

Factors Contributing to Research Team Effectiveness: Testing a Model of Team Effectiveness in an Academic Setting

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Abstract

Following the classic systems model of inputs, processes, and outputs, this study examined the influence of three input factors, team climate, work overload, and team leadership, on research project team effectiveness as measured by publication productivity, team member satisfaction, and job frustration. This study also examined the mediating effect of a process factor, team commitment. The sample comprised 292 faculty members of four research universities in Malaysia. The respondents were asked to consider one research project in which they were involved either as a project leader or team member when completing the questionnaire. The results of the study demonstrated that there were direct relationships only between team climate and team member satisfaction ($\beta = 0.265, p < 0.05$) work overload and team member frustration ($\beta = 0.381, p < 0.05$), and team leadership and team member satisfaction ($\beta = 0.200, p < 0.05$). Team commitment had a full or partial mediation effect on the relationships between team climate and research productivity ($\beta = 0.335, p < 0.05$) and team member satisfaction ($\beta = 0.235, p < 0.05$) and team member frustration ($\beta = -0.217, p < 0.05$). Team commitment only showed a statistically significant mediating effect on the relationship between work overload and research productivity ($\beta = -0.043, p < 0.05$) and team member satisfaction ($\beta = 0.030, p < 0.05$), and on the relationship between team leadership and research productivity ($\beta = 0.335, p < 0.05$). These findings suggest that different input factors influence different aspects of team effectiveness and that team climate is a key input factor that influences team effectiveness through team commitment as a process factor in an academic setting. The results of this study provide a potentially useful framework following the classical systems model of input-process-output for the establishment of effective research project teams in an academic setting.

Keywords: Team commitment, Team leadership, Publication productivity, Team member satisfaction, Job frustration, Academic research team effectiveness

The work structure in academic settings is traditionally regarded as an individual work structure in which academics work independently and are rewarded based on their individual achievements (Burke, Wagner & Van Hein, 1998). However, as universities place greater emphasis on research and publications (Enders & Musselin, 2008; Musselin, 2007), faculty members are increasingly working in teams, particularly in the context of research projects (Henkel, 2007; Shen, 2007). Although a team-based work structure has gained prominence in academic environments, very little attention has been given to investigating such work teams in this setting (Fox & Mohapatra, 2007). Moreover, research on work teams in academic settings still lacks theoretical support. A variety of team effectiveness models have been developed and empirically tested, but almost all of these models were developed based on industrial, service, and non-academic settings rather than academic settings (Fox & Mohapatra, 2007). Most of these theoretical models have adopted the systems approach of the input-process-output (I-P-O) model (Gladstein, 1984; Hackman, 1987; Ilgen, Hollenbeck, Johnson & Jundt, 2005; Kozłowski & Ilgen, 2006; Salas, Stagl, Burke & Goodwin, 2007). The I-P-O model regards process factors as mediators of the relationships between input factors and team effectiveness (Ilgen et al., 2005; Kozłowski & Bell, 2003; Marks, Mathieu & Zaccaro, 2001). To date, there have been only a limited number of research studies that treat team processes as mediators (Antoni & Hertel, 2009).

Moreover, although these models have suggested multi-dimensional outcomes to measure work team effectiveness (Cohen & Bailey, 1997), research on work teams in academic settings has focused solely on publication productivity as a team outcome (Fox & Mohapatra, 2007; Toutkoushian, Porter, Danielson & Hollis, 2003). Focusing solely on productive output as a measure of team effectiveness would disregard the possibility that teams can become burned out because of unresolved conflicts (Sundstorm, de Meuse & Futrell, 1990). Hence, studies should investigate other outcome measures such as team member satisfaction and well-being when investigating team effectiveness in academia.

The present study aimed to examine the influence of three input factors, team climate, work overload, and team leadership, on the effectiveness of academic research teams as measured by research productivity, team member satisfaction, and team member frustration. Second, this study examined the mediating effect of team commitment as a process factor on the relationships between the input and output factors examined. The importance of this study lies in the need for successful collaborative research teams in academia. Academic staffs are increasingly required to build up a sustainable research profile and develop an international reputation through publications (Hazelkorn & Moynihan, 2010). They must acquire research competencies, a complex process that requires significant resources (Hazelkorn & Moynihan, 2010). Therefore, it is pertinent to conduct more research on factors that contribute to research team effectiveness in the academic setting so that academicians can develop sustainable research profiles and gain international reputations. Moreover, because most of the existing theories and studies pertaining to work teams are based in an industrial setting, the model developed here may serve as a foundation for testing and developing a model of effective research teams in an academic setting following the classical systems model. In addition, most of the work team effectiveness models have focused on the positive outcomes. Unlike traditional team members, academic staffs often carry myriad roles and responsibilities and working in research team forms only a part of their responsibilities. Moreover, academic staff may be involved in multiple research projects at the same time. These myriad roles and demands contribute to a heavy workload, which has been associated with burnout and frustrations among academic staffs (Gonzalez & Bernard, 2006). Therefore, this study extended the existing models of work team effectiveness to examine the workload of academic staffs involved in research projects by examining whether working in teams may reduce negative outcomes such as the frustrations experienced by academic staffs.

1. Conceptual Framework

Project teams are formed with the aim of producing one-time outputs, such as a new product or service (Cohen & Bailey, 1997). In an academic setting, project teams consist of faculty members from various disciplines and areas of expertise grouped together to conduct research, and they may receive funding through grants requiring that specific goals be achieved within a specified time limit (Ryser, Halseth & Thien, 2009). This study draws on the sociotechnical system theory (STS theory) (Fox, 1995; Trist & Bamforth, 1951;) and from theoretical models of work team effectiveness. The STS theory suggests the integration (joint optimization) of social requirements and technical requirements. The latter comprises materials, machines, processes, and task structures used to convert inputs into outputs (Emery, 1959; Fox, 1995). The former includes work structures and occupational roles (Fox, 1995) that relate people to technology and to each other, e.g., the organization of work roles, support services, and the coordination of interdependent tasks (Fox, 1995). Organizations should focus on both of these sub-systems. Teams that focus primarily on tasks tend to overlook relationship issues and may experience strained and tense interactions. Meanwhile, teams that focus exclusively on the relationships between members may not be able to achieve their goals (Yeatts & Hyten, 1998). Hence, the combination of technical systems (work distribution, materials, and processes) and social systems (team climate, leadership, and coordination) is needed to yield team effectiveness: the improved productivity and well-being of team members.

The theoretical models of work team effectiveness adopted in this study were Gladstein's (1984) model of work team effectiveness, Pearce and Ravlin's (1987) model of self-regulating work group performance, and Tannenbaum, Beard and Salas's (1992) model of work team performance. The use of I-P-O models to frame team effectiveness is consistent with STS theory (Salas et al., 2007). These models suggest different input factors, such as task characteristics, leadership factors, organizational and situational characteristics, individual characteristics, team climate, and team cohesiveness. The I-P-O models posit that input factors are the primary causes of a process, which in turn influences team outcomes (Antoni & Hertel, 2009; Kozlowski & Bell, 2003). The process factors in the I-P-O framework are the mediating mechanisms linking input factors to output factors (Antoni & Hertel, 2009; Marks, Mathieu & Zaccaro, 2001; Yeatts & Hyten, 1998).

Even though models of work team effectiveness have suggested various typologies of team processes, there remains a lack of a unified conception of what team process means. Scholars have suggested that a team process is comprised

of two distinct processes, i.e., a task work process and a teamwork process (Goodwin, Burke, Wildman & Salas, 2009). The former refers to a/the team's interactions with tasks, tools, machines, and systems. Meanwhile, the latter refers to the set of interrelated thoughts, actions, and feelings that each team member engages in that are needed for team effectiveness (Goodwin et al., 2009). Marks et al. (2001) however have distinguished between the team process and emergent states. They suggest that the team process involves members interacting with other members and their task environment. Emergent states, which refer to the cognitive, motivational, and affective states of teams (such as team potency, team efficacy and trust), are not considered as a process but are products of team process outcomes (Marks et al., 2001). Marks et al. (2001) suggested that teams perform different processes at different times which they called performance episodes which refers to distinguishable periods of time over which work is performed and evaluated. They classified the team processes into three dimensions which occur during and between the performance episodes namely transition processes, action processes and interpersonal processes. In this study, we focused on interpersonal processes. Others such as Antoni and Hertel (2009) have incorporated emergent states as part of the team process. They argued that although it may conceptually be useful to restrict the definition of a team process to team interactions, in reality, it is difficult to distinguish between task work and emergent states. All of these distinctions and typologies remain inconclusive to date (Rico, de la Hera & Taberno, 2011). Finally, output factors are outcomes that are achieved by the team, often referred to as work team effectiveness (Goodwin et al., 2009, p.41). Past studies have measured team effectiveness from multidimensional perspectives. They are commonly analyzed based on three dimensions, namely: 1) the group's productive output; which is considered as a team or group-level outcome, such as team performance and productivity, 2) the capability of members to work interdependently in the future; which is also a group-level outcome (Rico et al., 2011), and 3) the growth and personal well-being of team members; which is concerned with the affective reactions of team members, such as satisfaction with the team (Antoni & Hertel, 2009; Cohen & Bailey, 1997; Goodwin et al., 2009; Mathieu, Maynard, Rapp & Gilson, 2008).

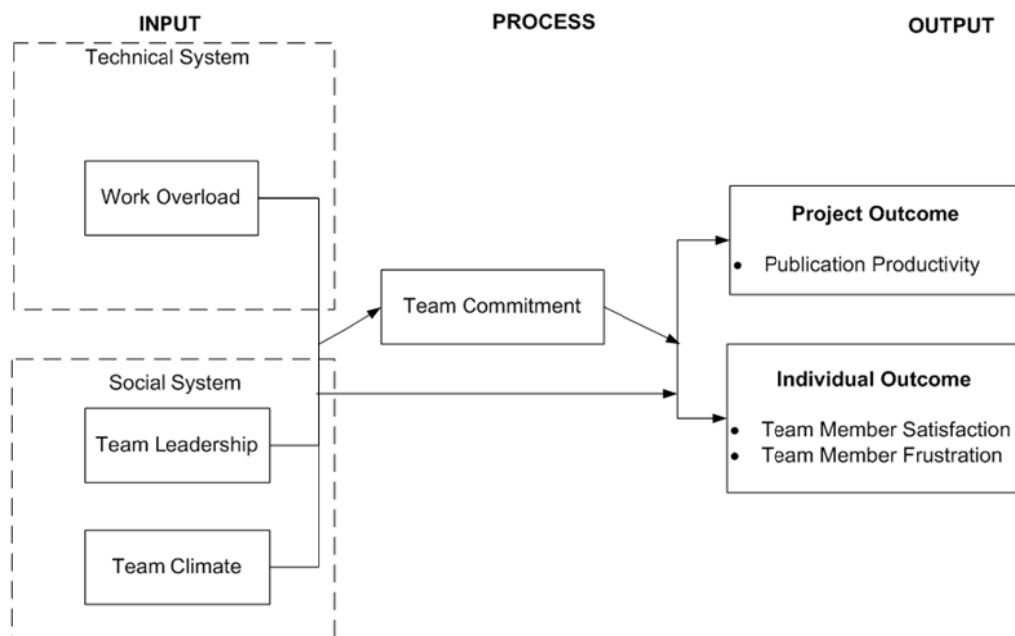


Figure 1. Conceptual Framework of this Study

This study focused on three input factors, namely, team leadership, team climate, and work overload (see Figure 1). Team climate and team leadership are elements of the social system (Fox, 1995). Team climate is a part of team characteristics (input factors) in Tannenbaum et al.'s (1992) model of team performance. Leadership is considered as an input factor in Gladstein's (1984) model. Meanwhile, work overload is part of the technical system because it relates to task structures (Emery, 1959). The workload experienced by team members can be construed as individual characteristics of the team member. In Tannenbaum et al.'s (1992) model, individual characteristics are considered as input factors.

The process factor examined is team commitment (Pearce & Ravlin, 1987; Yeatts & Hyten, 1998). Drawing from Pearce and Ravlin's (1987) model of self-regulating work group performance, we proposed team commitment as a

teamwork process factor. We also find support for this proposition from Marks et al.'s (2001) conceptualization of teamwork interpersonal processes that refers to team activities that are focused on the management of interpersonal relations. They suggested three dimensions of teamwork interpersonal processes, namely conflict management, motivation and confidence building, and affect management. We suggest that team commitment represents part of affect management dimensions. Affect management refers to activities that foster emotional balance, togetherness, and effective coping with stressful demands and frustration (LePine, Piccolo, Jackson, Mathieu & Saul, 2008; Marks, et al., 2001). Since team commitment is characterized by a strong belief in and acceptance of the team's goals and values, a willingness to exert considerable effort on behalf of the team, a strong desire to maintain membership on the team (Bishop, Scott & Burroughs, 2000), and a willingness to participate fully in group processes (Pearce & Ravlin, 1987), team commitment may be construed as part of activities that foster emotional balance, togetherness and effective coping with stressful demands and frustrations. Moreover, Watson, Ponthieu and Critelli (1995), based on their qualitative findings, have suggested four dimensions of interpersonal teamwork processes one of which is team commitment. Watson et al. (1995) described team commitment as coordination of group effort, having enthusiasm for team performance, and focusing on common team goals. Literatures have emphasised the importance of highly committed team members to help teams succeed (Aubé & Rousseau, 2011; Becker-Reems, 1994; Fisher, Rayner & Belgrad, 1995; Larson & LaFasto, 1989). Despite the importance of team commitment, very little attention has been given to examining this variable in the team setting and in testing its mediating effect as a process factor.

This study examined three domains of team effectiveness, namely: research productivity, which measures group-level effectiveness, team member satisfaction, and team member frustration, which measures the affective reactions of team members (Cohen & Bailey, 1997). Research productivity refers to the number of articles published and accepted for publication (Fox & Mohapatra, 2007). It is often used as a measure of research productivity and is central to performance in the academic setting (Fox & Mohapatra, 2007). Team member satisfaction refers to members' attitudes toward their work unit and their willingness to continue working together over time (Hackman & Morris, 1975). Almost all of the models of work team effectiveness have suggested team member satisfaction as an output factor (Gladstein, 1984, Rico et al., 2011; Hackman, 1987; Pearce & Ravlin, 1987). In this study, team member frustration was examined because working in a team can be frustrating, as it requires a team to work together and take collective actions and decisions, which may not be easily achieved due to conflicts between team members (Hackman, 1987; Vidal, 2007). Frustration can be defined as both the interference with goal attainment or goal-oriented activity and the interference with goal maintenance (Spector, 1978) and is considered to be a form of psychological strain similar to feelings of stress (Whinghter, Cunningham, Wang & Burnfield, 2008). The challenge of working in a team may be more pervasive in an academic setting due to the individualized nature of academic work and the multifaceted roles carried by academic staffs (Burke et al., 1998). Studies on work team effectiveness have predominantly examined team member satisfaction when examining team effectiveness at the individual level. Based on the STS theory, individual well-being or social/psychological outcomes (Appelbaum, 1997) cover various aspects of individual affective and behavioral reactions and are not only concerned with members' satisfaction. Affective reactions are not only concerned with positive reactions but also include job dissatisfaction, feelings of stress, feelings of frustration, anxiety and anger (Fox & Spector, 1999). Furthermore, frustration at work was chosen due to its importance to mental health outcomes (Whinghter et al., 2008).

1.1 Team Climate and Research Team Effectiveness

Team climate refers to the members' shared representation of a permanent or semi-permanent work team (Anderson & West, 1996), which comprises vision, participative safety, task orientation, support for innovation, and interaction frequency (Kivimäki, Kuk, Elovainio, Thomson, Kalliomäki-Levanto & Heikkilä, 1997). The team climate is important for team effectiveness (Loo, 2003). When team members share a similar pattern of understanding and behavior with other team members in their team, team commitment is strengthened. A psychologically safe climate allows people to feel free to ask questions, seek feedback, or discuss errors in their work because they do not expect to be penalized or to lose esteem (Ortega, Sanchez-Manzanares, Gill & Rico, 2010). Such a climate facilitates work team effectiveness. Past research reported that a positive team climate predicts general satisfaction (Proudfoot, et al., 2007). Proudfoot et al. (2007) also found that teams that had clear shared objectives were more structured, had a clear focus on tasks, worked well as a team and were more effective in their delivery. Past studies have reported that faculty members' perceptions of their departments' climate as exciting were positively associated with higher publication productivity (Fox & Mohapatra, 2007).

Working in teams can be frustrating (Vidal, 2007). The experience of frustration at work begins with an environmental event or situation that interferes with or prevents an individual from achieving or maintaining his or her personal goal at work (Fox & Spector, 1999; Spector, 1997). Team climate is considered as an environmental

factor that may inhibit or increase team member frustrations. When the team climate is positive, team members share similar understandings and actions with other team members. Members are also able to give and seek feedback from each other. Such a climate may assist team members in achieving their personal and team goals, which in turn may alleviate team member frustrations. Loo's (2003) qualitative study also revealed that teams with high positive team climate express very few frustrations with teamwork and other team members. Therefore, when research project team members develop a positive team climate, they will be committed to executing their roles and responsibilities because they will be actively involved in a non-threatening team atmosphere. Furthermore, shared perceptions and understandings among team members would elicit greater cooperation among members that may enhance members' satisfaction with the team and experience less frustration. It is therefore hypothesized that:

H1a: Positive team climate will positively influence research productivity.

H1b: Positive team climate will positively influence team member satisfaction.

H1c: Positive team climate will negatively influence team member frustration.

1.2 Leadership and Research Team Effectiveness

Team leadership is a complex phenomenon with a variety of conceptualizations (e.g., functions, roles, traits, competencies, implicit perceptions, and negotiated dyadic role exchanges) (Salas et al., 2007). In research project teams, the project leader leads and supervises the research according to the approved research proposal submitted with a grant application. Empirical evidence has shown that team leadership behavior influences employee performance, team productivity, team learning, and proactive behavior (Burke, Stagl, Klien, Goodwin, Salas & Halpin, 2006). For instance, leaders seek information that guides their problem-solving decisions that in turn serve to guide team members' behavior. They manage their personnel and material resources by providing compelling direction, enabling structures, and expert coaching and ensure that a supportive organizational context exists so that team members have easy access to resources, all which may enhance team effectiveness (Burke et al., 2006). Leaders' functions directed at coaching, developing, and mentoring the team, referred to as task leadership (Gladstein, 1984) or functional leadership (Burke et al., 2006), have been shown to enhance team processes and effectiveness (Morgeson, DeRue & Karam, 2010). Team leader behavior was found to have a positive influence on team member satisfaction (Miles & Mangold, 2002). If team members have a negative perception about their team leader, they are likely to experience internal tensions, which may negatively affect team member satisfaction with the team (Miles & Mangold, 2002). Inevitably, an effective team leader who provides clear definitions of roles and goals will minimize frustration among team members (Kotlyar & Karakowsky, 2007). This study investigated the following hypotheses:

H2a: Team leader behaviors associated with coaching, facilitating and managing the team will positively influence research productivity.

H2b: Team leader behaviors associated with coaching, facilitating and managing the team will positively influence team member satisfaction.

H2c: Team leader behaviors associated with coaching, facilitating and managing the team will negatively influence team member frustration.

1.3 Work Overload and Research Team Effectiveness

Academics are experiencing greater work overload due to increasing requirements for research productivity and publications and other growing responsibilities (Coaldrake & Stedman, 1999; Vardi, 2009). Academic duties consist of teaching, supervising students, research, administration, and service to the profession and the community (Coaldrake & Steadman, 1999; Forgasz & Leder, 2006). These varied responsibilities require a substantial time commitment, and faculty members are often caught between these competing obligations (Boyer, 1990). Work overload often occurs as a result of simultaneous and conflicting pressures, which may harm team effectiveness (Marrone, Tesluk & Carson, 2007). Individuals who occupy cognitively demanding and autonomous jobs, as is the case in academia, have a heavy workload stemming from multiple sources, resulting in increased frustration and decreased job satisfaction and performance (Whinghter et al., 2008). It is therefore hypothesized that:

H3a: Team member work overload will negatively influence research productivity.

H3b: Team member work overload will negatively influence team member satisfaction.

H3c: Team member work overload will positively influence team member frustration.

1.4 The Mediating Effect of Team Commitment

Team commitment refers to an "individual's feelings of identification with and attachment to the group's or

organization's goals or task" (Bettenhausen, 1991, p.364) that provide "a force that binds an individual to a course of action of relevance to one or more targets" (Powell, Gavin & Picolli, 2006, p.286). It is characterized by a strong belief in and acceptance of the team's goals and values, a willingness to exert considerable effort on behalf of the team, a strong desire to maintain membership on the team (Bishop, Scott & Burroughs, 2000), and a willingness to participate fully in group processes (Pearce & Ravlin, 1987). Input factors such as team leadership and team climate were reported to have a positive influence on team commitment (Burke et al., 2006; McComb, Kennedy, Green & Compton, 2008; Proudfoot et al., 2007). When research project team members develop a positive team climate, they will be committed to executing their roles and responsibilities because they are actively involved in a non-threatening team atmosphere (Ortega et al., 2010). Leaders who facilitate interactions within the team as well as task processes such as coordination and communication will be able to enhance the bonds among team members and their commitment to the team (Morgeson et al., 2010). Work overload, on the other hand, may negatively impact the commitment of academic staff to be "research active" (Lyons & Ingersoll, 2010, p.139; Mathieu & Zajac, 1990). Therefore, when academics are overloaded with a myriad of important academic functions, they may be less likely to be committed to their research project team.

Because the feeling of commitment reflects an individual's psychological disposition to their work, team member commitment will have a direct impact on team effectiveness (Powell et al., 2006). Committed employees are more likely to be intrinsically satisfied, have positive relationships with co-workers (Mathieu & Zajac, 1990), and make positive contributions to team performance (Aubé & Rousseau, 2005). Hence, the feeling of commitment evokes a sense of duty and willingness to achieve project goals (Hoegl, Weinkauff & Gemuenden, 2004). Moreover, when teams are highly committed to reaching their shared goals, they tend to motivate their fellow team members to build and maintain positive relationships with each other, satisfying rather than frustrating their individual needs (Aubé & Rousseau, 2005). In the context of this study, when academic research team members are committed to their team, they are more likely to be willing to work towards achieving their research project goals which involves writing papers for conference or journal publications. They will also be more satisfied with their teams and may experience a lesser feeling of frustration.

The I-P-O framework posits that input factors are the primary cause of a process, which in turn mediates the effects of inputs on outcomes (Antoni & Hertel, 2009; Kozlowski & Bell, 2003; Kozlowski & Ilgen, 2006). Based on this, we posit that the reason input factors such as team climate, team leadership, and work overload are related to output factors such as team performance, satisfaction and frustration is attributable to team commitment. Therefore, because the relationships between team climate, work overload, and team leadership (input factors) and team commitment (process factor) and team performance, satisfaction and frustration (output factors) have been previously confirmed, we hypothesize that:

H4a Team commitment mediates the relationship between team climate and research productivity, team member satisfaction, and team member frustration.

H4b Team commitment mediates the relationship between work overload and research productivity, team member satisfaction, and team member frustration.

H4c Team commitment mediates the relationship between team leadership and research productivity, team member satisfaction, and team member frustration.

2. Method

2.1 Sample

The study population comprised 2,429 faculty members from various disciplines and faculties who were involved as principal researchers and/or co-researchers in a research project that began within the previous two years. We selected such research projects because the normal duration of a research project is two years. Therefore, these projects would be at the end stage of the project and would have research outcomes available. We obtained written permission from all of the universities prior to conducting this study. We obtained information about the population of this study from all four universities. From the lists, a total of 100 faculty members involved in research projects per university were selected using a simple random sampling technique, yielding a total number of 400 faculty members as the study sample. Questionnaires were distributed to 400 faculty members, and 292 valid questionnaires were returned (73% response rate). Based on the empirical power tables developed by Fitz and MacKinnon (2007), for the bias-corrected bootstrap method used to test for mediation effect, the minimum sample size necessary with a Type 1 error of 0.5 and power of 0.8 and with medium effect size for path a and b (indirect effect), is 113. Therefore, the sample of 292 is considered adequate to obtain an adequate level of statistical power (i.e., 0.8).

From the 292 samples, women made up 51.4% of the sample. The four job positions were represented by professors (7.2%), associate professors (29.4%), senior lecturers (41.5%), and lecturers (21.9%). The median age was 41.5 years old, and the median duration of tenure was nine years. Individuals in the social sciences comprised 57.8% of the sample; the remainder specialized in life sciences and physical sciences. Respondents were asked to choose one research project in which they were involved as a project leader or team member when completing the questionnaire. More than half (62.7%) chose a project for which they were the project leader.

2.2 Measures

Team climate was measured using Anderson and West's (1996) Team Climate Inventory (TCI) as modified by Kivimaki et al. (1997), which has been widely used in studies on team climate. The inventory comprises 38 items with five subscales, namely, vision (eleven items; e.g., "Members are aware about the objectives set for this research project"), task orientation (seven items; e.g., "Members of this research project provide useful ideas and practical help for the research"), support for innovation (eight items; e.g., "The research team is always moving toward the development of new knowledge"), participative safety (eight items; e.g., "Members keep each other informed about project-related issues") and interaction frequency (four items; e.g., "We keep in touch with each other as a team"). Respondents rated the team climate using a five-point Likert-like scale from 1 = strongly disagree to 5 = strongly agree.

Team leadership was assessed using 17 statements developed by Kline (2003) to describe three types of leadership functions, namely, facilitator, coach, and manager. Respondents rated the extent to which their team leader (or themselves, if they completed the questionnaire as a project leader) performed the three functions using a seven-point Likert-like scale from 1 = strongly disagree to 7 = strongly agree. A sample item for facilitator function is "encourages members to provide feedback on this research project." A sample item for coach function is "models behavior," and a sample item for manager function is "ensures the resources needed for this research project are available"

Work overload was measured with a five-item instrument developed by Peterson et al. (1995) based on the instrument developed by Pareek (1976) and House, Schuler and Levanono (1983). Because work overload is considered an individual team member characteristic, respondents were asked to indicate how they perceived their own work overload (e.g., "I feel overburdened in my role") using a five-point Likert-like scale from 1 = strongly disagree to 5 = strongly agree.

Team commitment was examined using five items developed by Hoegl et al. (2004) using a five-point Likert-like scale from 1 = strongly disagree to 5 = strongly agree. This scale assesses how team members positively relate to the overall research project and its objectives (e.g., "Team members of this research team felt fully responsible for achieving the common research goals").

Research productivity was measured by publication productivity. The number of publications is commonly used as a measure of research productivity (Fox & Mohapatra, 2007). Respondents were asked to state the number of articles related to the research project published or accepted for publication in conference proceedings or journals in the previous two years. The impact of the research, often assessed by weighting according to citation or impact factors, was not taken into account because the weighting used varies by university.

Team member satisfaction was measured with four items developed by Spector (1997) on a five-point Likert-like scale (1 = strongly disagree, 5 = strongly agree). Because the instrument was developed to measure individual job satisfaction, the items were modified to measure team members' satisfaction with the task performed by their research project team (e.g., "I like doing the things I do in the team").

Team member frustration was measured using a three-item instrument developed by Peters, O'Connor and Rudolph (1980) (e.g., "Trying to get this research done was a very frustrating experience") on a five-point Likert-like scale (1 = strongly disagree, 5 = strongly agree). The original items were modified to reflect frustrations experienced by team members related to working in teams.

This study used both the referent-shift consensus and direct consensus (Chan, 1998) approaches in the construction of the items. For example, the referent-shift consensus approach was used to assess team climate, team leadership and team commitment because these measures represent members' assessments of their tasks and the conditions under which their team works. Thus, the referent for team climate and team commitment measures is the team, and the referent for team leadership is the team leader rather than the individual (see Chan's (1998) description of referent-shift consensus models). The direct response approach was used to assess work overload, team member frustration and team member satisfaction because these measures represent members' own assessment of their

workloads, frustration experienced, and feelings of satisfaction with the team.

2.3 Statistical Analysis of the Hypothesized Model

A structural equation modeling analysis was used to test the relationships among the measures, allowing us to test the entire systems of the relationships and to estimate the direct effects (effect of team climate, team leadership, and work overload on research productivity, team member satisfaction, and team member frustration) and the mediating effect of team commitment (Kline, 1998; Tanaka, Panter, Winborne & Huba, 1990). The data were analyzed using SPSS version 18, and the hypothesized structural equation model was tested with AMOS 18 using maximum likelihood estimations. The structural equation modeling analysis was conducted using a two-phase approach, i.e., a measurement model analysis and structural model analysis (Anderson & Gerbing, 1988). Goodness-of-fit was assessed using the 1) normed chi-square (CMIN/df), which indicates acceptable fit when the ratio is below 5.0, 2) the root-mean-square error of approximation (RMSEA), which indicates acceptable fit when the values are below 0.10, 3) the goodness-of-fit index (GFI), non-normed fit index, also known as the Tucker-Lewis Index (TLI) and, 4) the comparative fit index (CFI), which suggest reasonably good fit when above 0.90 (Hair, Black, Babin & Anderson, 2010).

The hypothesized direct effects (H1a, H1b, H1c, H2a, H2b, H2c, H3a, H3b and H3c) and mediated effects (H4a, H4b, H4c) were tested following the SEM approach recommended by James, Mulaik and Brett (2006) and the bootstrapping procedure suggested by Hayes (2013). The Baron and Kenny (BK) (1986) classical causal steps approach was not employed due to its limitations (Hayes, 2013; Hayes, Preacher & Myers, 2011; Preacher & Hayes, 2008; Rucker, Preacher, Tormala & Petty, 2011; Zhao, Lynch & Chen, 2010). The SEM approach omits the requirement for a significant total effect between the independent variable (X) and the dependent variable (Y) (Hayes, 2013; James et al., 2006; Preacher & Hayes, 2004) prior to testing the mediating effect. The exploration of mediation should be guided by theory instead of the presence of a significant total effect (James et al., 2006; Rucker et al., 2011).

Because the theoretical propositions shown in Figure 1 suggest the presence of a direct and mediated effect between input factors to outcome factors through process factors, a partial mediation model was used as the baseline model (James et al., 2006). The partial mediation model differs from the complete mediational model by the addition of a direct effect from input factors to output factors. In this study, the addition of direct effects connotes that part of the effect of team climate, team leadership and workload on publication productivity, team member satisfaction and team member frustration is direct, whereas another part of the effects between these factors passes through the mediator, namely, team commitment. We tested the significance of the mediated effect using the bias-corrected bootstrapping test suggested by Preacher and Hayes (2004, 2008). As recommended, a 5,000 resample with replacement was used to derive a 95% confidence bias-corrected confidence interval with which to test for the indirect effects (Preacher & Hayes, 2004, 2008).

3. Results

3.1 Confirmatory Factor Analysis (CFA)

The overall measurement of model fit with $\chi^2/df = 1.85$, RMSEA = 0.055, CFI = 0.97, GFI = 0.90, and TLI = 0.96 indicated a good fit between the CFA model and the data (Hair et al., 2010). The measurement model was also evaluated for reliability and convergent validity (Table 1).

Table 1. Descriptive statistics, reliability, correlations, squared correlations and average variance extracted

Variable	<i>M</i>	<i>SD</i>	<i>CR</i>	α	TC	TL	WOL	TCO	TMS	JF
TC	4.23	0.63	0.98	0.91	(0.690)					
TL	4.30	0.65	0.98	0.97	0.512***	(0.660)				
WOL	2.81	1.09	0.93	0.83	-0.121	-0.101	(0.619)			
TCO	4.09	0.76	0.98	0.96	0.885***	0.541***	-0.214**	(0.822)		
TMS	4.09	0.72	0.96	0.92	0.621***	0.502***	-0.109	0.624***	(0.791)	
TMF	2.50	0.82	0.82	0.70	-0.220**	-0.242**	0.423***	-0.301***	-0.430***	(0.571)
RP	4.08	2.82	-	-	0.319***	0.220**	-0.093	0.374***	0.324***	-0.282***

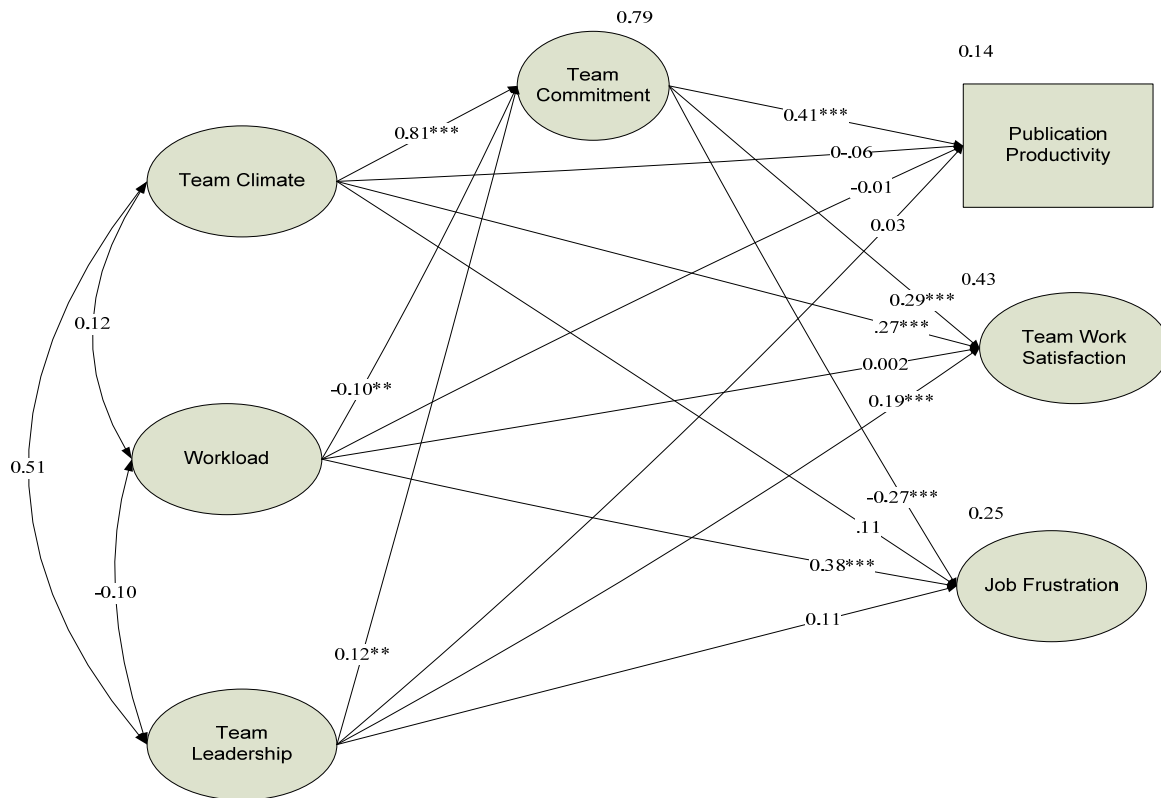
** $p < .01$, *** $p < .001$

Note: TC =Team Climate, TL = team leadership, WOL work overload, TCO = Team Commitment, TMS = team member satisfaction, TMF = team member frustration, RP = research productivity. Correlations are below the diagonal, and AVE estimates are presented on the diagonal in parenthesis. *CR* = construct reliability, α = Cronbach's alpha.

The value of Cronbach’s α and the construct reliability estimates for all latent variables exceeded 0.70 indicating good internal consistency. The average variance extracted values exceeded the threshold value of 0.50, suggesting high convergent validity. The intercorrelations among the variables shown in Table 1 provide partial support for the hypothesized structural model. Team climate and team leadership were significantly related to research productivity, team member satisfaction and team member frustration. Work overload was only significantly related to job frustration. Team climate, team leadership and work overload were significantly related to team commitment, and team commitment was significantly related to all output factors, supporting the requirement for testing team commitment as a mediator.

3.2 Structural Model Analysis

The partial mediation model shown in Figure 2 estimated the direct path from team climate, team leadership and workload on publication productivity, teamwork satisfaction and team member frustration and indirect paths stemming from the mediator variable (team commitment). Overall, the goodness-of-fit indexes indicated an acceptable fit for the model [$\chi^2/df=1.940$, $RMSEA=0.058$, $CFI=0.960$, $GFI=0.876$, $TLI=0.953$].



* $p < .05$, ** $p < .01$, *** $p < .001$

Figure 2. Estimated Path Coefficients and the Percentages of Variance Explained by the Partial Mediation Model

Table 2 presents the standardized regression weights of the direct and mediated paths and their corresponding p-values based on bias-corrected methods. The results indicate that direct effects exist only between team climate and team member satisfaction ($\beta = 0.265, p < 0.05$), work overload and team member frustration ($\beta = 0.381, p < 0.05$), and team leadership and team member satisfaction ($\beta = 0.200, p < 0.05$). Hence, support was only found for H1b, H2c and H3b, while H1a, H1c, H2a, H2b, H3a and H3c were unsupported.

For the mediating effect (Table 2), the result revealed that team climate ($\beta = 0.841, p < 0.05$) work overload ($\beta = -0.103, p < 0.05$) and team leadership ($\beta = 0.114, p < 0.05$) have a significant influence on team commitment. Team commitment has a significant influence on research productivity ($\beta = 0.412, p < 0.05$), team member satisfaction ($\beta = 0.288, p < 0.05$), and team member frustration ($\beta = -0.267, p < 0.05$), suggesting the presence of a mediating effect

Table 2. Standardized estimates for the direct and mediated (indirect) effects

Variables		Standardized estimate	Standard error	<i>p</i> -value	
Direct effects					
TC	RP	0.060	0.098	n.s	
TC	TMS	0.265	0.094	0.045	
TC	TMF	0.108	0.130	n.s	
WOL	RP	-0.014	0.039	n.s	
WOL	TMS	-0.002	0.037	n.s	
WOL	TMF	0.381	0.064	0.001	
TL	RP	0.029	0.045	n.s	
TL	TMS	0.200	0.044	0.002	
TL	TMF	-0.111	0.061	n.s	
Mediating effect					
TC	→	TCO	0.814	0.038	0.001
WOL	→	TCO	-0.103	0.023	0.003
TL	→	TCO	0.114	0.027	0.002
TCO	→	RP	0.412	0.151	0.008
TCO	→	TMS	0.288	0.144	0.033
TCO	→	TMF	-0.267	0.130	0.025

Note: *p*-values were based on a bias-corrected method. n.s = non-significant. TCO = Team Commitment, TC =Team Climate, RP = research productivity, TMS = team member satisfaction, TMF = team member frustration, WOL work overload, TL = team leadership.

The bias-corrected bootstrap confidence intervals for the mediating effects were based on 5,000 samples (Table 3). The result revealed that team commitment is a statistically significant mediator of the relationships between team climate and research productivity ($\beta = 0.335, p < 0.05$) and team member satisfaction ($\beta = 0.235, p < 0.05$) and team member frustration ($\beta = -0.217, p < 0.05$), supporting H4a. Team commitment showed a statistically significant mediating effect on the relationship between work overload and research productivity ($\beta = -0.043, p < 0.05$) and team member satisfaction ($\beta = 0.030, p < 0.05$), but was not a significant mediator of the relationship between work overload and team member frustration ($\beta = 0.028, p > 0.05$). Therefore, Hypothesis 4b was only partly supported. Team commitment had a statistically significant mediating effect on the relationship between team leadership and research productivity ($\beta = 0.335, p < 0.05$) but had no significant mediating effect on the relationships between team leadership and team member satisfaction ($\beta = 0.033, p > 0.05$), and team member frustration ($\beta = -0.030, p > 0.05$). Therefore, H4c was only partly supported.

Table 3. Indirect Effects of Team Climate, Work Overload, and Team Leadership on Research Productivity, Team Member Satisfaction and Team Member Frustration through Team Commitment

Mediator	Relationship	Product of coefficient			Bootstrapping Bias Corrected 95% CI			
		Estimate	SE	<i>p</i> -value	Lower limit	Upper limit		
TCO	TC	→	RP	0.335	0.062	0.001	0.187	0.429
	TC	→	TMS	0.235	0.072	0.001	0.379	0.654
	TC	→	TMF	-0.217	0.060	0.001	-0.367	-0.130
	WOL	→	RP	-0.043	0.016	0.001	0.011	0.069
	WOL	→	TMS	-0.030	0.024	0.001	-0.116	-0.024
	WOL	→	TMF	0.028	0.030	n.s	-0.009	0.167
	TL	→	RP	0.047	0.014	0.001	-0.076	-0.014
	TL	→	TMS	0.033	0.045	n.s	-0.003	0.112
	TL	→	TMF	-0.030	0.025	n.s	-0.096	0.002

Note: CI = confidence interval. n.s = non-significant. TCO = Team Commitment, TC =Team Climate, RP = research productivity, TMS = team member satisfaction, TMF = team member frustration, WOL work overload, TL = team leadership.

4. Discussion

Following the classical systems model, this study aimed to test a model of project team effectiveness in an academic setting by examining the direct effects of three input factors on the outcome factors or the effectiveness of academic research teams as measured by research productivity, team member satisfaction, and team member frustration as well as the mediating effect of team commitment as a process factor on the relationships between input and output factors. Four key findings are discussed: First, direct effects only existed between team climate and team member satisfaction. This finding offers further support to previous research that a positive team climate enhances team members' satisfaction (Ortega et al., 2010; Proudfoot et al., 2007). Such a climate facilitates work team effectiveness. Past research reported that a positive team climate predicts general satisfaction (Proudfoot et al., 2007). Although no direct effect was found between team climate and the other output factors examined in this study, the findings showed the presence of an indirect effect of team climate on all three output factors through team commitment. Most studies (Acuna, Gomez, & Jouristo, 2008; Blansett, 2003; Fox & Mohapatra, 2007) that have examined the influence of team climate on performance did not examine the mediating effect of a third variable. Hence, the influence of team climate on team performance found in those studies may be due to process factors such as team commitment. This supports the assertion that when team members develop a positive team climate, they will be committed to executing their roles and responsibilities because they will be actively involved in a non-threatening team atmosphere (Ortega et al., 2010), suggesting that a positive team climate will enhance team commitment, which in turn impacts team effectiveness.

Second, the findings showed that the work overload experienced by team members has a direct effect on team member frustration, and this relationship was not mediated by team commitment. This supports the challenge of managing work from multiple sources, such as teaching, supervising students, participating in multiple research projects, publishing, providing professional services, and performing administrative duties, which may directly lead to frustrations, especially when the faculty member is unable to accomplish these tasks and responsibilities on time (Whinghter et al., 2008). Work overload has no direct effect on the other output factors. Nevertheless, work overload has an indirect effect on research productivity and team member satisfaction mediated through team commitment. The finding supports the assertion that when faculty members have too much to do within a limited time, their commitment to research project teams may suffer (Mathieu & Zajac, 1990). Also supporting Tannenbaum et al.'s (1992) model of work team effectiveness, this study suggests that the individual characteristics of team members such as their overall workload may transcend into and impact the team process and team outcomes. The findings suggest that academicians with heavy workloads may not be effective members in a research team and may inhibit a research team from achieving its desired goals. They also experience greater frustrations with their team as a result of their heavy workloads. The previous literature and studies have suggested several key input variables of team process and team effectiveness that are predominantly focused on the team design such as task structure, group norms and group composition and aspects of the organizational context of teams (Antoni & Hertel, 2009). This study suggests that studying individual factors related to the team members such as work overload are also key to team processes and effectiveness, especially in project teams where the members carry out other duties and responsibilities in addition to carrying out their project tasks.

Third, the result revealed that team leadership only has a direct influence on team member satisfaction and only has a mediating effect on research productivity through team commitment. The results of this study offer further support to past studies that found a leader's support and consideration as strong determinants of job satisfaction in a variety of work settings (Griffin, Peterson & West, 2001). However, the findings of this study did not support past studies that reported a direct influence of team leadership on team performance (see Burke et al., 2006; Gupta, Huang & Niranjana, 2010). This may be due to the nature of academia: academicians are highly autonomous and have specialized areas of expertise operating within a self-regulated code of collegiality (Hazelkorn & Moynihan, 2010). They are able to work independently and could achieve their work-related goals with little intervention from deans, heads of departments and team leaders. Hence, research project team leaders may have less influence on research productivity because faculty team members can work independently without the need for constant support or supervision. In fact, research productivity in this study was driven more by team climate and commitment than by team leadership. Furthermore, project leaders in academic settings do not have formal authoritative power over project team members. They assume temporary roles as research project leaders. Hence, they may not be able to exert much influence on team performance, unlike team members in industrial settings, who are appointed by management (Gladstein, 1984). Nevertheless, research project team leaders still play an important role in influencing team members' satisfaction.

Finally, these results demonstrated that not all input factors have a direct effect on all aspects of research project team

outcomes and that multiple input factors must be addressed to achieve good outcomes. Similar patterns were reported by investigators testing models of work team effectiveness in service industries such as in the financial services organization (Campion, Medsker & Higgs, 1993; Campion, Papper, Medsker, 1996), and communications (Cohen, Ledford & Spreitzer, 1996; Gladstein, 1984). These findings support the assertion of the STS theory that different factors (of social and technical systems) affect different outcomes. In the context of this study, the combination of the technical system (e.g., task distribution determined the workload of faculty members) and the social sub-system (e.g., team climate, team member commitment, and team leadership) led to research project team effectiveness (productivity and team member satisfaction) in academic setting. The results obtained showed that team climate is a key contributor to research project team effectiveness, as it leads to increased team commitment, which in turn contributes to research project team effectiveness. The findings of this study suggest that different types of teams, such as project teams, quality circles or self-managed work teams, show different relationships between team processes and effectiveness (Antoni & Hertel, 2009). For instance, Bain, Mann and Pirola-Merlo (2001) reported that the team climate for innovation was stronger for research teams compared to developmental teams. Therefore, we may conclude that different key input and process factors contribute to team effectiveness in different types of teams. In this study, we conclude that team commitment is a key process factor that influences research project team effectiveness in an academic setting. These findings can guide further specification of the theoretical modeling of a research team effectiveness model as well as in the design and implementation of organizational interventions to enhance research project teams in the academic setting. Because different types of teams may account for different key input factors and influences on team process and outcomes, it would be worthwhile to conduct studies involving other types of teams to identify the key factors for such team types.

This study has several limitations that need to be considered when interpreting and further utilizing the results. This study focused on one type of team, i.e., research project teams in an academic setting, where members are brought together for a short period of time and often possess distinct areas of expertise. Because it has been suggested that different key input and process factors may contribute to team effectiveness in different types of teams, the results of this study may not be generalized to other types of teams and other types of settings. Although this study examined team effectiveness, the unit of analysis was at an individual level. Further research could be conducted to replicate this study at the team level of analysis.

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