Self-directed teams in IS: correlates for improved systems development work outcomes

Brian D. Janz*

Fogelman College of Business and Economics, Room 300, The University of Memphis, Memphis TN 38152, USA

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Abstract

Self-directed work teams (SDWTs) often result from reengineering and process innovation efforts as well as recent movements to 'downsize', or 'flatten' organizations. Information systems (IS) departments have not been insulated from these trends. In spite of the rising interest in these teams, little is known about them in knowledge work settings like IS. Past research in blue-collar contexts suggests that teams result in performance improvements, while anecdotal evidence in the IS industry suggests that such improvements may never materialize. This paper reports on research conducted on 231 IS professionals from 28 systems development SDWTs across 13 organizations. Results indicate that while the autonomy inherent in SDWTs may lead to increased levels of satisfaction, motivation, and performance, the level of cooperative learning that takes place on the teams may be more important to achieving improved work outcomes. The paper concludes with a discussion of implications for both theory and managerial practice. © 1999 Elsevier Science B.V. All rights reserved

Keywords: Autonomy; Cooperative learning; Process improvement; Reengineering; Self-direction; Systems development; Team development; Teams; Teamwork

1. Introduction

With increased levels of competition in the marketplace, the push for 'downsizing', and the contraction of time and distance brought about through advancing information technology, the interest level in 'business reengineering' [40] and 'business process improvement' [21, 42] has risen dramatically as organizations seek radical improvements in business-as-usual. Often, these initiatives require or result in the formation of autonomous, team-based organizations [40, 71, 90]. It is not surprising then, that the interest in autonomous teams has risen dramatically as well [63]. These teams are referred to as self-directed teams (SDWTs).

The increased interest in radically re-designing business processes has not gone unnoticed within the field of information systems (IS) [7]. For IS departments, process change translates into the need to develop, deliver, and support information systems more responsively, with higher quality, and with lower levels of IS staffing [48]. Further, the move to team-based work is a phenomenon that IS organizations and researchers have long been familiar with, e.g., chief-programmer teams [2], joint-application design or
JAD teams [1, 88], participative, team-based system design [45, 73, 86], socio-technical systems design (e.g., Mumford’s ETHICS methodology) [64, 65], etc. However, in spite of the interest in teams, aside from Mumford’s ETHICS research, little is known about SDWTs within the IS context given that the majority of studies on SDWTs have taken place in industrial settings focusing on ‘blue-collar’ workers [34, 84, 85]. Given IS’s long reliance on team-based work, and given the fact that anecdotal evidence exists that suggests that a significant number of SDWTs in IS have failed [90], a deeper understanding of teams and characteristics of SDWTs have on the satisfaction and performance workers involved in information systems development (ISD) activities.

2. Background

SDWTs are groups of collocated workers (versus dyads or organizations) who self-regulate work on interdependent tasks. Workers on SDWTs typically: (a) have a variety of skills; (b) apply those skills to a meaningful, whole group task (wholeness in this discussion refers to a task that has an identifiable beginning and end); and (c) they have control over the management of work methods, task scheduling, and assignment of group members to tasks. Decisions regarding payments to employees as well as feedback from management are based in part on the performance of the group as a whole rather than the individual. In general, it is believed that the increases in autonomy from SDWTs will result in increased motivation, job satisfaction, and as a result, enhanced job performance of workers [24, 39, 47].

The research presented here studied SDWTs in the ISD domain. This context-specific focus is important for several reasons:

1. IS work has long been team-based. The size and complexity of information systems and associated design, development, implementation, and maintenance activities that go with it has necessitated that groups or teams of people work on them. Historically, chief programmer teams [2] JAD teams [1], and walk-through teams [4] are examples of such team-based approaches to IS work.

2. The ISD process embodies sufficient unique characteristics to warrant further investigation [4]. Teams involved in ISD are unique in that they must translate business requirements into the language of IS, address end-user requirements, and then re-translate the solution back into the language of business [23].

3. The project orientation of ISD brings with it conflicting expectations of success. ISD projects represent meaningful, whole tasks. Pearce and Ravlin [70] hypothesize that this should promote the success of the team. On the other hand, the short-term nature of ISD projects (compared to the long-term nature of providing ongoing services) has been hypothesized to cause SDWTs to be unsuccessful [14]. This conflict sets up an interesting tension worthy of investigation.

4. IS’s existing familiarity with self-directed work. One of the major challenges present in IS work is the ability to stay current with ever-changing technologies. It is common for IS professionals to perform tasks with technology that their managers or supervisors know little, if anything, about. This kind of knowledge has long given IS workers a certain amount of autonomy in how they approach their job.

5. SDWTs in IS might actually represent a decrease in autonomy. Although the self-directed nature of SDWTs may provide new forms of autonomy for IS workers, SDWTs often bring a certain amount of structure to the job in terms of developing and adhering to group norms. If these norms outweighed the increased autonomy of SDWTs and the autonomy inherent in possessing technological expertise, SDWTs would represent a net decrease in overall job freedom. This ‘myth of self-leadership’ has been discussed in the organizational behavior literature [58, 59, 61].

6. Research suggests that IS personnel tend to have a high need for growth from their job [17, 89]. Research has also shown that IS workers also have a high need for autonomy [12, 32].

7. Researchers have suggested that the outcomes stemming from SDWTs are context sensitive and that research on teams in general, and SDWTs in particular, needs to be done within the context of interest [36, 62, 74].
Job characteristics theory [38, 39, 82] and cooperative learning theory (e.g., Johnson and Johnson [49]) will be enlisted in this research to assist in gaining a better understanding of SDWTs in ISD. Briefly, job characteristics theory suggests that a positive relationship exists between certain characteristics of work (e.g., level of autonomy) and the outcomes of work (e.g., job satisfaction and performance). Cooperative learning theory suggests that if members of a group have interdependent goals, feel individually responsible for the group’s performance, help or teach each other the needed skills for work, possess adequate social skills, and periodically evaluate the group’s performance, the achievement and productivity of the group will be enhanced. In addition, team development will be measured to determine whether it moderates the independent–dependent variable relationships. Organizational climate will be treated as a control variable.

The research reported here is organized as follows. First, a conceptual research model will be developed and research propositions will be generated. Second, the research methods employed in conducting the research will be presented. Third, the data gathered from the research is analyzed and the results are presented. Finally, the paper concludes with a discussion of the results, the implications and contribution to knowledge, and potential avenues for follow-on research.

3. Prior relevant research

3.1. SDWTs in organizations

The most widely-known research on SDWTs [33, 84, 85] derives from sociotechnical systems research [8, 20, 80]. These studies were conducted in blue collar industries like food processing and coal mining. The findings, which are corroborated by meta-analyses (Macy, as cited in [34]) [5] indicate that the intervention of SDWTs correlates with modest improvements in productivity but slight decreases in job satisfaction. Mumford [65] has extended the sociotechnical philosophy to the systems development domain with her ETHICS methodology. Here, the focus is on developing systems that strike a balance between the social and technical aspects of the completed system.

Acknowledging the trend toward SDWT implementation in knowledge work settings, recent studies are beginning to consider the impact of SDWTs in these contexts. Cohen and Ledford [16] found significantly higher perceptual ratings of performance and satisfaction (both growth and social satisfaction) for SDWTs than for non-SDWTs in a telecommunications company (where subjects consisted of both blue-collar and white-collar workers). Shreidnck, Schutt and Weiss [78] and Janz and Wetherbe [48] report on case studies of SDWTs in the IS industry with findings that suggest a coincidence of SDWTs and cost savings as well as increases in customer satisfaction, responsiveness, and quality (e.g., a reduction in programming errors).

Overall, the results from SDWT interventions are somewhat mixed and a dearth of SDWT research in knowledge work settings exists. This could be due in part to the implementation-specific differences between SDWTs, however little research exists which seeks to find the relationship between the nature of SDWT characteristics (e.g., level of autonomy and cooperative learning) and resulting SDWT effectiveness. Finally, it appears that SDWTs may be sensitive to the context in which they are implemented. The research presented here is motivated by these challenges coupled with the unique characteristics of the IS domain (e.g., dynamic, historically team-centered, project based, pre-existing levels of autonomy), as well as the unique characteristics of the IS knowledge worker (e.g., high need for personal growth and autonomy).

3.2. Autonomy

Autonomy (equivalently referred to as ‘self-direction’ or ‘self-management’) is the extent to which an individual or group of individuals has the freedom, independence, and discretion to determine what actions are required and how best to execute them [44, 52, 60]. In terms of work design and our definition of SDWTs, autonomy includes responsibility for such things as the management of work methods, task scheduling, process monitoring, and the assignment of group members to tasks.

Theoretically, the more autonomy an individual or team possesses, the greater the degree to which the individual or team will feel responsible for the outcomes of their work [39]. This heightened responsi-
bility is a ‘critical psychological state’ which translates to increased motivation, satisfaction, and work effectiveness. Empirical support exists for this relationship in the group context [11, 44].

3.3. Cooperative learning theory

Cooperation, coordination, and collective approaches to work are all desirable characteristics of team work. Weick and Roberts [87] discuss the notion of effective work groups possessing a ‘collective mind’. Within the systems development arena, Crowston and Kammerer [19] suggest that collective or coordinated approaches may result in improved information requirements development. Cooperative learning exists when team members work together to maximize their own as well as other team members’ learning [51]. Cooperative learning groups have been found to outperform other types of teams [49]. Certain characteristics are essential for cooperative learning to exist: positive interdependence, face-to-face promotive interaction, and group process [51]. In addition, having team members feel individually accountable and adequate social skills are important.

Positive interdependence refers to members of a group that are linked in such a way that each member feels that they can not be successful unless all other members of the group are successful. A shared group goal that each group member identifies with and accepts is one way to achieve positive interdependence. As a by-product, if interdependence is structured in a positive manner, group members should also feel individually accountable to the group as well as for the group’s work product.

Face-to-face promotive interaction is the degree to which members of the group identify the individual strengths and weaknesses in the group and seek to assist others in developing the skills necessary for the group to achieve its goal through explaining or teaching. Adequate social skills are a necessary prerequisite for effective promotive interaction.

Group process refers to groups periodically assessing: (a) those things it has done effectively; (b) those things it has done ineffectively; and (c) the measures the group might take to address the identified weaknesses.

Meta-analytic studies reveal that well over half of almost 400 classroom studies have shown a statistically significant relationship between cooperative efforts and productivity and achievement while only 10 percent show a positive relationship between competitive or individualistic efforts and productivity and achievement [49, 53]. Whether these results hold when moving from the classroom to the workplace is an objective of this research.

3.4. Team development

A characteristic common to all teams pertains to how they mature over time. One of the most widely-known development models suggests that groups pass through a series of stages over time: forming, storming, norming, and performing [81]. Another category of models suggests that groups pass through stages in a cyclical manner [41, 76]. A third category introduces the notion of groups in a state of equilibrium which at some point is punctuated by an increase in awareness (say, of time or deadlines), at which time the team’s behavior undergoes a revolutionary change [27, 28].

There is little literature that investigates this maturation process in SDWTs. This research investigates this phenomena and refers to it as team development. To determine if one model is better or more true than another is not the intent of this research. Rather, the intent of this research is to ascertain how the development of the SDWT affects the relationships between SDWT autonomy levels and work outcomes and cooperative learning and work outcomes.

3.5. Organizational context

One variable often cited in the models of group work can be broadly categorized as an organizational context variable. For this research, this perspective is termed organizational climate [57].

Empirical research suggests that organizational climate has a significant effect on organizational performance and employee satisfaction (e.g., [25, 54, 57, 72, 75]). Given that this influence represents a potentially confounding force that could inhibit an improved understanding of direct SDWT effects, it makes sense to account for it. The specific operationalization of organizational climate will be described in later sections.
3.6. **Summary of literature and questions to be answered**

There is a paucity of research on SDWTs in knowledge work settings like IS. A review of the literature on SDWTs reveals anecdotal evidence suggesting both improvements and failures resulting from the implementation of SDWTs as well as empirical evidence which suggests more modest improvements in performance and satisfaction. This inconsistency is the overriding issue motivating the research presented here. In addition, the literature suggests that SDWTs are sensitive to the context in which they exist. Thus, research in the IS context is warranted and findings may likely contribute to the IS discipline and extend our knowledge of SDWTs in general.

SDWTs vary widely in how they are implemented. For example, each SDWT is implemented with varying levels of autonomy afforded to the team members. Given that we know little about the relationship between the degree of autonomy or the type of autonomy and its effect on SDWT outcomes, the following question is offered:

**Q1**: In the IS domain, what is the relationship between the degree and type of autonomy in SDWTs and work outcomes?

Cooperative learning mechanisms relate closely to the dynamics described in SDWT literature. However little research exists which investigates the relationship between these mechanisms and SDWT effectiveness. This paucity of research motivates the second question:

**Q2**: To what degree do SDWTs exhibit characteristics of cooperative learning, and what is the relationship between these characteristics and work outcomes?

Empirical research suggests that groups mature over time. How they progress through the maturation process is less clear. Existing models suggest that as maturity increases, levels of performance and work increase as well. Given this, the final two research questions seem warranted:

**Q3**: What effect does the level of SDWT team development have on the relationship between SDWT autonomy and SDWT work outcomes?

**Q4**: What effect does the level of SDWT team development have on the relationship between SDWT cooperative learning and SDWT work outcomes?

4. **Research development**

This research seeks to build on the existing theories of work redesign, group effectiveness, and cooperative learning. During this process, the research questions will be addressed and testable research propositions will be developed.

4.1. **The dependent variables: work outcomes**

Work outcomes include not only the good or service produced by people at work, but also the results of the work: the attitudes and feelings people have while producing the good or service, and the quality of the good or service.

Hackman and Oldham’s [39] job characteristics represents outcomes of work with the following constructs: satisfaction, internal motivation, and work effectiveness.

Here, satisfaction is conceptualized into two secondary constructs: growth satisfaction and general job satisfaction. Growth satisfaction is a measure of the opportunity for personal learning and growth that is available from the work itself. Given that an individual has a certain need for growth, increasing growth opportunities translates to more growth satisfaction. General job satisfaction is a measure of how much a worker is satisfied with the work he or she does. To measure both growth satisfaction and general job satisfaction, survey items from the job diagnostic survey (JDS) will be used [39].

Internal motivation refers to the feelings that an individual possesses that are tied to the individual’s level of performance [39]. Higher levels of performance result in positive feelings that serve as a ‘self-reward’. This reward serves to motivate the individual to seek continuing levels of high performance. Lower levels of performance would not offer these self-rewards and the individual would then seek to increase
the level of performance in order to achieve the self-reward. Again, items from Hackman and Oldham’s JDS instrument will be used.

The term effectiveness is often used when describing how teams perform. Hackman and Oldham [39] suggest that quantity and quality of the work output be used, while Hackman [37] is more explicit by suggesting that one element of effectiveness is that work outputs meet quality and quantity expectations of those who review it, e.g., supervisor or customer. Gladstein [29] suggests that group effectiveness can in part be measured by self-reports of performance. All these views will be enlisted in this research under the primary construct of performance.

Quality refers to the degree that the work product is free from errors or defects. Quantity refers to the amount or volume of the work product. Quality and quantity will be measured by asking the key stakeholders (i.e., organizational participants that have a vested interest in the team’s work product) for their evaluation. For this research, stakeholders included managers in the organization that interacted with the teams, end-users that received the teams’ work products (i.e., internal customers), and employees and consultants that worked directly with the teams. Stakeholder evaluations have the added benefit of reducing the potential for common method variance [11]. Henderson [43] and Henderson and Lee [44] have developed a validated stakeholder instrument that will be used here (again, refer to Appendix A). In addition, self-reports of performance will be used in this research by enlisting selected survey items from the Campbell–Hallam team development survey (TDS) [9]. It is important to acknowledge that the work outcome variables mentioned here are attempting to measure team-level constructs by measuring them at the individual level. This level of analysis is supported for knowledge work [22] as well as for understanding group performance [10].

4.2. SDWT autonomy and work outcomes

Autonomy takes many forms in SDWTs. For example, Manz [58] discusses several opportunities where autonomy can be given to self-directed teams. Several dimensions of responsibility typically given to SDWTs were borrowed and adapted from a previously validated instrument [6]. In addition, a panel of experts with extensive experience in systems development practices and theory generated a list of possible systems development-related autonomy items. These items are classified as IS-related autonomy. Refer to the Appendix for a listing of these items as well as the rest of the survey items.

Previous relevant research studies generally show a modest ‘more is better’ effect on work outcomes [16, 84, 85]. Thus, the following proposition is posited:

P1: SDWTs in IS with high levels of autonomy will have higher levels of work outcomes in terms of general satisfaction, growth satisfaction, internal motivation, stakeholder-rated performance, and self-reported performance than SDWTs in IS with low levels of autonomy

4.3. Cooperative learning and work outcomes

The level of cooperative learning will be comprised of survey items borrowed from instruments previously developed and validated [50, 9]. Specifically, the Johnson, et al. [50] instrument measures the degree of positive interdependence (as a function of both goal and resource interdependence) and promotive interaction, while Campbell and Hallam’s TDS measures group process. Individual accountability and social skills are believed to be inherent in the task and the process of performing the task, and will not be explicitly measured. A numerical composite of these item scores will be developed to yield a measure of cooperative learning. Although no research was found that relates cooperative learning with SDWTs, previous research supports the notion that SDWTs benefit from elements of cooperation [11]. Insofar as these elements are similar to cooperative learning, it seems reasonable to propose that a positive relationship exists between cooperative learning and SDWT effectiveness. In other words:

P2: SDWTs in IS with high levels of cooperative learning will have higher levels of work outcomes in terms of general satisfaction, growth satisfaction, internal motivation, stakeholder-rated performance, and self-reported performance than SDWTs in IS with low levels of cooperative learning.
4.4. Team development as a moderator

This research explores how team development affects the autonomy-work outcome relationship and the cooperative learning-work outcome relationship. Team development will be operationalized into three variables: mission clarity, team coordination, and team unity. Mission clarity refers to the whole of the group understanding what its purpose is. It is probably most similar to Tuckman’s [81] notions of forming and performing. Team coordination refers to how organized and efficient the group feels it is. It is probably most similar to forming and norming. Team unity refers to how well the group feels it works together in harmony. It is most closely related to the notions of storming and norming.

We predict that if a SDWT possesses higher levels of team development, the strength of the respective relationships between autonomy and work outcomes and between cooperative learning and work outcomes would be increased. In other words:

P3: The level of team development will have a moderating effect on the relationship between SDWT autonomy and SDWT work outcomes and between SDWT cooperative learning and SDWT work outcomes.

4.5. The effect of organizational climate

Within the literature on organizational climate, several dimensions have been offered [54, 55, 56, 57, 75] to have an effect on behavioral and work outcomes. In this research, rather than explicitly hypothesizing and testing for these effects, climate-related variables were chosen as control variables to account for the macro-level differences that might exist between the various organizations included in the study. Ultimately, any climate-related effects will be reported.

Although the choice of which climate dimensions to use may come down to an educated guess [35], it makes sense to focus on those dimensions which have empirically shown a relationship with performance, satisfaction, or motivation [54, 57, 72]. These studies used surveys that possess several similarities. The variables risk, reward, warmth, and support were chosen from the Litwin and Stringer instrument [57] since they were found to be common in at least two of the three instruments. Risk measures the orientation of the organization towards risk. Reward is a measure of how well the organization recognizes performance with rewards. Warmth is a measure of the friendliness of the atmosphere in the organization. Finally, support is a measure of the organization’s interest in the welfare of the employee.

![Conceptual research model](image-url)
4.6. The conceptual research model

Since all the research constructs have been operationalized into measurable variables and hypothetical relationships between them have been proposed, the following conceptual model is offered (see Fig. 1). From inspection of the model we note the proposed direct relationships between autonomy, cooperative learning, and organizational climate and work outcomes as well as the moderating relationship team development has between the independent and dependent variables. It is also evident how the general variables of interest, i.e., autonomy, etc., have been operationalized into lower-level measurable variables. Note that although the collection of measurable dimensions in the model is unique to this research, there are similarities in structure with several earlier studies [11, 29, 39, 54].

5. Research methodology

5.1. Research design

As alluded to earlier, the research methodology consisted of the administration of three survey instruments. Two surveys were administered to each member of the SDWTs, while a third survey was administered to SDWT stakeholders. For each team, the input from five stakeholders was sought. The responsibility for choosing the stakeholders was left up to the contact individual for each organization. The contact was advised to choose stakeholders that were familiar with the team and their work product, yet was not a member of the team. This was done to reduce the chance of biased responses from stakeholders that may have been team confederates.

5.2. Pilot survey administration

A pilot administration of the instruments was conducted to check reliability, readability, and the time required to complete the surveys. Five MBA teams working on field-based systems development projects and one four-year-old SDWT from industry were chosen for the pilot.

Readability of the items was satisfactory. Since every effort was made to keep the items and scale scores identical to that of the formats found in the original surveys, items had five-, six-, or seven-point Likert scales. To lessen the risk of error, warning notes were inserted in the surveys at the points at which the scale numbering changed. As a result of pilot subject comments, all item scale polarities were made uniform with a ‘1’ being an indication of a high or positive score. The revised instruments were tested on a new MBA team with favorable results.

With few exceptions, the survey responses indicated that the dimensions had reasonable reliability scores (as measured by Cronbach’s alpha) above 0.70, indicating an acceptable level of internal consistency [68]. Because the pilot sample was small (n=25), it was decided to keep all the items for the actual survey administration.

6. Analysis and interpretation of results

The research setting for this research consisted of IS organizations that had implemented SDWTs in systems development environments. An invitation to participate generated responses from 20 organizations. Follow-up phone interviews were conducted to describe the research and to determine if the teams met the requirements of SDWTs as defined for this research. This resulted in a final sample of 270 team members from 28 SDWTs belonging to 13 organizations across the US and Canada.

Usable surveys were received from 231 respondents (85.6%). In order for a team’s returned surveys to be considered usable, responses were required from at least three team members and at least three stakeholders. This helped to insure anonymity among respondents. At the team level, 27 sets of data were considered usable (96.4%), and was sufficient to provide statistical power to determine an effect size equal to one standard deviation of the distribution of dependent variables with a power=0.95 and α=0.05 [66]. Of the possible 140 stakeholders which could have provided performance feedback on the SDWTs, surveys were received from 114 (81.4%).

On average, the teams surveyed were 19.2 months old and consisted of 9.9 systems development professionals. The team members were highly-educated (over 75% with college degrees), highly-experienced (over 75% with more than five years of work experi-
ence), and had significant tenure in their organizations (over 75% had over three years’ experience in their respective companies). These are characteristics we might expect for knowledge workers which differ significantly from the characteristics of workers measured in previous SDWT research. Of the stakeholders that responded, 36.8% were in management, 51.9% were internal customers of the teams, 1.9% were external customers, and the remaining listed as ‘other’, e.g., non-team peers, suppliers, vendors, etc.

6.1. Testing the propositions

When working with both individual and team-level phenomena, it is important to exercise care in how data are grouped or aggregated. Consequently, prior to testing the propositions, a considerable amount of testing for scale and item validity, testing for the appropriateness of data reduction and aggregation, and factor analyses were performed. The results of this portion of research can be found in Appendix B.

The propositions and the model were analyzed using a combination of partial correlation analyses and linear regression techniques. Both an individual-level of analysis using a sample of \( n=231 \) and a team-level of analysis using a sample of \( n=27 \) was conducted. See Tables 1–3.

6.2. Autonomy and work outcomes

Using partial correlation to control for organizational climate, it was found that overall average autonomy correlated positively, although not particularly strongly, with all measures of work outcomes at

<table>
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<th>Measurement scale</th>
<th># of items</th>
<th>( n )</th>
<th>Mean</th>
<th>SD</th>
<th>( \alpha^b )</th>
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<td>0.77</td>
<td>0.90</td>
</tr>
<tr>
<td>Timeliness (stakeholder perf)</td>
<td>2</td>
<td>111</td>
<td>3.50</td>
<td>0.44</td>
<td>0.80</td>
</tr>
</tbody>
</table>

\(^a\) IS-related autonomy is included in general autonomy as well.  
\(^b\) [18].
the individual level of analysis thus supporting the first proposition (refer to Table 4). Surprisingly, IS-related autonomy was found to correlate less positively for most measures of work outcomes.

When the scores for the variables were averaged together within teams to obtain a team-level score, the resulting correlation values between autonomy and work outcomes generally decreased (and lost statistical significance due to smaller sample size). The correlation between IS-related autonomy and growth in fact became slightly negative ($r = -0.02; p = 0.46$). Overall, it appears that overall autonomy at the individual and team level, and IS-related autonomy at the individual level are closely related to feelings of positive growth from the job.

### 6.3. Cooperative learning and work outcomes

Like autonomy, the hypothesized relationship between cooperative learning and work outcomes was posited to correlate positively (again, refer to Table 4). At the individual level of analysis, the relationship between cooperative learning and work outcomes are statistically significant thus supporting the proposition. For the most part, the strength of the relationships between cooperative learning and work outcomes is stronger than those for autonomy and work outcomes. Of particular interest is the strength between cooperative learning and perceptions of team performance.

The proposition was also strongly supported when the scores for the variables were averaged together within teams to obtain a team-level score. In these cases, the correlations between cooperative learning and work outcomes became much stronger. Of special note are the high correlations between ‘team’ cooperative learning and job satisfaction and both measures of performance.

#### 6.4. The moderating effect of the level of team development

The existence of a moderating effect is most easily tested by measuring the significance of the product variable or interaction term using linear regression [3, 66]. In this case, the interaction terms of AUTONOMY × TEAM DEVELOPMENT and COOPERATIVE LEARNING × TEAM DEVELOPMENT were included in regression models and their levels of significance tested.

The following regression models were analyzed:

<table>
<thead>
<tr>
<th>Variable</th>
<th>$F$-ratio</th>
<th>$F$ probability</th>
<th>Intraclass correlation (ETA)</th>
<th>ETA$^2$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Autonomy</td>
<td>3.73</td>
<td>0.01</td>
<td>0.56</td>
<td>0.31</td>
</tr>
<tr>
<td>IS autonomy</td>
<td>2.62</td>
<td>0.00</td>
<td>0.52</td>
<td>0.27</td>
</tr>
<tr>
<td>Goal interdependence</td>
<td>3.02</td>
<td>0.00</td>
<td>0.54</td>
<td>0.29</td>
</tr>
<tr>
<td>Group process</td>
<td>4.71</td>
<td>0.00</td>
<td>0.62</td>
<td>0.39</td>
</tr>
<tr>
<td>Promotive interaction</td>
<td>2.50</td>
<td>0.00</td>
<td>0.50</td>
<td>0.25</td>
</tr>
<tr>
<td>Resource interdependence</td>
<td>2.65</td>
<td>0.00</td>
<td>0.51</td>
<td>0.26</td>
</tr>
<tr>
<td>Team mission</td>
<td>4.49</td>
<td>0.00</td>
<td>0.62</td>
<td>0.38</td>
</tr>
<tr>
<td>Team coordination</td>
<td>7.23</td>
<td>0.00</td>
<td>0.70</td>
<td>0.50</td>
</tr>
<tr>
<td>Team unity</td>
<td>9.18</td>
<td>0.00</td>
<td>0.74</td>
<td>0.55</td>
</tr>
<tr>
<td>Risk</td>
<td>3.67</td>
<td>0.00</td>
<td>0.58</td>
<td>0.33</td>
</tr>
<tr>
<td>Reward</td>
<td>2.06</td>
<td>0.00</td>
<td>0.47</td>
<td>0.22</td>
</tr>
<tr>
<td>Support</td>
<td>2.34</td>
<td>0.00</td>
<td>0.49</td>
<td>0.24</td>
</tr>
<tr>
<td>Warmth</td>
<td>1.57</td>
<td>0.04</td>
<td>0.42</td>
<td>0.18</td>
</tr>
<tr>
<td>Growth</td>
<td>2.18</td>
<td>0.00</td>
<td>0.48</td>
<td>0.23</td>
</tr>
<tr>
<td>Motivation</td>
<td>1.53</td>
<td>0.05</td>
<td>0.41</td>
<td>0.17</td>
</tr>
<tr>
<td>Satisfaction</td>
<td>2.66</td>
<td>0.00</td>
<td>0.51</td>
<td>0.26</td>
</tr>
<tr>
<td>Self-perception of performance</td>
<td>10.92</td>
<td>0.00</td>
<td>0.77</td>
<td>0.60</td>
</tr>
<tr>
<td>Effectiveness (stakeholder perfection)</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td>Efficiency (stakeholder perfection)</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td>Timeliness (stakeholder perfection)</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
</tr>
</tbody>
</table>
Table 3
Data reduction: factor analyses

Factor analysis for autonomy measures
Kaiser–Meyer–Olkin measure of sampling adequacy = 0.71
Bartlett test of sphericity = 282.64 – significance = 0.00

Factor analysis for cooperative learning measures
Kaiser–Meyer–Olkin measure of sampling adequacy = 0.76
Bartlett test of sphericity = 223.88 – significance = 0.00

<table>
<thead>
<tr>
<th>Variable</th>
<th>Factor</th>
<th>Eigenvalue</th>
<th>Pct of Var</th>
<th>Communality</th>
</tr>
</thead>
<tbody>
<tr>
<td>Goal interdependence</td>
<td>1</td>
<td>2.36</td>
<td>59.0</td>
<td>0.67</td>
</tr>
<tr>
<td>Group process</td>
<td>2</td>
<td>0.68</td>
<td>17.1</td>
<td>0.51</td>
</tr>
<tr>
<td>Promotive interaction</td>
<td>3</td>
<td>0.52</td>
<td>13.1</td>
<td>0.60</td>
</tr>
<tr>
<td>Resource interdependence</td>
<td>4</td>
<td>0.43</td>
<td>10.9</td>
<td>0.58</td>
</tr>
</tbody>
</table>

Factor analysis for organizational climate measures
Kaiser–Meyer–Olkin measure of sampling adequacy = 0.72
Bartlett test of sphericity = 339.86 – significance = 0.00

<table>
<thead>
<tr>
<th>Variable</th>
<th>Factor</th>
<th>Eigenvalue</th>
<th>Pct of Var</th>
<th>Communality</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reward</td>
<td>1</td>
<td>2.50</td>
<td>62.6</td>
<td>0.74</td>
</tr>
<tr>
<td>Risk</td>
<td>2</td>
<td>0.844</td>
<td>21.1</td>
<td>0.30</td>
</tr>
<tr>
<td>Support</td>
<td>3</td>
<td>0.39</td>
<td>9.7</td>
<td>0.82</td>
</tr>
<tr>
<td>Warmth</td>
<td>4</td>
<td>0.26</td>
<td>6.6</td>
<td>0.65</td>
</tr>
</tbody>
</table>

Factor analysis for team development measures
Kaiser–Meyer–Olkin measure of sampling adequacy = 0.72
Bartlett test of sphericity = 286.28 – significance = 0.00

<table>
<thead>
<tr>
<th>Variable</th>
<th>Factor</th>
<th>Eigenvalue</th>
<th>Pct of Var</th>
<th>Communality</th>
</tr>
</thead>
<tbody>
<tr>
<td>Team mission</td>
<td>1</td>
<td>2.30</td>
<td>76.5</td>
<td>0.73</td>
</tr>
<tr>
<td>Team coordination</td>
<td>2</td>
<td>0.40</td>
<td>3.4</td>
<td>0.80</td>
</tr>
<tr>
<td>Team unity</td>
<td>3</td>
<td>0.30</td>
<td>0.1</td>
<td>0.76</td>
</tr>
</tbody>
</table>

Factor analysis for stakeholder performance measures
Kaiser–Meyer–Olkin measure of sampling adequacy = 0.68
Bartlett test of sphericity = 542.10 – significance = 0.00

<table>
<thead>
<tr>
<th>Variable</th>
<th>Factor</th>
<th>Eigenvalue</th>
<th>Pct of Var</th>
<th>Communality</th>
</tr>
</thead>
<tbody>
<tr>
<td>Effectiveness</td>
<td>1</td>
<td>2.57</td>
<td>85.7</td>
<td>0.93</td>
</tr>
<tr>
<td>Efficiency</td>
<td>2</td>
<td>0.32</td>
<td>10.7</td>
<td>0.81</td>
</tr>
<tr>
<td>Timeliness</td>
<td>3</td>
<td>0.11</td>
<td>3.7</td>
<td>0.83</td>
</tr>
</tbody>
</table>

Table 4
Partial correlations – Autonomy/IS autonomy and work outcomes

<table>
<thead>
<tr>
<th></th>
<th>Growth</th>
<th>Motivation</th>
<th>Satisfaction</th>
<th>Self-perfection</th>
<th>Stakeholder perfection</th>
</tr>
</thead>
<tbody>
<tr>
<td>Autonomy</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Individual</td>
<td>0.33(0.00)</td>
<td>0.22(0.00)</td>
<td>0.15(0.01)</td>
<td>0.23(0.00)</td>
<td>0.14(0.02)</td>
</tr>
<tr>
<td>Team</td>
<td>0.10(0.62)</td>
<td>0.23(0.26)</td>
<td>0.17(0.41)</td>
<td>0.17(0.40)</td>
<td>0.18(0.38)</td>
</tr>
<tr>
<td>IS autonomy</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Individual</td>
<td>0.31(0.00)</td>
<td>0.16(0.01)</td>
<td>0.14(0.02)</td>
<td>0.27(0.00)</td>
<td>0.13(0.03)</td>
</tr>
<tr>
<td>Team</td>
<td>-0.02(0.93)</td>
<td>0.12(0.56)</td>
<td>0.20(0.31)</td>
<td>0.24(0.23)</td>
<td>0.16(0.42)</td>
</tr>
<tr>
<td>Cooperative learning</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Individual</td>
<td>0.33(0.00)</td>
<td>0.28(0.00)</td>
<td>0.34(0.00)</td>
<td>0.56(0.00)</td>
<td>0.38(0.00)</td>
</tr>
<tr>
<td>Team</td>
<td>0.54(0.00)</td>
<td>0.44(0.02)</td>
<td>0.62(0.00)</td>
<td>0.62(0.00)</td>
<td>0.64(0.00)</td>
</tr>
</tbody>
</table>
Autonomy model

\[ Y_i = \beta_0 + \beta_1 X_{AUT} + \beta_2 X_{TD} + \beta_3 X_{OC} \\
+ \beta_4 X_{AUT} X_{TD} + \varepsilon_i \]

Cooperative learning model

\[ Y_i = \beta_0 + \beta_1 X_{CL} + \beta_2 X_{TD} + \beta_3 X_{OC} \\
+ \beta_4 X_{CL} X_{TD} + \varepsilon_i \]

where \( Y_i \) is the value of the dependent variable of interest in the \( i \)th trial, \( \beta_0, \beta_1, \ldots, \beta_8 \) the unknown parameters, \( X_{OC, CL, AUT, TD} \) the values of the independent variable of interest (i.e., organizational climate, level of cooperative learning, level of autonomy, and team development), and \( \varepsilon_i \) a normally distributed random error for \( i=1, 2, \ldots, n \).

Since there was significant evidence of intracorrelation within teams which suggests a lack of independence between individual subjects, the regression analyses for all models was performed on individual-level data \( (n=231) \), as well as aggregated team-level data \( (n=27) \).

6.4.1. Validity of regression assumptions

Since regression analysis is predicated on assumptions pertaining to normality and equality of variance, independence of observations, the existence of a linear relationship between independent and dependent variables, and the normal distribution of independent, random error terms [67], the regression results were inspected to insur that no significant deviations from these assumptions existed. In addition, the existence and degree of multicollinearity between the independent variables were ascertained.

Multicollinearity among the independent variables was investigated by examining the intercorrelations between the models’ independent variables and by conducting an analysis of each variable’s variance inflation factor (VIF) as well as the models’ mean VIF values [66]. See Table 5 for intercorrelation matrices for the individual and team-level unit of analysis, and Tables 6 and 7 for VIF data.

The intercorrelation and VIF analyses suggest that multicollinearity could impact the model. Consequently, following from Cohen and Cohen [15], the following strategy was adopted in the regression analyses:

- Organizational climate, an exogenous control variable, was entered into the model analyses first, followed by the remaining independent variables.
- The independent variables were entered and analyzed in a cumulative fashion. That is, all independent variables were entered into their respective models and interpreted in terms of their ‘partial’ relationship with the dependent variable of interest, given the existence of relationships with the other independent variables. They were entered in a stepwise fashion in which the most influential independent variables were entered first followed by the less influential variables.
Proposition 3 was tested with the autonomy model presented earlier. The autonomy model was tested both with individual-level data as well as team-level data with the organizational climate variable entered first as control variable with the autonomy, team development and the AUTONOMY×TEAM DEVELOPMENT interaction term entered in a stepwise fashion. Proposition 3 for autonomy is supported if the interaction term is statistically significant. Table 6 displays the regression results for both these levels of analysis.

The support for the moderating effect of team development on the autonomy-work outcome relationship was weak with only three of 10 analyses showing significance of the interaction term. It appears that the influence of team development was underestimated since seven of the 10 analyses revealed significant team development main effects. In none of the regression analyses did autonomy display the regression results for both these levels of analysis.

### Table 6
Autonomy model regression parameters

<table>
<thead>
<tr>
<th>Independent variables</th>
<th>Growth</th>
<th>Motivation</th>
<th>Satisfaction</th>
<th>Self-performance</th>
<th>Stakeholder perfection</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Individual</td>
<td>Team</td>
<td>Individual</td>
<td>Team</td>
<td>Individual</td>
</tr>
<tr>
<td>Autonomy ($\beta$)</td>
<td>0.00</td>
<td>-0.03</td>
<td>0.01</td>
<td>-0.20</td>
<td>0.02</td>
</tr>
<tr>
<td>Team development</td>
<td>-0.12</td>
<td>0.55 $^b$</td>
<td>-0.19</td>
<td>0.07</td>
<td>0.47 $^b$</td>
</tr>
<tr>
<td>Organizational climate</td>
<td>0.16 $^b$</td>
<td>0.13</td>
<td>0.02</td>
<td>0.03</td>
<td>0.28 $^b$</td>
</tr>
<tr>
<td>Autonomy×Team deviation</td>
<td>0.50 $^b$</td>
<td>0.02</td>
<td>0.35 $^b$</td>
<td>0.51 $^b$</td>
<td>0.09</td>
</tr>
<tr>
<td>$R^2$</td>
<td>0.34</td>
<td>0.36</td>
<td>0.13</td>
<td>0.27</td>
<td>0.41</td>
</tr>
<tr>
<td>Adj. $R^2$</td>
<td>0.34</td>
<td>0.31</td>
<td>0.12</td>
<td>0.21</td>
<td>0.41</td>
</tr>
<tr>
<td>$F$-value</td>
<td>59.0</td>
<td>7.4</td>
<td>16.8</td>
<td>4.8</td>
<td>79.9</td>
</tr>
<tr>
<td>Prob&gt;F</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.02</td>
<td>0.00</td>
</tr>
<tr>
<td>Mean VIF</td>
<td>2.3</td>
<td>2.0</td>
<td>2.3</td>
<td>2.2</td>
<td>2.0</td>
</tr>
</tbody>
</table>

Note: Individual $n=231$; Team $n=27$.

$^a p<0.05$.

$^b p<0.01$.

### Table 7
Cooperative learning regression model

<table>
<thead>
<tr>
<th>Independent variables</th>
<th>Growth</th>
<th>Motivation</th>
<th>Satisfaction</th>
<th>Self-performance</th>
<th>Stakeholder perfection</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Individual</td>
<td>Team</td>
<td>Individual</td>
<td>Team</td>
<td>Individual</td>
</tr>
<tr>
<td>Cooperative learning ($\beta$)</td>
<td>0.00</td>
<td>0.10</td>
<td>0.30 $^b$</td>
<td>0.07</td>
<td>0.05</td>
</tr>
<tr>
<td>Team development</td>
<td>0.05</td>
<td>-0.38</td>
<td>0.07</td>
<td>-0.63</td>
<td>0.47 $^b$</td>
</tr>
<tr>
<td>Organizational climate</td>
<td>0.19 $^b$</td>
<td>0.11</td>
<td>0.05</td>
<td>0.08</td>
<td>0.28 $^b$</td>
</tr>
<tr>
<td>Cooperative learning×</td>
<td>0.41 $^b$</td>
<td>0.60 $^b$</td>
<td>0.17</td>
<td>0.50 $^b$</td>
<td>0.16</td>
</tr>
<tr>
<td>Team deviation</td>
<td>$R^2$</td>
<td>0.28</td>
<td>0.41</td>
<td>0.11</td>
<td>0.28</td>
</tr>
<tr>
<td>Adj. $R^2$</td>
<td>0.27</td>
<td>0.36</td>
<td>0.10</td>
<td>0.22</td>
<td>0.41</td>
</tr>
<tr>
<td>$F$-value</td>
<td>44.1</td>
<td>9.0</td>
<td>13.9</td>
<td>5.0</td>
<td>80.0</td>
</tr>
<tr>
<td>Prob&gt;F</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.01</td>
<td>0.00</td>
</tr>
<tr>
<td>Mean VIF</td>
<td>4.0</td>
<td>6.0</td>
<td>2.2</td>
<td>6.0</td>
<td>2.0</td>
</tr>
</tbody>
</table>

Note: Individual $n=231$; Team $n=27$.

$^a p<0.05$.

$^b p<0.01$. 

### 6.4.2. Autonomy model

Proposition 3 was tested with the autonomy model presented earlier. The autonomy model was tested both with individual-level data as well as team-level data with the organizational climate variable entered first as control variable with the autonomy, team development and the AUTONOMY×TEAM DEVELOPMENT interaction term entered in a stepwise fashion. Proposition 3 for autonomy is supported if the interaction term is statistically significant. Table 6 displays the regression results for both these levels of analysis.

The support for the moderating effect of team development on the autonomy-work outcome relationship was weak with only three of 10 analyses showing significance of the interaction term. It appears that the influence of team development was underestimated since seven of the 10 analyses revealed significant team development main effects. In none of the regression analyses did autonomy...
contribute significantly in explaining model variance. This is a result of the marginal variance being explained by other first-order variables and the interaction term.

6.4.3. Cooperative learning model

Proposition 3 was also tested with the cooperative learning model presented earlier with individual-level data as well as team-level data with the organizational climate variable entered first as control variable with the cooperative learning, team development, and the COOPERATIVE LEARNING×TEAM DEVELOPMENT interaction term entered in a stepwise fashion. As with the autonomy model, proposition 3 for cooperative learning is supported if the interaction term is statistically significant. Table 7 displays the regression results for both these levels of analysis.

Some support for the proposition was found with six of 10 independent–dependent relationships being moderated by team development. As with the autonomy model, perhaps the effect of team development was underestimated since it had a main effect on three of 10 relationships.

6.5. Summary of findings

All propositions relating to the correlation between the independent variables of autonomy and cooperative learning and the dependent work outcome variables were supported. The propositions suggesting that team development has a moderating effect between the independent and dependent variables were partially supported, depending on the particular work outcome variable in question. In general, it can be said that in those cases where team development did not moderate the independent–dependent relationship, it had a stronger main effect.

7. Discussion

The research presented here was designed to investigate the phenomena of SDWTs of highly-skilled knowledge workers in the information systems industry, a category of workers which is becoming increasingly important in a previously unresearched context.

7.1. Expected findings

As expected, both autonomy and cooperative learning were found to be positively correlated with job satisfaction, growth satisfaction, levels of motivation on the job, self-perceptions of performance, and the perceptions of performance of those external to the team. In the case of autonomy, the correlations were statistically significant at the individual level only, while for cooperative learning, the correlations were significant for both the individual and team-level of analysis. These findings completely supported the first two propositions.

There was moderate support for propositions 3 and 4 suggesting that along some dimensions, the level of team development does indeed moderate the relationships between autonomy and work outcomes and cooperative learning and work outcomes.

7.2. Unexpected findings

The strength of the relationship between cooperative learning and work outcomes was found to be much stronger than those between autonomy and work outcomes. Although the relative strength of the relationships was not hypothesized, given that the defining characteristic of the teams under study was their level of autonomy, it was surprising to find that cooperative learning eclipsed autonomy as a positive correlate of team outcomes. Of particular interest was the strength between cooperative learning and job satisfaction and perceptions of team performance (both self and stakeholder perceptions). Perhaps, the fact that cooperative learning is in essence a team-level phenomena helps in explaining the strength of its correlation with team-level performance.

The strength of the team development-work outcome relationships was also unexpected. In many cases, team development had statistically significant main effects rather than the hypothesized moderating effect. In other words, the level of team development
seemed to have a direct effect on work outcomes rather than having a more minor secondary effect (measured as an effect only on the relationship between team characteristics and work outcomes).

The negative correlation between IS autonomy and work outcomes at the team level perhaps supports the notion that autonomy on SDWTs has a smaller impact one might originally think. This argument suggests that perhaps the autonomy inherent in SDWTs represents only a marginal increase in the autonomy that knowledge workers (like the IS workers studied here) have come to expect, or worse, the structure and role expectations of the SDWT represents a decrease in autonomy that IS workers value (i.e., the myth of self-leadership as discussed by Manz and Angle [59] and Manz [58]).

7.3. Limitations of the research

Much of the research presented here is exploratory in nature, and as such is not perfectly conceptualized. Future research in this area should seek to clarify and refine further operationalization of constructs like autonomy and cooperative learning.

Second, although the size of the research sample was chosen to provide an adequate level of statistical power, it should be pointed out that the research presented here is based on the statistical inferences derived from a finite sample of research subjects.

Third, although attempts were made to secure objective, quantitative data, the data on which the findings were based were perceptual in nature; the perceptions of team members and external stakeholders.

Fourth, the research presented here is cross-sectional versus longitudinal in nature; Consequently, causality can not and should not be inferred from the relationships discussed here.

Finally, the research presented here is concerned with SDWTs within IS organizations involved in systems development activities across a wide variety of industries. Organizational climate has been measured as a control variable to control for variance across industries. As such, the generalizability of the research findings is limited to other self-directed systems development teams in IS organizations. Care must be taken if one attempts to generalize to SDWTs of knowledge workers in general.

7.4. Implications of the research

The importance of autonomy as supported in this research adds strength to the existing theory bases relating to self-regulation and autonomy. The positive relationship between autonomy and affective work outcomes suggests that increased autonomy in SDWTs may improve the satisfaction and motivation levels of IS workers. These findings are consistent with the fundamental tenets of sociotechnical systems theory [13, 20] as well as the ETHICS approach [64, 65]. This positive relationship also contributes to our understanding of what may make SDWTs more inherently satisfying. Since most SDWT studies in the past have shown only modest improvements in satisfaction levels [34], the statistically significant positive relationships presented here corroborates earlier propositions that suggest that the autonomy inherent in SDWTs may be especially well-suited for knowledge workers like those found in the IS profession [64].

The positive relationship between level of autonomy and perceptions of performance is consistent with much of the literature from practice [69], sociotechnical systems theory [20], and existing SDWT research [16, 34] and suggests that SDWTs may in fact be worthwhile interventions for IS organizations to consider.

The support found for the importance of cooperative learning in SDWTs is important for several reasons. First, the findings are consistent with earlier findings that suggest mechanisms like team coordination and ‘collective mind’ may be beneficial for ISD activities [19]. Second, the findings are consistent with the already large body of research on cooperative learning, and extend cooperative learning theory to the workplace – a much different context from the classroom. Due to the dearth of literature investigating cooperative learning in SDWTs and in business settings, these findings should be considered a contribution to both theory and practice since they illuminate some of the underlying group mechanisms that contribute to SDWT performance. Furthermore, given the recent emphasis on the importance of the ‘learning organization’ to improved organizational effectiveness [77], the findings offered here constitute empirical support.

The importance of team development as an independent variable in team research was also found.
These findings contribute to the literature on SDWTs that currently has little to say about the importance of team development.

Finally, we propose that this research has extended SDWT research into the IS arena, which, by association extends it into the area of knowledge work. This is needed research, given the context-sensitive nature of teams [62, 79].

7.5. Implications for managerial practice

Although the research presented here does not posit a causal relationship, it does appear that providing more autonomy is coincident with improved team performance. More importantly, it appears that it would be prudent for management to stress the importance of and provide ample opportunity for cooperative learning while teams address their typical work objectives. In addition, these opportunities for cooperative learning can be strengthened by instilling a sense of interdependence in all that the team does. By developing a large percentage of team-level objectives and by insuring that team members are responsible for backing each other up, the level of interdependence can be increased. Furthermore, the fact that this learning should be cooperative in nature – that is, performed within the team through cross-training – addresses the increasing pressures to reduce training budgets for off-site or out-of-team training.

Finally, the importance of team development should be considered by managers. The research here suggests that it is important to provide adequate time for teams to develop into mature, high-functioning teams. SDWTs can not be viewed as a quick fix or as a temporary management initiative. A long-term commitment is necessary if teams are to attain the level of maturity and comfort necessary to exercise the autonomy given to them.

7.6. Future research directions

There are several avenues that could be pursued for follow-on research. An understanding of the causal relationships between autonomy, cooperative learning, and work outcomes would be useful and could be gained through research employing a time-series or pre/post-treatment design.

This research suggested that thinking of autonomy as a multi-dimensional construct appears to be a meaningful way to think about autonomy. Further research needs to be undertaken to strengthen the internal validity of context-specific autonomy subtypes.

Finally, more research needs to be conducted in order to better understand the phenomena of cooperative learning in the workplace. As the research findings suggest here, cooperative learning may provide a significant amount of employee satisfaction and performance – a true win–win proposition in these times of radical business change.

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Appendix A

Survey items – independent variables

Autonomy – general autonomy (source: adapted from Beyerlein, et al. 1993)

1. Identify product or service problems.
2. Fire members of the team.
3. Determine compensation plans for the team.
4. Develop budgets.
5. Maintain contact with customers.
6. Plan the team’s work.
7. Conduct peer evaluations.
8. Suggest new product or service ideas.
9. Set team goals or objectives.
10. Solve product or service problems.
11. Determine the team’s training needs.
12. Recruit/hire team members.
13. Handle discipline problems on the team.
14. Monitor product or service quality.
15. Schedule the team’s work.

Autonomy – IS-related autonomy (source: personally developed)

1. Develop system and end-user documentation.
2. Specify which development tools will be used by the team.
3. Determine appropriate system quality and assurance (i.e., testing) procedures.
4. Determine information and application requirements.
5. Specify which development methods will be used by the team.

**Cooperative learning – goal interdependence** (source: Johnson, et al. 1988)

1. When we work together on our team, we try to make sure everyone on the team learns from each other.
2. When we work together as a team, our job is not finished until everyone on the team has finished his or her job.
3. When we work together on the team, we all receive the same performance evaluation.
4. When we work together on the team, our performance evaluations depend in part on how much all members learn.
5. When we work together on the team, I have to make sure the other members of the team learn if I want to do well on the project.

**Cooperative learning – resource interdependence** (source: Johnson, et al. 1988)

1. When we work together on our team, we cannot complete a project unless everyone contributes.
2. When we work together on our team, the work is divided up so that everyone has a part and everyone has to share.
3. When we work together on the team, we have to share work material in order to complete the project.
4. When we work together on the team, everyone’s ideas are needed if we are going to be successful.
5. When we work together on the team, I have to find out what everyone else knows if I am going to be able to complete my part of the project.

**Cooperative learning – promotive interaction** (source: Johnson, et al. 1988)

1. On this team I like to share my ideas and work material with other members of the team.
2. On this team I can learn important things from other team members.
3. On this team I like to help my teammates learn.
4. On this team I like to share my ideas and work materials with my teammates when I think it will help them.
5. On this team it is a good idea for teammates to help each other learn.
6. On this team I like to cooperate with my teammates.
7. Members of my team learn a lot of important things from each other.

**Cooperative learning – group process** (source: Camp-bell and Hallam, 1994)\(^1\)

1. We take the time as a team to examine areas in which we need more skill or experience.
2. We rarely stop to consider how we can work better as a team.
3. We have recently discussed what we did right or wrong on a particular project or job.

**Organizational climate – risk** (source: Litwin and Stringer, 1968)

1. Decision making in this Organization is too cautious for maximum effectiveness.
2. Our management is willing to take a chance on a good idea.
3. Our business has been built up by taking calculated risks at the right time.
4. The philosophy of our management is that in the long run we get ahead fastest by playing it slow, safe, and sure.
5. We have to take some pretty big risks occasionally to keep ahead of the competition in the business we’re in.

**Organizational climate – reward** (source: Litwin and Stringer, 1968)

1. There is not enough reward and recognition given in this Organization for doing good work.
2. There is a great deal of criticism in this Organization.
3. In this Organization people are rewarded in proportion to the excellence of their job performance.
4. We have a promotion system here that helps the best person to rise to the top.

\(^1\)Survey items used with permission from one of the authors.
5. In this Organization the rewards and encourage-
ments you get usually outweigh the threats and the
criticism.
6. If you make a mistake in this Organization you will
be punished.

Organizational climate – warmth (source: Litwin and
Stringer, 1968)
1. A friendly atmosphere prevails among the people
in this Organization.
2. It is very hard to get to know people in this
Organization.
3. This Organization is characterized by a relaxed,
easy-going working climate.
4. There is a lot of warmth in the relationships
between management and workers in this Organi-
zation.
5. People in this Organization tend to be cool and
aloof toward each other.

Organizational climate – support (source: Litwin and
Stringer, 1968)
1. The philosophy of our management emphasizes
the human factor, how people feel, etc.
2. Management makes an effort to talk with you about
your career aspirations within the Organization.
3. When I am on a difficult assignment I can usually
count on getting assistance from my boss and co-
workers.
4. People in this Organization don’t really trust each
other enough.
5. You do not get much sympathy from higher-ups in
this Organization if you make a mistake.

Team development – mission clarity (source: Campbell
and Hallam, 1994)
1. We have a clear overall team purpose.
2. The team leader has a clear vision of where we are
going as a team.
3. I am not sure what we are trying to accomplish as a
team.
4. We have a time schedule for achieving our team
goals.

Team development – team coordination (source: Camp-
bell and Hallam, 1994)
1. Our team meetings are well organized.
2. We have a difficult time reaching decisions.
3. We often do not know who is responsible for
important tasks.
4. Team members anticipate what they will need from
me and tell me so I can plan ahead.

Team development – team unity (source: Campbell and
Hallam, 1994)
1. This team often laughs together.
2. When we disagree, we usually work out our differ-
ences in an honest, healthy way.
3. Team members offer help when I need it.
4. Voicing disagreement on this team is risky.
5. Team members compete with each other rather
than cooperate.

A.1 Survey items – dependent variables
SDWT Performance – general satisfaction (source:
Hackman and Oldham, 1980)
1. Generally speaking, I am very satisfied with this
job.
2. I frequently think of quitting this job.
3. I am generally satisfied with the kind of work I do
in this job.
4. Most people doing this job are very satisfied with
the job.
5. People doing this job often think of quitting.

SDWT performance – growth satisfaction (source:
Hackman and Oldham, 1980)
1. The amount of personal growth and development I
get from doing my job.
2. The feeling of worthwhile accomplishment I get
from doing my job.
3. The amount of independent thought and action I
can exercise in my job.
4. The amount of challenge in my job.

SDWT performance – internal motivation (source:
Hackman and Oldham, 1980)
1. My opinion of myself goes up when I do this job
well.
2. I feel a great sense of personal satisfaction when I
do this job well.
3. I feel bad and unhappy when I discover that I have
performed poorly on this job.
4. My own feelings generally are not affected much
one way or the other by how well I do on this job.
5. Most people doing this job feel a great sense of personal satisfaction when they do the job well.
6. Most people doing this job feel bad or unhappy when they find that they have performed the work poorly.

**SDWT performance – self-perception of performance**
*(source: Campbell and Hallam, 1994)*

1. Reports on our performance are favorable.
2. We are meeting our team objectives.
3. Our work is high quality.
4. So far, our team has been a great success.

**SDWT performance – stakeholder perception of effectiveness**
*(source: Henderson and Lee, 1992)*

1. Effectiveness of the team’s interactions with people outside the team.
2. The quality of work the team produces.
3. The team’s ability to meet the goals of the project.

**SDWT performance – stakeholder perception of efficiency**
*(source: Henderson and Lee, 1992)*

1. The efficiency of team operations.
2. The team’s adherence to budgets.
3. The amount of work the team produces.

**SDWT performance – stakeholder perception of time-liness**
*(source: Henderson and Lee, 1992)*

1. Most people doing this job feel a great sense of personal satisfaction when they do the job well.
2. The team’s adherence to schedules.
3. The team could have done its work faster with the same level of quality.
4. The team met the goals as quickly as possible.

**Appendix B**

**Data reliability, validity, and reduction**

In addition to the pilot analysis, a second analysis of reliability was conducted in order to determine if any of the items within the scales had the potential to contribute problematic results. High correlations within each scale suggested that the items could be averaged to arrive at a composite measure for each scale. This type of data reduction is common in research on groups [11]. Table 1 provides a listing of the scales measured in the surveys and the corresponding descriptive statistics for each scale.

As a generally accepted guideline, pre-validated instruments should have Cronbach’s alpha values of at least 0.7, while non-validated items should have alpha values of at least 0.6 [68]. Table 1 provides an overview of reliabilities for each scale as measured by Cronbach’s alpha. With few exceptions, the results suggest that the validated scales used in survey instruments were acceptable.

For statistical analysis, individual responses were averaged together to form composite team measures for each team. In cases like this, it is important to understand the level of agreement by respondents within teams before the validity of a team measure is accepted.

Much has been offered when considering the aggregation of survey measures [30, 31, 46, 83]. The majority of the measures used here were sufficiently explicit in informing the respondents that they were to supply team-level information. In these cases, aggregation is appropriate [83]. In those cases where individual-level phenomena were aggregated to arrive at a team-level measure (e.g., individual satisfaction aggregated to arrive at a measure of ‘team satisfaction’), the aggregation issue is more pertinent. Glick [30, 31] suggests that intraclass correlations should exceed 0.60 before aggregation is appropriate. Georgopoulos [26] suggests that data should possess an $\eta^2$ (the square of the intraclass correlation) of at least 0.16 and an $F$-ratio greater than 1.0 (with $p<0.05$) suggesting that the team shares a level of agreement which is statistically greater than individuals across teams, and as such, signifies that a team-level effect is operative [15].

Intraclass statistics were calculated for each scale, and are presented in Table 2. Every scale surpasses Georgopoulos’ criteria for aggregation, while many surpass Glick’s. Since the results were not extremely strong either way, and since the sample size of teams was not large ($n=27$), research propositions were tested using both the individual and the team as the unit of analysis.

**B.1 Data reduction through factor analysis**

Exploratory factor analyses were performed on the independent variables in Table 1 in order to determine if the composite variables could be further reduced.
into global constructs (see Table 3). Factors were extracted utilizing principal components analysis without rotation since ideally we were looking for a reduction to one underlying factor. Eigenvalues greater than 1.0 were considered the cut-off for viable factors extracted in the factor analysis. The Kaiser–Meyer–Olkin (KMO) measure of sampling adequacy [67] was employed to determine the applicability of factor analysis. Small KMO values (under 0.5) suggest that a factor analysis of the variables in question may not be appropriate since correlations between pairs of variables cannot be explained by the other variables. Bartlett’s test of sphericity [67] was used to test the hypothesis that the correlation matrix was an identity matrix (i.e., no common factors exist).

The KMO and Bartlett test values suggested that factor analyses were appropriate for all composite variables. In all cases, the principal components analysis resulted in the extraction of a main factor for all composite variables suggesting the appropriateness of using consolidated measures. As a result of the low intercorrelations, the low communality, and the marginal level of reliability, it was decided to drop the risk factor analysis. Small KMO values (under 0.5) suggest that a factor analysis of the variables in question may not be appropriate since correlations between pairs of variables cannot be explained by the other variables. Bartlett’s test of sphericity [67] was used to test the hypothesis that the correlation matrix was an identity matrix (i.e., no common factors exist).

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Brian D. Janz is an Assistant Professor of MIS at the Fogelman College of Business and Economics at The University of Memphis where he teaches in the undergraduate, MBA, and Executive MBA programs. In addition, he is the Associate Director of the FedEx Center for Cycle Time Research at the University of Memphis. Prior to receiving his Ph.D. in Management Information Systems from the Carlson School of Management at The University of Minnesota in 1995, Dr. Janz spent 12 years in the information systems field working for Fortune 100 companies. Dr. Janz’s research interests focus on how information technologies affect organizational strategy, design, and knowledge worker behavior. Specifically, he is interested in the effects that self-direction, cooperation, and organizational learning have on teams of IS system development professionals, development cycle time and systems quality.