta = 0.813$, $p<0.001$), confirming H3. Thus, the predicted direct effects of shared leadership on perceived work complexity received empirical support. See Table 5 below for the regression weights.

(Insert table 5 here)

Together, perceived work complexity and shared leadership are strong predictors of team performance as they explained 71.7% of the variance in team performance. See Table 6 below for the correlation results.

(Insert table 6 here)

Shared leadership impacted the hypothesized perceived work complexity ($\beta = -.293$, $p < .001$), which in turn had significant effects on the outcome variable, that is, team performance ($\beta = -.097$, $p < .05$), suggesting mediation could exist.

Mediation

To determine whether the indirect effect is significant, the researchers made use of the bootstrap samples (as they don't assume normal distribution of the sample) to determine the standard error of the indirect effect (Preacher & Hayes, 2008). AMOS 24.0 bias-corrected percentile bootstrap method ($\beta = 2000$ samples) was employed. See Table 7 for the mediation results.

(Insert table 7 here)

The indirect effects of shared leadership on team performance is significant ($\beta = 0.028$, $p < 0.05$) and perceived work complexity partially mediates the effect of shared leadership on team performance (reduces the regression weight). Sobel tests confirmed statistically significant mediation effects of perceived work complexity on shared leadership ($z = 2.16751636$, $p = 0.030$, two-tailed probability).

Moderation

To understand if perceived work complexity reduces the effect of shared leadership on team performance, it was decided to explore whether perceived work complexity can act as a moderator. Other studies have shown that one variable can act as both a mediator and moderator (James & Brett, 1984; Choi, Ullah, & Kwak, 2015; Kong, Zhao, & You, 2013; Uysal, Satici, Satici, & Akin, 2014). This research created an interaction variable which was the product of the standardized score of shared leadership and perceived work complexity (Frazier, Tix, & Barron, 2004; Hayes, 2012). The model fits the data perfectly with fit statistics at: $\chi2 = 2.912$, df = 7, $\chi2/df = .416$, RMSEA = .000, PCLOSE = 0.970, GFI = 1, see Figure 3.

(Insert figure 3 here)

Figure 3. Moderation model

The results relating to predictors of team performance show that shared leadership ($\beta = .793$, $p < .001$) and perceived work complexity ($\beta = -.111$, $p < .05$) significantly predicted team performance, see Table 8 below. In this model, lower shared leadership and lower perceived work complexity were associated with lower team performance. Most importantly, there was a significant interaction between shared leadership and perceived work complexity ($\beta = .082$, $p < .05$). See Table 8 for the moderation results.

(Insert Table 8 here)

Consistent with procedures outlined by Dawson (2014), the researchers used the simple slope for the regression of team performance on shared leadership by using the high and low values for perceived work complexity. High and low values are represented as one standard deviation above and below the mean respectively. As Figure 4 shows, there is a significant positive relation between shared leadership and team performance at high and low levels of perceived work complexity.

(Insert figure 4 here)

Figure 4. Two-way interaction moderation

Summary of findings

After screening the data and participants, and proving the validity and reliability of the measures, SEM was used to test the hypotheses and assess the indirect and direct effects of the independent variables on the dependent variables.

All hypotheses were supported, specifically: perceived work complexity negatively predicts team performance, while shared leadership negatively predicts perceived work complexity and positively predicts team performance. See Table 9.

(Insert Table 9 here)

Additional analyses suggest that perceived work complexity partially mediates the effects of shared leadership on team performance. The partial mediating effect reduces the effect that shared leadership has on team performance. The moderating effect shows there is a significant positive relation between shared leadership and team performance at high and low levels of perceived work complexity. Also, working at different locations increases perceived work complexity and age reduces perceptions of shared leadership.

Discussion

Perceived work complexity and team performance

These results confirm the link between perceived work complexity and team performance. IT employees who reported higher levels of perceived work complexity experienced lower team performance. The findings suggest that higher levels of perceived work complexity are associated with lower levels of efficiency and effectiveness. The study therefore contributes to the literature by developing and testing the measure of perceived work complexity and its relationship with team performance.

Shared leadership and perceived work complexity

The findings suggest that IT employees who report higher levels of shared leadership experience lower perceived work complexity. This finding relates to previous research showing that promoting mutual knowledge-sharing increases learning and ultimately team performance (Shah et al., 2015). The study by Shah et al. (2015) also found this relationship embedded in environments where work is more interdependent and knowledge-based. The software development project context resembles this work environment. Pearce and Manz (2005) suggest that the more complex the work becomes, the more likely shared leadership is needed for optimal performance as it is less likely that a single person can possess the expertise required for high performance in more complex work. Our results confirm this link. However, those researchers did not use perceived work complexity as a measure. The current study therefore extends the current literature by offering evidence of the relationship between shared leadership and the specific construct of perceived work complexity.

Shared leadership and team performance

Our results confirm the link identified by Wang, Tsai et al., (2014) that shared leadership has a positive correlation with team performance. IT employees who reported higher levels of shared leadership experienced higher team performance. We confirmed shared leadership as a predictor of team performance in the context of information technology and provided further support for this relationship. In addition, we investigated a more complex model than that explored in previous studies of a linear relationship between shared leadership and team performance. We contribute to the literature on shared leadership by including the mediator, perceived work complexity, in this relationship and thus extend the current knowledge about the boundaries of the relationship between shared leadership and team performance. Our study shows that in the absence of shared leadership, complex work is even more complex and leads to negative team performance.

Perceived work complexity as a mediator

According to D'Innocenzo et al. (2016), teams performing tasks with higher levels of complexity exhibit lower effects of shared leadership on team performance. Task complexity showed a significant moderator effect. However, those researchers referred to objective measures of levels of task complexity, whereas the current study measures the respondents' perceived work complexity. We found that higher levels of perceived work complexity account for some, but not all, of the effect of shared leadership on team performance.

Perceived work complexity as a moderator

This study also empirically evaluated whether perceived work complexity could moderate the relationship between shared leadership and team performance. Other studies have shown that one variable can act as both a mediator and moderator (James & Brett, 1984; Choi et al., 2015; Kong et al., 2013; Uysal et al., 2014). This study showed a significant positive relationship between shared leadership and team performance at high and low levels of perceived work complexity. Shared leadership appears to be beneficial in terms of team performance for teams with high and low levels of perceived work complexity

Control variables

This study shows that working at different locations increases perceptions of work complexity. Age has a direct negative relationship with shared leadership such that more senior (in terms of age) IT employees perceive less shared leadership than younger employees. The reason for this significant and fairly weak relationship may be that older members do not seek many new ideas as they conform to practices they have followed for a long time (Berhane, 2008). Older employees are probably more accepting of more autocratic styles while new generations, by contrast, may be more accepting of, and recognize, shared leadership. Other controls, such as gender, education, job level and organizational tenure, have no significant effects on perceived work complexity, shared leadership or team performance.

Conclusion

At the time of this study, no research could be found to explain how shared leadership affected team performance of IT employees by changing their perceptions about the complexity of their work. Our findings show that perceived work complexity negatively predicts team performance while shared leadership negatively predicts perceived work complexity and positively predicts team performance. The emergent conceptual model is shown in Figure 5.

(Insert figure 5 here)

Figure 5. Revised conceptual model

The findings also reveal that not spending 100% of one's working hours in one specific environment increases perceptions of complexity and that more senior IT employees perceive less shared leadership than younger employees. Lastly, respondents' perceptions of complexity partially mediate the effects of shared leadership on team performance.

Implications for management

These findings suggest that managers of software development projects should lessen their employees' perceptions of work complexity, thereby increasing team performance. While it is difficult to reduce the actual complexity of the IT work environment managers are able to reduce *perceptions* of work complexity and should find practical solutions to do so, e.g. by breaking complex ideas down into palatable parts or acting as buffers between changing client requirements and teams.

To manage complexity, managers today should **firstly** understand perceptions of complexity, which can be reduced in the work environment by adopting shared leadership principles and increasing team performance. Employees must be encouraged to share team leadership responsibilities. In this regard, Carson, Tesluk, and Marrone (2007) advise managers to motivate, empower and give individuals a shared purpose which have been shown to increase members' willingness to share team leadership responsibilities.

Secondly, to increase team performance software development managers should adopt shared leadership principles, and purposefully share their power, to reduce IT employees' perceptions of the complexity of work projects. This sharing of management responsibilities promotes mutual learning and knowledge-sharing, which then reduces perceptions of complexity. Management should encourage participation in decision-making, which promotes the uninhibited, open exchange of information and ideas. In practice, managers should promote members' sense of belonging to the community by creating space and time for exchanging expertise and stories, and teaching them the value of storytelling.

In addition, norms and standards for knowledge-sharing need to be clearly communicated; these reduce uncertainty and associated anxiety about what violates corporate rules and what constitutes acceptable sharing (Ardichvili, 2008). Action learning could be encouraged through reflection on how the team deals with unfamiliar problems with real-time work experiences, which has been suggested as a gateway to shared leadership (Raelin, 2006).

Thirdly, when IT employees have high perceptions of work complexity, they have lower perceptions of team performance. This study focused on perception, and not actual work complexity. IT managers therefore need to understand their employees’ perceptions of work complexity and reduce these in areas where individuals are struggling. Floricel et al. (2016) suggest that organizational strategies that foster collaboration, such as partnering and integrated project delivery (Naoum, 2003; Cohen, 2010), or encouraging frequent communication, such as agile methods (Ballard & Tommelein, 2012), can be used to organize and address complexity-related uncertainties.

Fourthly, this study reveals that working at different locations has a direct effect on employees’ perceptions of complexity. IT managers should reduce the amount of time their employees spend at different locations, thus reducing perceptions of work complexity and increasing team performance. Dispersed teams need to bridge the technology-mediated and distance boundaries (Hinds & Bailey, 2003) which make it more difficult to work together. Their members need ways to coordinate their work as they do not enjoy the benefits of compresence, such as awareness, presence, contextual reference and frequent communication, and this could increase their perceptions of work complexity. Espinosa et al. (2007) suggest that, regardless of location, team members that are more familiar with each other may obtain quicker responses and cooperation as they know who to contact to get answers. This can mitigate the negative effects of complexity on team performance. Espinosa et al. (2007) further suggest managers should invest in developing team familiarity (e.g. by using members that have worked together to form teams, visiting each other's sites frequently and implementing technologies that foster team familiarity, such as video conferencing).

Lastly, this study showed that older IT employees perceive shared leadership as lower in the work environment. If they do not experience this, shared leadership in the team and team performance is reduced. Organizations could benefit from taking note of this finding and acknowledging that older employees may not be open to shared leadership and the mutual sharing of knowledge in the team. Managers should look out for this lack of buy-in and purposefully build open relationships with these, probably more experienced, older software developers to ascertain their levels of knowledge-sharing and engagement. When they resist change, the underlying causes should be explored by interacting with them and directly confronting their lack of cooperation if necessary. Managers could also think about a reward system to encourage older employees to engage in knowledge-sharing within the team.

We referred to a practical application story in the introduction to this paper. The researcher as manager forced software developers to collaborate by creating common deliverables and requiring regular interactions within the team which led to performance improvement. The empirical research supported these anecdotal results by confirming that shared leadership reduces perceived work complexity which, in turn, improves team performance. When developers share the leadership role equally they may be brainstorming the solutions they create such that they better understand the deliverable and reduce perceived work complexity.

Limitations of the research

A subjective rating approach was used to measure team performance although the use of objective ratings is preferable. D'Innocenzo et al. (2016), however, did not find any significant differences between shared leadership indices and members' ratings of team performance, so this risk was therefore reduced. Additionally, it was difficult to obtain data for objective measures or to compare different measuring systems. Perceptions were therefore selected to measure team performance. Future research could use more objective measures.

The problem of common method bias (CMB) is a second limitation. Using only self-reported survey data may have biased the results; a correlation could have been found that was actually attributable to the use of the same survey instrument and the fact that the same respondent provided all the data for all variables. We used statistical analyses to check for CMB as suggested by Schwarz, Rizzuto, Carraher-Wolverton, Roldan and Barrera-Barrera (2017). We conducted the Harman's test for CMB (see Table 10) which showed that the percentage of total variance that could be explained by one variable is 36.063%; this is acceptable and suggests CMB was not a problem in this study.

(Insert table 10 about here)

In addition, the design of this study required responses from individuals themselves to test their perceptions of perceived work complexity, shared leadership and team performance. Furthermore, it has been suggested that single-item and poorly-designed scales are more susceptible to common method bias; this is less of a problem with multi-item, well-designed scales (Spector, 1987). This concern was diminished by using scales with high reliability and multiple items.

Finally, the preferred random sampling method was supplemented with a snowball and convenience sampling approach. As a result, some caution is required when generalizing to the larger population.

Suggestions for future research

Firstly, the importance of the perceived work complexity construct was demonstrated. The study of perceived work complexity should be extended to include other variables not examined here. Perceived work complexity was measured using only four items from the original 11-item scale. It could be perceived that this study might not have measured perceived complexity as a whole, but rather change complexity. The items used to measure perceived work complexity referred more to the change aspects of complexity.

Secondly, Pearce and Manz (2005) suggest it is more likely that shared leadership would be needed for optimal performance the more complex the work becomes. D'Innocenzo et al. (2016) suggest it becomes too hard to manage shared leadership when tasks become more complex and more advantages can be achieved by having fewer leaders. This study supports both theories. First, perceived work complexity partially mediates the effects of shared leadership on team performance; second, when perceived work complexity is viewed as a moderator, a positive relationship exists between shared leadership and team performance. Future research should explore other variables that could explain why shared leadership is slightly less effective when perceptions of work complexity are high. It could be that higher ratings on the perceived work complexity scale represent a chaotic system, in which high shared leadership is less effective. Future research should explore how shared leadership can be designed so that it is still effective when systems are chaotic.

Previous research suggests that team cohesion affects morale, willingness and motivation to engage in task-related and social activities, performance and, ultimately, group potency (Ensley, Pearson, & Pearce, 2003). Ensley et al. (2003) also suggest that shared team leadership may have a negative effect in less cohesive teams and the opposite effect on performance in highly cohesive teams. Future research might want to explore other mediating variables, like cohesion.

Lastly, future research may wish to better explore the relationship between perceived work complexity and actual work complexity, and the study of actual team performance, rather than perceptions of team performance, is encouraged.

In closing

This study recognizes that perceived work complexity is a problem for IT employees within South Africa. It addressed this challenge through a research model that furthers our understanding of perceived work complexity, shared leadership and IT employee team performance. By collecting valid and reliable data from these employees the researchers demonstrated the direct and indirect effects of shared leadership and perceived work complexity. Results support the significant effects of shared leadership on team performance and perceived work complexity, and the importance of perceived work complexity on team performance. IT managers working in more complex environments with non-managerial and technical level IT employees should find the findings especially helpful. This study, as a result, provides support and much needed empirical evidence on shared leadership of IT employees. It adds to the growing body of knowledge, and provides new insights into perceived work complexity and team performance of IT employees in South Africa.

References

Anderson, J. C., & Gerbing, D. W. (1988). Structural equation modeling in practice: A review and recommended two-step approach. *Psychological Bulletin, 103*(3), 411-423.

Anderson, S. W., & Dekker, H. C. 2005. Management Control for Market Transactions: The Relation between Transaction Characteristics, Incomplete Contract Design, and Subsequent Performance. *Management Science, 51*(12), 1734-1752.

Ardichvili, A. (2008). Learning and knowledge sharing in virtual communities of practice: Motivators, barriers, and enablers. *Advances in Developing Human Resources, 10*(4), 541-554.

Ballard, G., & Tommelein, I. (2012). Lean management methods for complex projects. *Engineering Project Organization Journal, 2*(1-2), 85-96.

Bass, B. M., & Bass, R. (2009). *The Bass handbook of leadership: Theory, research, and managerial applications*. New York, NY: Simon and Schuster.

Berhane, G. (2008). *Participatory Approach for the Development of Agribusiness Through Multi-Purpose Cooperatives in Degua Tembien Woreda, South Eastern Tigray, Ethiopia* (Doctoral dissertation, Mekelle University).

Bhattacherjee, A. (2012). *Social science research: principles, methods, and practices*. Textbooks Collection. Florida: University of South Florida.

Bolden, R. (2011). Distributed leadership in organizations: A review of theory and research. *International Journal of Management Reviews, 13*(3), 251-269.

Bollen, K. A. (1989). A new incremental fit index for general structural equation models. *Sociological Methods & Research, 17*(3), 303-316.

Carson, J. B., Tesluk, P. E., & Marrone, J. A. (2007). Shared leadership in teams: An investigation of antecedent conditions and performance. *Academy of Management Journal, 50*(5), 1217-1234.

Chen, Y., Bharadwaj, A., & Goh, K. Y. (2017). An empirical analysis of intellectual property right sharing in software development outsourcing. *MIS Quarterly, 41*(1), 131-161.

Choi, S. B., Ullah, S. M., & Kwak, W. J. (2015). Ethical leadership and followers' attitudes toward corporate social responsibility: The role of perceived ethical work climate. *Social Behavior and Personality: An International Journal, 43*(3), 353-365.

Cohen, J. (2010). Integrated project delivery: Case studies. *Sacramento, CA, The American Institute of Architects California Council*. Sacramento, CA.

D'Innocenzo, L., Mathieu, J. E., & Kukenberger, M. R. (2016). A meta-analysis of different forms of shared leadership–team performance relations. *Journal of Management*, 42(7), 1964-1991.

Dawson, J. F. (2014). Moderation in management research- What, why, when, and how. *Journal of Business and Psychology, 29*(1), 1-19.

DeVellis, R. F. (2016). *Scale development: Theory and applications* (Vol. 26). Thousand Oaks, CA: Sage publications.

Ensley, M. D., Pearson, A., & Pearce, C. L. (2003). Top management team process, shared leadership, and new venture performance: A theoretical model and research agenda. *Human Resource Management Review, 13*(2), 329-346.

Espinosa, J. A., Slaughter, S. A., Kraut, R. E., & Herbsleb, J. D. (2007). Familiarity, complexity, and team performance in geographically distributed software development. *Organization science, 18*(4), 613-630.

Fausing, M., Jeppesen, H. J., Jønsson, T., Lewandowski, J., & Bligh, M. C. (2013). Moderators of Shared Leadership: Function and Autonomy. *Team Performance Management*, 19(5/6), 244-262. DOI: 10.1108/TPM-11-2012-0038.

Floricel, S., Michela, J. L., & Piperca, S. (2016). Complexity, uncertainty-reduction strategies, and project performance. *International Journal of Project Management, 34*(7), 1360-1383.

Fornell, C., & Bookstein, F. L. (1982). Two structural equation models: LISREL and PLS applied to consumer exit-voice theory. *Journal of Marketing Research, 19*(4), 440-452.

Fornell, C., & Larcker, D. (1987). A second generation of multivariate analysis: Classification of methods and implications for marketing research. *Review of Marketing, 51*, 407-450.

Frazier, P. A., Tix, A. P., & Barron, K. E. (2004). Testing moderator and mediator effects in counseling psychology research. *Journal of Counseling Psychology*, *51*(2), 115-157.

Friedrich, T. L., Vessey, W. B., Schuelke, M. J., Mumford, M. D., Yammarino, F. J., & Ruark, G. A. (2014). Collectivistic leadership and George C. Marshall: A historiometric analysis of career events. *The Leadership Quarterly*, *25*(3), 449-467.

George, D., & Mallery, P. (2010). *SPSS for Windows step by step. A simple study guide and reference (10. Baskı)*.

Geraldi, J., Maylor, H., & Williams, T. (2011). Now, let's make it really complex (complicated) A systematic review of the complexities of projects. *International Journal of Operations & Production Management, 31*(9), 966-990.

Gerbing, D. W., & Anderson, J. C. (1984). On the meaning of within-factor correlated measurement errors. *Journal of Consumer Research, 11*(1), 572-580.

Graen, G. B., & Uhl-Bien, M. (1995). Relationship-based approach to leadership: Development of leader-member exchange (LMX) theory of leadership over 25 years: Applying a multi-level multi-domain perspective. *The Leadership Quarterly, 6*(2), 219-247.

Grewal, R., Cote, J. A., & Baumgartner, H. (2004). Multicollinearity and measurement error in structural equation models: Implications for theory testing. *Marketing Science, 23*(4), 519-529.

Hair, J., Black, W., Babin, B. & Anderson, R. (2010). *Multivariate Data Analysis. 7 ed*. New Jersey, NY: Pearson Prentice Hall.

Hair, J. F., Wolfinbarger Celsi, M., Money, A. H., Samouel, P., & Page, M. J. (2015). *Essentials of Business Research Methods.* 2nd Edition, London & New York: Routledge.

Hayes, A. F. (2012). PROCESS: A versatile computational tool for observed variable mediation, moderation, and conditional process modelling.

Hinds, P. J., & Bailey, D. E. (2003). Out of sight, out of sync: Understanding conflict in distributed teams. *Organization Science*, *14*(6), 615-632.

Hoch, J. E. (2014). Shared leadership, diversity, and information sharing in teams. *Journal of Managerial Psychology*, 29, 541–564.

Hoch, J. E., Pearce, C. L., & Welzel, L. (2010). Is the most effective team leadership shared? The impact of shared leadership, age diversity and coordination on team performance. *Journal of Personnel Psychology*, 9, 105–116.

Hoch, J. E., & Kozlowski, S. W. (2014). Leading virtual teams: Hierarchical leadership, structural supports, and shared team leadership. *Journal of Applied Psychology*, *99*(3), 390-403.

Hoegl, M., & Gemuenden, H. G. (2001). Teamwork quality and the success of innovative projects: A theoretical concept and empirical evidence. *Organization Science*, *12*(4), 435-449.

Hu, L. T., & Bentler, P. M. (1999). Cutoff criteria for fit indexes in covariance structure analysis: Conventional criteria versus new alternatives. *Structural Equation Modeling: A Multidisciplinary Journal, 6*(1), 1-55.

Jaques, E. (1996). *The requisite organisation: a total system for effective managerial organizational and managerial leadership for the 21st century* (2nd ed.). Arlington, VA: Cason Hall.

James, L. R., & Brett, J. M. (1984). Mediators, moderators, and tests for mediation. *Journal of Applied Psychology, 69*(2), 307-321.

Kang, H., Zhang, A., Cai, T. T., & Small, D. S. (2016). Instrumental variables estimation with some invalid instruments and its application to Mendelian randomization. *Journal of the American Statistical Association, 111*(513), 132-144.

Kemp, N. J., Wall, T. D., Clegg, C. W., & Cordery, J. L. (1983). Autonomous work groups in a greenfield site: A comparative study. *Journal of Occupational Psychology, 56*(4), 271-288.

Kong, F., Zhao, J., & You, X. (2013). Self-esteem as mediator and moderator of the relationship between social support and subjective well-being among Chinese university students. *Social Indicators Research, 112*(1), 151-161.

Krigsman, M. (2012). Worldwide cost of IT failure (revisited): $3 trillion. *ZDNet*, April 10, 2012, accessed 3 Feb 2019, https://www.zdnet.com/article/worldwide-cost-of-it-failure-revisited-3-trillion/

Leonardi, P. M., Bailey, D. E., Diniz, E. H., Sholler, D., & Nardi, B. (2016). Multiplex Appropriation in Complex Systems Implementation: The Case of Brazil's Correspondent Banking System. *MIS Quarterly*, *40*(2), 461-473.

Lord, R. G., Day, D. V., Zaccaro, S. J., Avolio, B. J., & Eagly, A. H. (2017). Leadership in applied psychology: three waves of theory and research. *Journal of Applied Psychology*, 102(3), 434-451.

Luftman, J., Zadeh, H. S., Derksen, B., Santana, M., Rigoni, E. H., & Huang, Z. D. (2013). Key information technology and management issues 2012–2013: an international study. *Journal of Information Technology, 28*(4), 354-366.

Mattsson, S., Li, D., Fast-Berglund, Å., & Gong, L. (2017). Measuring Operator Emotion Objectively at a Complex Final Assembly Station. *In Advances in Neuroergonomics and Cognitive Engineering* (pp. 223-232). Springer International Publishing.

Metcalf, L., & Benn, S. (2012). The corporation is ailing social technology: Creating a ‘fit for purpose’ design for sustainability. *Journal of Business Ethics, 111*(2), 195-210.

Metcalf, L., & Benn, S. (2013). Leadership for sustainability: An evolution of leadership ability. *Journal of Business Ethics*, *112*(3), 369-384.

Morgeson, F. P., DeRue, D. S., & Karam, E. P. (2010). Leadership in teams: A functional approach to understanding leadership structures and processes. *Journal of Management, 36*(1), 5-39.

Naoum, S. (2003). An overview into the concept of partnering. *International Journal of Project Management, 21*(1), 71-76.

Pearce, C. L. (2004). The future of leadership: Combining vertical and shared leadership to transform knowledge work. *The Academy of Management Executive, 18*(1), 47-57.

Pearce, C. L., & Manz, C. C. (2005). The new silver bullets of leadership: The importance of self- and shared leadership in knowledge work. *Organizational Dynamics, 34*(2), 130-140.

Pearce, C. L., & Sims, H. P. (2002). Vertical versus shared leadership as predictors of the effectiveness of change management teams: An examination of aversive, directive, transactional, transformational and empowering leader behaviors. *Group Dynamics: Theory, Research, and Practice, 6*(2), 172–197.

Preacher, K. J., & Hayes, A. F. (2008). Asymptotic and resampling strategies for assessing and comparing indirect effects in multiple mediator models. *Behavior Research Methods, 40*(3), 879–891.

Raelin, J. (2006). Does action learning promote collaborative leadership? *Academy of Management Learning & Education, 5*(2), 152-168.

Roepke, R., Agarwal, R., & Ferratt, T. W. (2000). Aligning the IT human resource with business vision: the leadership initiative at 3M. *MIS Quarterly, 24*(2), 327-353.

Rouse, W. B. (2003). Engineering complex systems: Implications for research in systems engineering. *IEEE Transactions on Systems, Man, and Cybernetics, Part C (Applications and Reviews), 33*(2), 154-156.

Saunders, M., & Lewis, P (2012). *Doing Research in Business and Management: An essential guide to planning your project.* Pearson: Edinburgh Gate.

Schwarz, R.L., Barros, E., Behnke, A., Chang, Y., Christiansen, A., Faber, A., Kwon, Y.I., Johnson-Mehta, A., Beal, D., MacDermid, S.M., & Weiss, H.M., (2004). MFRI Resources for Researchers.

Schwarz, A., Rizzuto, T., Carraher-Wolverton, C., Roldan, J., & Barrera-Barrera, R. (2017). Examining the Impact and Detection of the "Urban Legend" of Common Method Bias. *ACM SIGMIS Database: The DATABSE for Advances in Information Systems*, 48(1), 93-119.

Shah, N. P., Cross, R., & Levin, D. Z. (2015). Performance benefits from providing assistance in networks relationships that generate learning. *Journal of Management*, 44(2), 412-444.

Snowden, D. J., & Boone, M. E. (2007). A leader's framework for decision making. *Harvard Business Review, 85*(11), 68-78.

Spector, P. E. (1987). Method variance as an artifact in self-reported affect and perceptions at work: Myth or significant problem? *Journal of Applied Psychology*, *72*(3), 438-443.

Tal, D., & Gordon, A. (2016). Leadership of the present, current theories of multiple involvements: a bibliometric analysis. *Scientometrics*, *107*(1), 259-269.

The Standish Group International, Inc. (2013). *Chaos Manifesto: Think Big, Act Small*, accessed 3 Feb 2019, https://www.immagic.com/eLibrary/ARCHIVES/GENERAL/GENREF/S130301C.pdf

Tian, R. (2013). *Effect of work complexity & individual differences on nursing IT utilization* Doctoral dissertation, Purdue University.

Uhl-Bien, M., Marion, R., & McKelvey, B. (2007). Complexity leadership theory: Shifting leadership from the industrial age to the knowledge era. *The Leadership Quarterly, 18*(4), 298-318.

Uysal, R., Satici, S. A., Satici, B., & Akin, A. (2014). Subjective Vitality as Mediator and Moderator of the Relationship between Life Satisfaction and Subjective Happiness. *Educational Sciences: Theory and Practice, 14*(2), 489-497.

Wang, C. J., Tsai, H. T., & Tsai, M. T. (2014). Linking transformational leadership and employee creativity in the hospitality industry: The influences of creative role identity, creative self-efficacy, and job complexity. *Tourism Management*, *40*, 79-89.

Wang, D., Waldman, D. A., & Zhang, Z. (2014). A meta-analysis of shared leadership and team effectiveness. *Journal of Applied Psychology*, *99*(2), 181-198.

Whitson, J. A., & Galinsky, A. D. (2008). Lacking control increases illusory pattern perception. *Science*, 322(5898), 115-117. doi: 10.1126/science.1159845

Table 1 - KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		0.893
Bartlett's Test of Sphericity	Approx. Chi-Square	3 200.057
	df	276
	Sig.	0.000

Table 2 – Pattern matrix

Items	PC	SLTF	SLDR	SLTX	TPEF	TPEC
PC 1 Implementing a minor change in the project can produce disproportionately major consequences	0.715					
PC 2 Internal conditions related to the project changes constantly	0.616					
PC 3 Internal environmental influences are difficult to reverse in the project	0.817					
PC 4 External environmental influences are difficult to reverse in the project	0.727					
SLTF 1 My team members approach a new project or task in an enthusiastic way		0.670				
SLTF 2 My team members encourage me to go above and beyond what is normally expected of one (e.g., extra effort)		0.657				
SLTF 3 My team members provide a clear vision of where our team is going		0.919				
SLTF 4 Because of my team members, I have a clear vision of our team's purpose		0.871				
SLTF 5 My team members aren't afraid to 'break the mould' to find different ways of doing things		0.666				
SLDR 1 My team members let me know about it when I perform poorly			0.795			
SLDR 2 My team members reprimand me when my performance is not up to par			0.853			
SLDR 3 When my work is not up to par, my team members point it out to me			0.836			
SLTX 1 My team members give me positive feedback when I perform well				0.805		
SLTX 2 My team members commend me when I do a better-than-average job				0.914		
SLTX 3 My team members give me special recognition when my work performance is especially good				0.796		
TPEF 1 Going by the results, this project can be or will be regarded as successful					0.824	
TPEF 2 All demands of the customers have been or will be satisfied					0.935	
TPEF 3 From the company's perspective, all project goals were or will be achieved					0.900	
TPEF 4 The project result was or will be of high quality					0.821	
TPEF 5 The team was or will be satisfied with the project result					0.572	

TPEC 1 From the company's perspective one could be or will be satisfied with how the project progressed	0.453
TPEC 2 Overall, the project was done or has been done in a cost-efficient way	0.971
TPEC 3 Overall, the project was done or has been done in a time-efficient way	0.730
TPEC 4 The project was or is within budget	0.695

Note: PC is Perceived complexity; SLTF is Transformational shared leadership; SLDR is Directive shared leadership; SLTX is Transactional shared leadership; TPEF is Team performance effectiveness; TPEC is Team performance efficiency. Extraction Method: Maximum Likelihood. Rotation Method: Promax with Kaiser Normalization. a. Rotation converged in 7 iterations.

Table 3 - Fit indexes

Structure	$\chi2$	df	$\chi2$/df	CFI	RMSEA	PCLOSE
First-order factor model	372.748	237	1.573	0.956	0.053	0.301
Second-order factor model	393.213	244	1.612	0.951	0.055	0.206

Table 4 - Construct Validity

	Cronbach's Alpha	CR	AVE	MSV	**SL**	**PC**	**TP**
Shared leadership	0.805	0.773	0.546	0.543	0.739		
Perceived work complexity	0.907	0.812	0.521	0.080	-0.249	0.722	
Team performance	0.913	0.810	0.680	0.543	0.737	-0.283	0.825

Table 5 - Regression weights

Relationship			Estimate	S.E.	C.R.	P
SL	<---	Age	-.186	.091	-2.704	.007*
PC	<---	Work On Site	.172	.164	2.604	.009*
PC	<---	SL	-.293	.076	-4.432	**
TP	<---	PC	-.097	.026	-2.492	.013*
TP	<---	SL	.813	.030	20.843	**

Note: ** p-value significant at smaller than .001 significance level or 99% confidence interval, * p-value at smaller than .05 significance level or 95% confidence interval

Table 6 – Squared multiple correlations

	Estimate
SL	.035
PC	.115
TP	.717

Table 7 - Regression weights

Relationship	Total effect	Direct effect	Indirect effect
Team performance			
Shared leadership **	0.842 (0.001)	0.813 (0.001)	0.028(0.002)
Perceived work complexity *	-0.097 (0.003)		

Note: ** p-value significant at smaller than .001 significance level or 99% confidence interval, * p-value at smaller than .05 significance level or 95% confidence interval. The factor loadings in parentheses are for the significance. Extraction Method: Maximum Likelihood. Indirect effect was tested using bias corrected bootstrap method with a Two Tailed Significance.

Table 8 – Regression weights

Relationship	Standardized regression weights
Team performance	
Shared leadership **	0.793 (0.000)
Perceived work complexity *	-0.111 (0.005)
Shared leadership x Perceived work complexity *	0.082 (0.031)

Note: ** p-value significant at smaller than .001 significance level or 99% confidence interval, * p-value at smaller than .05 significance level or 95% confidence interval.

Table 9 - Table of Hypotheses and study Outcomes

Hypotheses		Outcome
Hypothesis H1	Perceived work complexity has a negatively effect on team performance	Supported
Hypothesis H2	Shared leadership has a negative effect on perceived work complexity	Supported
Hypothesis H3	Shared leadership has a positive effect on team performance	Supported

Table 10 – Results of Harman's test for Common Method Bias

Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	8.655	36.063	36.063	8.655	36.063	36.063
2	2.960	12.331	48.394			
3	2.401	10.003	58.397			
4	1.489	6.204	64.601			
5	1.249	5.206	69.807			
6	1.035	4.314	74.120			
7	0.678	2.826	76.946			
8	0.607	2.531	79.477			
9	0.558	2.326	81.803			
10	0.545	2.269	84.072			
11	0.485	2.022	86.094			
12	0.412	1.717	87.811			
13	0.384	1.601	89.412			
14	0.362	1.510	90.922			
15	0.325	1.356	92.278			
16	0.296	1.235	93.512			
17	0.260	1.085	94.597			
18	0.231	0.962	95.559			
19	0.219	0.913	96.472			
20	0.203	0.846	97.318			
21	0.189	0.788	98.106			
22	0.166	0.691	98.797			
23	0.147	0.613	99.410			
24	0.142	0.590	100.000			

Extraction Method: Principal Component Analysis.

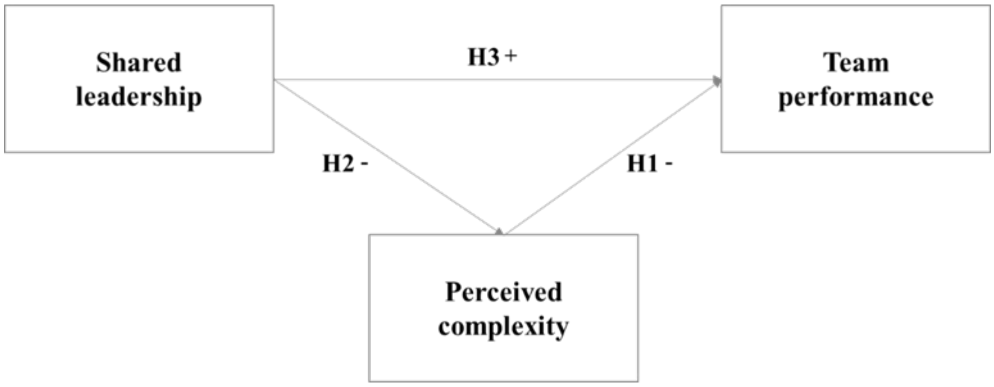
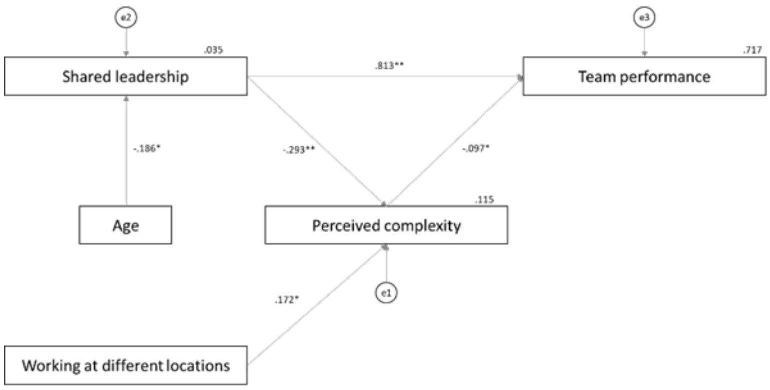


Figure 1. Conceptual model



Note: ** $p < 0.001$, * $p < 0.05$

Figure 2. Structural model

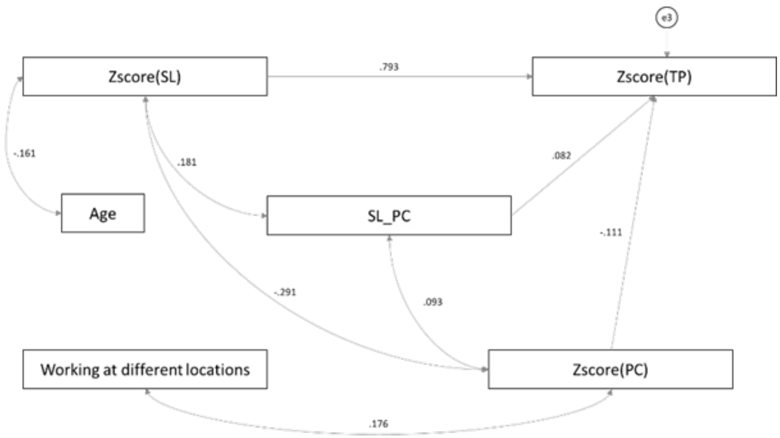


Figure 3. Moderation model

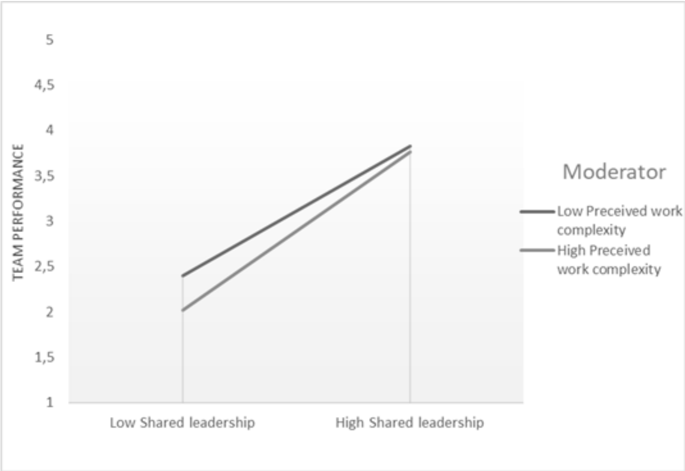


Figure 4. Two-way interaction moderation

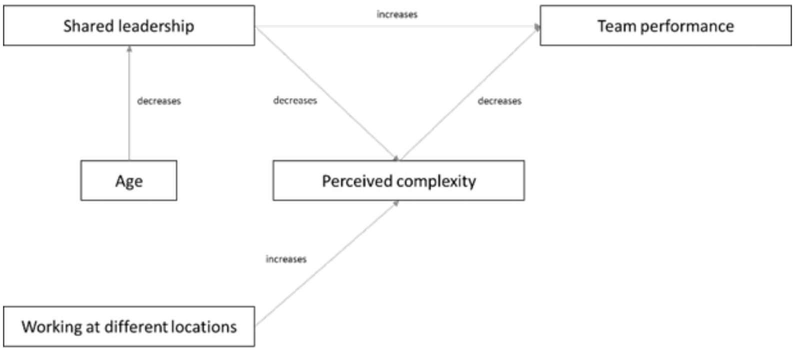


Figure 5. Revised conceptual model