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# Factors influencing the performance of activity based costing teams: a field study of ABC model development time in the automobile industry☆

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**Abstract**

This paper examines how the group dynamics of activity based costing (ABC) development teams and the level of organizational resources devoted to model development affect model complexity and development time. A theoretical framework is developed based on the organizational literature on teams. The framework is tested using objective data from 18 ABC projects in two automobile manufacturing firms and survey data from ABC team members. Results show that ABC team cohesion is the key determinant of the time it takes to develop the first ABC model. Further, ABC models become more complex in the presence of an external consultant and as the level of competition increases.


## 1. Introduction

Satisfaction with, and acceptance of, activity based costing (ABC) systems has been mixed (Cooper, Kaplan, Maisel, Morrissey, & Oehm, 1992; Ness & Cuccuzza, 1995) and the process of implementation has been implicated in these results. Research on the determinants of ABC system implementation effectiveness has identified contextual and implementation process factors that correlate with evaluations of the ABC system (Anderson, 1995; Anderson & Young, 1999; Foster & Swenson, 1997; Gosselin, 1997; Shields, 1995; Swenson, 1995). These studies define factors that relate the ABC implementation initiative to the broader organization. For example, Foster and Swenson (1997) and Shields (1995) examine whether the initiative is perceived to have top management support, and whether users believe there are benefits associated with adopting ABC.

An aspect of ABC implementation that researchers have neglected is the process of designing the ABC model—i.e. the resources, activities and cost drivers that are the "economic map" of the organization (Kaplan & Cooper, 1998, p. 79). Studies have investigated the structure of ABC models that emerge from the design process (e.g. Noreen & Soderstrom, 1994) but have not explored how group processes that culminate in a particular model design affect the ABC implementation project outcomes. Failure to consider these issues is particularly incongruous with early writings on ABC implementation (Beaujon

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& Singhal, 1990; Cooper, 1990; Eiler & Campi, 1990; Haedicke & Feil, 1991; Jones, 1991). These studies, and recent research on teams in the organizational literature (Cohen & Bailey, 1997), focused on the composition, training and group dynamics of the ABC development team. Since organizations have begun to rely on teams as a significant form of organizing work, gaining more insight about the inner workings of teams has assumed a high level of importance for researchers and practitioners.

The objective of this paper is to provide more understanding about how the external environment, team processes and team dynamics affect ABC team performance. We develop the general framework from the literature. We use pre-study interviews to develop operational measures of key constructs and test the hypotheses derived from the framework using survey data from team members.[1] Then we test the hypotheses using objective data about the ABC projects and survey data from ABC developers from 18 ABC teams in two US auto manufacturers (which we refer to as Company A and Company B).[2]

Our findings suggest that a key benefit of ABC training for team members is that it strongly influences the perceived significance of the task of developing the first ABC model, as does the perceived level of competition each plant faces. As perceptions of task significance and the ability to resolve team conflicts increase, so does the level of team cohesion. Three factors affect ABC model complexity: the presence of an external ABC consultant, the level of external competition and the ability to resolve team conflicts. Finally, while the degree of model complexity does not significantly affect the time to complete the model, a higher level of team cohesion leads to faster development of the first ABC model.

The paper is organized into five sections. Section 2 reviews the organizational literature on development teams and the literature on ABC implementation to develop the theoretical framework of the study. Section 3 describes the research method, data collection and variable measurement. Section 4 presents the results of hypothesis testing. The implications of these findings are discussed in Section 5.

## 2. A framework for studying ABC development teams

Approximately 68% of the Fortune 1000 firms use self-managed teams as a work unit to perform many types of organizational tasks (Lawler, Mohrman, & Ledford, 1995). The high incidence of the use of teams has generated a significant amount of research in the organizational studies literature (Bettenhausen, 1991; Galbraith & Lawler, 1993; Guzzo & Shea, 1992; Katzenbach & Smith, 1993; Mohrman, Cohen, & Mohrman, 1995). Some research has also been conducted within management accounting although the focus has centered on workgroups performing routine tasks (Drake, Haka, & Ravenscroft, 1999; Young, Fisher, & Lindquist, 1993; Young & Selto, 1993). Typically, workgroups perform production tasks in manufacturing settings (Safizadeh, 1991). However, implementing management innovations (such as ABC) usually involves project and development teams (Cohen, 1993). Unlike workgroups, project and development teams are cross-functional; comprised of engineers, cost analysts, designers, operators, functional managers and others who together perform non-routine tasks. By including a diverse set of perspectives, development teams have the potential to generate new ideas or derive novel solutions to vexing problems. This research extends previous studies on team performance in management accounting contexts to development teams.

The framework that we employ is derived from the literature on group dynamics (e.g. Lewin, 1943), previous research on ABC implementation (Anderson, 1995; Anderson & Young, 1999; Foster & Swenson, 1997; Shields, 1995) and pre-study

[1] Data were collected from a different group of respondents from those interviewed in the pre-study phase.

[2] In total, we studied 21 ABC projects. Three sites were excluded from this study. Two were excluded because they include significant non-manufacturing activities. The nature of the production process is quite different and consequently it is not valid to compare the model structure of these sites with the others. Similarly, the other site is excluded because it included an assembly plant.

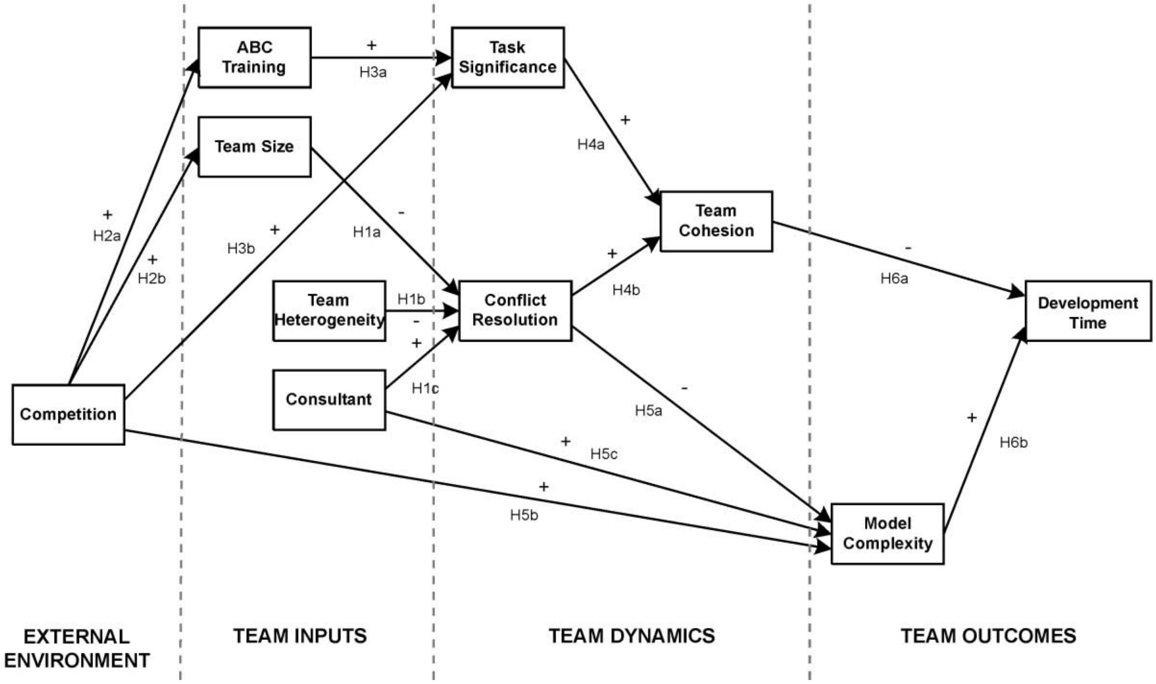


Fig. 1. Hypothesized model structure.

interviews with our research companies. As shown in Fig. 1, the framework links: (1) a measure of the *external environment* (level of competition), (2) *team inputs* including team size, team member heterogeneity, ABC training, and use of an external consultant, (3) *team dynamics* variables, such as task significance, conflict resolution, and team cohesion to (4) the *team outcomes* of ABC model complexity, and time to develop the initial ABC model. We use ABC model complexity and time to develop the initial ABC model as dependent variables for two reasons. First, ABC implementation failure has been attributed to surprise and concern over the effort involved in trying to develop a functioning ABC model (Ness & Cucuzza, 1995). Second, many ABC models languish when they are too complex, which in turn leads to long lead-time (Anderson, 1995). Understanding the relations among the variables in Fig. 1 may lead to greater efficiency and effectiveness in ABC model development. The motivation for each of the pathways in our model is presented in this section and Fig. 1. We begin with the relations among the team inputs and team dynamics variables followed by the additional links of the competition variable to team dynamics and team outcome variables.

### *2.1. Effects of team size, team heterogeneity and external consultants on conflict resolution*

#### *2.1.1. Team size and team heterogeneity*

Well-functioning and high-performing teams are able to resolve conflicts in an expedient manner (Hackman, 1987).[3] Generally, as teams grow larger, the potential is greater for diversity of opinions, even for people of similar backgrounds. Larger teams are more likely to exhibit greater team heterogeneity, measured in this study as the number of functional areas (e.g. engineering, finance, human resource management) represented on the team. Diversity of opinion can be a positive force as team members are challenged to consider other ideas. However, greater diversity can also

[3] The construct that we are investigating in this paper is "conflict resolution" and not the level of "conflict" per se. When respondents are asked about conflict resolution, their experiences with conflict in a group are impounded in their answers to the questions (Thomas, 1976).

lead to conflicts over how to proceed with the task, scope of data to collect, etc. Overall, we expect that increases in both team size and heterogeneity make conflict resolution more difficult.[4]

**$H_{1a}$**. As team size increases, the team's ability to resolve conflicts decreases.

**$H_{1b}$**. As team heterogeneity increases, the team's ability to resolve conflicts decreases.

#### 2.1.2. External consultant

All of the plants in Company B employed an experienced, external consultant (from the same Big-5 firm) whose task was to facilitate ABC model development. Company A did not use consultants. Consultants at Company B brought prior experience at similar plants and used standardized templates that specified the parameters of the ABC models.[5] The advantage of using templates was that each plant did not have to start from scratch and that disagreements about design parameters could be resolved more easily. This approach is consistent with a type of conflict resolution known as the "procedural form" of process consultation (Prein, 1984). Process consultation uses structured procedures and designs for solving problems and resolving conflict.

**$H_{1c}$**. The presence of an external consultant increases the team's ability to resolve conflicts.

### 2.2. Effect of competition on ABC training and team size

#### 2.2.1. Competition

Plants in our companies typically are exposed to one of two levels of competitive pressure. *Core* plants (plants A1–A5 and B1–B5) are those in which the corporation has invested heavily in capital equipment. These plants included major metal stamping, engine and transmission assembly, and foundry castings. The core manufacturing process provides the manufacturing identity of the firm. Essentially, core plants are captive to their respective corporations and historically have been able to sell almost all products they could produce to the corporation. Accordingly, the relative level of competition that Core plants face is low.

*Non Core* plants (A6–A9 and B6–B9) are those that produce automobile components. These plants are much more peripheral to the firm. Both firms in our study have been criticized for excessive vertical integration, and recent outsourcing decisions have Non Core plants at these firms facing a great deal of competitive pressure and plant closings. Compared with Core plants, the relative level of competition at Non Core plants is high. Managers in Non Core plants are motivated to develop the most accurate cost models in order to be cost competitive. In the development of the ABC model, managers have discretion over the amount of technical ABC training and the number of personnel available for ABC teams. This discussion suggests the following hypotheses:

**$H_{2a}$**. ABC Teams that face a high level of competition will have a greater level of ABC training than those that face a low level of competition.

**$H_{2b}$**. ABC Teams that face a high level of competition will have larger team sizes than those that face a low level of competition.

### 2.3. Effect of ABC training and competition on task significance

#### 2.3.1. ABC training

Having teams view their task as significant is essential. Prior research has suggested that increasing levels of perceived task significance (Hackman & Oldham, 1976, 1980) could result in more motivated employees.[6] Apart from regular team interactions both managerial and environmental influences can affect the perceived level of task significance. An important managerial influence is training and a key environmental influence is the degree of competition.

[4] We do not explicitly model the link between team size and heterogeneity. While our measure of heterogeneity relates to greater representation of different functional areas, some teams may have a disproportionate number of team members from one functional area, while others may be comprised of an even distribution of members from several areas.

[5] This issue is discussed in greater detail in developing hypothesis $5_c$.

In order to educate team members, training was conducted locally and off-site by the corporate ABC group, the consultant or by an academic faculty member (not the authors).[7] ABC training, the first factor to explain task significance (Fig. 1), was designed to help employees understand the technical aspects of ABC and its implications for more accurate product costing and resource allocation compared to traditional costing methods. Such knowledge gives more meaning and significance to the model development task they are performing.[8]

**$H_{3a}$**. As the level of ABC training increases, the perceived level of task significance increases.

*2.3.2. Degree of competition and task significance*

As mentioned earlier, Core plants face less outside competition than Non Core plants. Typically, Non Core teams face a higher degree of uncertainty and cost pressure, which in turn, leads to increased importance of the ABC model building task. This discussion leads to the next hypothesis:

**$H_{3b}$**. ABC Teams that face a high level of competition will experience a higher level of task significance than those that face a low level of competition.

*2.4. Effects of task significance and ability to resolve conflict on team cohesion*

Team, or group, cohesion is defined as the commitment of members to the team task (see Goodman, Ravlin, & Schminke, 1987). The team task is the set of activities that the team must perform to achieve the group's goal. While many factors can explain cohesiveness, the literature suggests that dimensions of cohesiveness include the degree to which team members are friendly toward each other and the degree to which people are working toward a common goal (see Goodman et al., 1987). These relations are presented in the following hypotheses.

**$H_{4a}$**. As the level of task significance increases, the level of ABC team cohesion increases.

**$H_{4b}$**. As the team's ability to resolve conflicts increases, so does the level of ABC team cohesion.

*2.5. Effects of external consultant, competition and ability to resolve conflicts on model complexity*

One goal of ABC model building is to develop a model that reflects operations in a parsimonious manner (see Kaplan & Cooper, 1998). In theory, designers should invest in model complexity up to the point where marginal returns in improved information are equal to the cost of model development and maintenance. In practice, it is difficult to know when this point is reached (see Datar & Gupta, 1994 for more discussion). While we do not attempt to resolve this issue here, we do suggest that three factors play a role in determining ABC model complexity. These are the ability of the team to resolve team conflicts, the presence of an external consultant and the perceived level of competition.[9]

[6] In this context our observation was that task significance was a process rather than input variable. For instance, some ABC members were drafted into the ABC implementation while others volunteered. Some team members understood the importance of building an ABC model in an expedient fashion, whereas others understood the task's significance when they became educated about the benefits of ABC. Thus, task significance is not considered a fixed input here but rather a variable that is more related to team processes and training.

[7] ABC team members received various types of training including formal course work, in-house seminars and meetings sponsored by the Corporate ABC group.

[8] While task significance is usually a task-related variable, we group the construct together with the team dynamic's variables. We hypothesize that management innovations are more likely to fail if a project team does not see what they are doing as important for their organization. The task significance measure in this paper is a group measure and, in part, captures members' motivation to perform as a team.

[9] In our model, Fig. 1, the perceived level of competition is the factor we model as the one representing the external environment. We chose this factor as representative of the external environment for two reasons. First, discussions with many plant employees and ABC team members indicated that the perception of t competition was the external factor that drove behavior in their organizations. Second, we chose only one factor for the sake of developing a parsimonious model.

Anderson (1995) documents the progression of one company from extremely complex models to more parsimonious models in the early prototyping of the ABC concept. The sites of this study, which implemented ABC after the prototyping stage, were familiar with the costs of model complexity. Indeed, a key feature of ABC training was to sensitize ABC team members to the importance of designing simple, yet useful models. Thus, if complex models emerge, we believe that it is either a response to a need for more discrimination among product costs (e.g. an outcome of competitive needs), or due to the failure of the team to reach compromises on what constitutes adequate simple models. Ineffective conflict resolution surrounding issues such as how to reduce model complexity (e.g. number of activity centers, number of cost drivers) can result in compromises that leave model complexity excessively high.

**$H_{5a}$**. As the team's ability to resolve conflicts increases, ABC model complexity decreases.

As mentioned previously, the competition faced by Non Core plants is greater than that faced by Core plants. For Non Core plants, competing successfully means that they can offer products and services at prices below that of competitors. The decision to implement activity based costing was made at corporate headquarters with the objectives of improving the accuracy of product costs and providing plant managers data on the cost of operations and opportunities for improvement. The literature in activity based costing suggests that in many cases more accurate product costs are obtained as overhead support activities are broken down into finer components and are assigned to products using cost drivers that are correlated with resource usage (Cooper & Kaplan, 1998). Thus greater accuracy will occur as more activity centers and cost drivers (first and second stage) are used to assign costs to products. We hypothesize that:

**$H_{5b}$**. As the perceived level of external competition increases, ABC model complexity increases.

As mentioned previously, of the two companies we studied, Company A did not use an external consultant but rather allowed each plant to develop its own ABC model structure within suggested guidelines. ABC team members were permitted to choose the number and kind of activity centers, and first and second stage cost drivers. Some guidance on choosing parameters was provided by the Corporate ABC group that facilitated information sharing by ABC teams from common process environments.

Company B employed consultants to oversee plant-level ABC implementation and to facilitate shared practices in model development. Consultants used implementation templates that were superimposed on plants of similar type. The template consisted of a standardized corporate activity dictionary.[10] In some cases a plant was permitted to add site-specific activities, however, design parameters were largely pre-determined. Through interviews, Company B stated that one of its goals was to be the low cost producer of products. The strategy of being the low cost producer increased the demand for more accurate costing information. To reduce costs, consultants in Company B had to obtain more detailed information about the firm's cost structure that is made possible by the creation of more complex models.[11] This argument is reflected in the next hypothesis.

**$H_{5c}$**. The presence of a consultant increases ABC model complexity.

### *2.6. Effect of team cohesion and ABC model complexity on time to develop the initial ABC model*

Research by DeLone and McLean (1992), Hackman (1987), and Wageman (1995) suggests a number of team effectiveness measures. Of the large number of effectiveness measures available, the most relevant for this study is Hackman's (1987) "speed to a solution of a problem". In this study, we operationalize this concept as the amount of *time (in months) to develop the initial*

[10] An activity dictionary defines admissible "activities" that are cost objects in the 1st of a two-stage cost assignment.

[11] We note that this hypothesis is specific to our organizational context and may not hold in situations where consultants are not faced with the goal of being the low cost producer.

*ABC model*. This variable is important because developing an effective ABC model was the key goal of the ABC team and a source of competitive advantage.

Previous research has found that the level of team cohesion (defined earlier as the commitment of members to the team task) is an important predictor of a team achieving its goals (see Gladstein, 1984; Goodman et al., 1987). Building an ABC model in these plants is a complex task. The need for more complex models requires more effort and time. Since constructing a representative ABC model in as short a time as possible was the team goal, we make the following predictions:

**$H_{6a}$**. As the level of team cohesion increases, the time it takes to develop the ABC model decreases.

**$H_{6b}$**. As ABC model complexity increases, the time to develop the ABC model increases.

## 3. Selection of research sites, research approach and variable measures

### 3.1. Site selection

Anderson's (1995) previous research provided insight on the roll out plan for ABC at the plant level. Using this information as well as interviews conducted with both firms' corporate ABC teams, we developed a sampling plan for selecting sites for study. At the time of the study, both firms were operating from a corporate directive that allowed each plant to implement ABC during a three to five year window. The first consideration for selecting sites was to include only those that developed ABC systems after the corporate directive. This meant excluding experimental or prototype sites. Attention was paid to obtaining a range of sites over the firm's history of the implementation. The second consideration was gathering data from sites representing all aspects of automobile manufacturing including major metal stamping, engine and transmission assembly, foundry castings and automotive component's plants. We relied on the expertise of corporate managers in matching sites between firms based on these considerations. The purpose in matching was to insure a full range of task complexity and competitive conditions within each firm. Since both firms had a very similar internal industrial organizational structure, plant matching was not controversial. When data were collected all sites had completed the first ABC model.

### 3.2. Research approach

Entry was granted to both firms because of previous interactions and research and because both firms were interested in an objective study of ABC implementation.[12] For each plant visit, a standardized procedure was followed. Once a plant agreed to participate, a project administrator arranged our visits and requested interviews with plant personnel selected from a list of job titles provided by the researchers. At least one principal researcher and one research assistant gathered data at each plant.

Data were collected in interviews and with surveys. About a week prior to our visit, the plant received two surveys; a *Plant Statistics Questionnaire* and an *ABC Model Questionnaire* designed to elicit objective data about the plant and its ABC model. The *Plant Statistics Questionnaire* included questions related to plant characteristics and product and process complexity. The *ABC Model Questionnaire* included questions related to the process of developing the ABC system, including the structural design parameters of the ABC system.

In addition, two comprehensive surveys were developed—one for ABC team members (*ABC Team Survey*), and the other for managers (*Manager Survey*).[13] Surveys were completed prior to the visit and collected at the start of the personal interviews. Survey items were developed in two ways. First, we used previously developed scales or portions of scales from the literature (e.g.

[12] We received funding for travel and administrative expenses from the IMA Foundation for Applied Research and the IMVP program at MIT.

[13] This paper focuses on data collected from ABC developers about the ABC model building process. Another paper uses data that applies more broadly to team members and managers (see Anderson & Young, 1999).

Jaworski & Young, 1992; Seashore, Lawler, Mirvis, & Cammann, 1983; Van de Ven & Ferry, 1980). In some cases, wording changes were made to fit the organizational setting and the ABC model development task. Second, since many of the constructs are unique to this study, we developed these using information gathered during the pre-study phase. A pre-test of the two surveys was administered to approximately 10 corporate and divisional ABC employees (all with prior experience implementing ABC in manufacturing sites) at each company. The pre-test helped identify and improve ambiguous questions.

### 3.3. *Variable measures*

#### 3.3.1. *External environment*

The degree of competition was determined using a categorical variable based on whether a plant was a Core or a Non Core plant. As mentioned previously, Core plants faced a low level of competition whereas Non Core plants faced competition from external suppliers.

#### 3.3.2. *Team inputs*

We measure four aspects of team inputs: team size, team heterogeneity, the amount of ABC training and the presence or absence of a consultant.

*3.3.2.1. Team size*. Team size was measured by the number of plant employees assigned to the project (see Table 1, panels A and B). On average, for Company A (see panel A, Table 1, column 2), the number of team members was 4.0 ($s = 1.73$). Company B's teams (see panel B, Table 1, column 2) average 3.9 team members ($s = 2.42$). The largest teams were in the highly complex task environments of engine and transmission plants.

*3.3.2.2. Team heterogeneity*. Team heterogeneity is a measure of the number of different functional departments represented by team members. Six types of employees are represented in Company A. The areas represented are finance, industrial engineering, manufacturing, human resources, information systems and the union. The majority of team members come from the finance organization (see column 4, Table 1), and only one plant had a union member on its team. An unusual characteristic is that only one manufacturing employee is represented across all of the plant teams.

At Company B the same types of personnel comprise the teams, however, no human resource people were involved and, similar to Company A, only one team used a union employee. At Company B, however, more manufacturing employees were on ABC teams than at Company A.

*3.3.2.3. Amount of ABC training*. The amount of training was obtained by summing the number of ABC class hours provided by the company or plant and through formal education for each of the team members divided by the number of team members in each plant. Accordingly, the construct measures the average level of training provided to each team member in a plant. Table 1 (panels A, column 6) shows that each ABC team member in Company A averaged 36.7 ($s = 16.39$) hours of training, while each member in Company B averaged 32.1 ($s = 26.77$; Table 1, panel B, column 6).

*3.3.2.4. Presence of a consultant*. Because plants in only one company used a consultant to help in their implementations, and the others did not, we used a categorical variable to indicate the presence of a consultant (1) or the absence of a consultant (0) in our analyses.[14]

#### 3.3.3. *Team dynamics*

Items comprising the three behavioral constructs related to team dynamics, task significance, conflict resolution and team cohesion are shown in Table 2. All questions were scored on a five-point Likert scale anchored by "1", *strongly disagree*, and "5", *strongly agree*. Descriptive statistics are detailed for each construct in Table 3.[15]

[14] The results of the analysis are qualitatively unchanged when a measure of "perceived effectiveness of the consultant" is substituted for those plants that use consultants.

[15] Subject to data limitations, we performed a confirmatory factor analysis on individual team member responses ($N = 89$). Although our sample size was below minimum recommended levels and was multivariate non = normal, none of the correlations among the three latent variables included the value of 1.0. Combined with face validity of the items and satisfactory measures of reliability, the analyses are supportive of scale validity.

Since reliability coefficients were satisfactory (as noted in the following sections), we obtained summated scales for each subject. These scores were then averaged across team members to obtain a measure for each plant. To assess the appropriateness of aggregation, we computed interrater reliability coefficients for each construct and plant (James, Demaree, & Wolf, 1984). Values above 0.60 indicate good agreement among judgments made by a group of judges on a variable in regard to a single target. Of the 54 coefficients computed, only seven were below 0.60. Three of these were at a single plant (B5) where the team members appeared to disagree on all three constructs. Because of our small sample size, we decided to retain this plant, noting the disagreement among team members. Our results are not sensitive to our decision to retain plant B5 in our sample. See Table 4.

#### 3.3.4. Outcome variables

*3.3.4.1. Model complexity.* The ABC models developed were structured around (a) *the number of activity centers*, (b) the *number of first stage cost drivers*, and (c) the *number of second stage cost drivers*. All data reported were measured using the *ABC Model Questionnaire*. See Table 5, panel A and panel B.

*3.3.4.2. Number of activity centers.* The average total number of activity centers for Company A was 25. In Company B, the average number of

Table 1
ABC development team characteristics

| Plant number | Number of team members[a] | Number of full-time equivalent team members | Number of team members from Finance dept. | Functional departments represented | Average ABC class hours per team member |
|---|---|---|---|---|---|
| *Panel A: Company A* | | | | | |
| Plant A1 (Engine) | 5 | 1.55 | 1 | 4 | 48.0 |
| Plant A2 (Engine) | 2 | 0.20 | 2 | 1 | 40.0 |
| Plant A3 (Transmission) | 7 | 2.60 | 7 | 1 | 7.4 |
| Plant A4 (Foundry) | 4 | 1.30 | 3 | 2 | 17.5 |
| Plant A5 (Stamping) | 3 | 1.50 | 2 | 2 | 24.0 |
| Plant A6 (Components)[b] | 6 | 5.00 | 2 | 3 | 48.0 |
| Plant A7 (Components) | 3 | 2.75 | 3 | 1 | 44.0 |
| Plant A8 (Components) | 4 | 2.20 | 4 | 1 | 45.0 |
| Plant A9 (Components) | 2 | 2.00 | 1 | 2 | 56.0 |
| *All Plants Median*: | *4.0* | *2.0* | *2.0* | *2.0* | *44.0* |
| *All Plants Average*: | *4.0 (1.73)* | *2.1 (1.32)* | *2.8 (1.86)* | *1.9 (1.05)* | *36.7 (16.39)* |
| *Panel B: Company B* | | | | | |
| Plant B1 (Engine) | 9 | 5.70 | 5 | 4 | 22.0 |
| Plant B2 (Engine) | 5 | 3.75 | 2 | 3 | 83.2 |
| Plant B3 (Transmission)[c] | 6 | 5.50 | 4 | 3 | 29.6 |
| Plant B4 (Foundry) | 2 | 1.75 | 0 | 2 | 12.0 |
| Plant B5 (Stamping) | 2 | 0.35 | 2 | 1 | 20.0 |
| Plant B6 (Components) | 2 | 1.75 | 1 | 2 | 14.0 |
| Plant B7 (Components) | 4 | 2.35 | 3 | 2 | 67.5 |
| Plant B8 (Components) | 2 | 1.25 | 2 | 1 | 3.0 |
| Plant B9 (Components) | 3 | 2.00 | 2 | 2 | 38.0 |
| *All Plants Median*: | *3.0* | *2.0* | *2.0* | *2.0* | *22.0* |
| *All Plants Average*: | *3.9 (2.42)* | *2.7 (1.87)* | *2.3 (1.50)* | *2.2 (0.97)* | *32.1 (26.77)* |

Values in parentheses are standard deviations.
[a] Excludes consultants.
[b] One subject in Plant A6 failed to indicate department.
[c] One subject in Plant B3 failed to indicate department.

Table 2
Summary statistics for survey items and constructs

| Construct | Survey items Anchors: 1 = strongly disagree; 5 = strongly agree | Item *N* | Item mean | Standard deviation | Cronbach's α |
|---|---|---|---|---|---|
| *Task significance* | | | *3.4* | *0.81* | *0.89* |
| 1. | A lot of people will be affected by how I do my job on ABC. | 85 | 3.5 | 1.00 | |
| 2. | The future of this plant will be affected by how well I do my job on ABC. | 79 | 3.0 | 1.09 | |
| 3. | Working on ABC gave me the opportunity to contribute something worthwhile to this plant. | 84 | 3.7 | 0.91 | |
| 4. | The work I did on ABC was extremely meaningful to me. | 86 | 3.7 | 0.94 | |
| 5. | My work on ABC had a visible effect on this plant. | 86 | 3.1 | 1.12 | |
| 6. | As I performed my tasks on ABC, I could see the contribution I was making. | 84 | 3.7 | 0.95 | |
| *Conflict resolution* | | | *4.0* | *0.59* | *0.76* |
| 1. | On the ABC team, everyone's opinions were heard. | 82 | 4.1 | 0.76 | |
| 2. | When a decision was required, every member of the ABC team was involved. | 80 | 3.6 | 0.84 | |
| 3. | If a disagreement arose between ABC team members, the issue was dealt with in an open fashion. | 80 | 4.0 | 0.71 | |
| 4. | When a disagreement arose between ABC team members everyone tried to find a workable solution. | 79 | 4.0 | 0.68 | |
| *Team cohesion* | | | *3.9* | *0.81* | *0.80* |
| 1. | When I was on the ABC team I felt that I was really a part of the group. | 79 | 3.9 | 0.93 | |
| 2. | I looked forward to working with ABC team members each day. | 82 | 3.8 | 0.89 | |
| 3. | There was a strong feeling of camaraderie among ABC team members. | 83 | 3.9 | 0.90 | |

Descriptive data for constructs averaged across all plants are shown in italic. Item statistics for all respondents are shown in regular font below the construct name.

activity centers in each plant was 41. See Table 5, panel A and panel B, column 2.

*3.3.4.3. Number of 1st and 2nd stage cost drivers.* Company A used an average of 28, 1st stage cost drivers. In contrast, Company B averaged 65 first stage drivers. A similar pattern is evidenced with 17 second stage cost drivers for Company A and 22 for Company B. See Table 5, panels A and B, columns 3 and 4.

Overall model complexity was defined as the sum of activity centers, first stage cost drivers and second stage cost drivers for each plant. The raw data were standardized before being combined (*Z*-scores are reported in Table 5, column 5).[16]

[16] One outlier was dropped.

*3.3.4.4. Time to develop the initial ABC model.* The time to develop the initial ABC model was calculated from the time that the team began ABC training to the time when the first product costs were generated by the model.[17] Table 5, column 6 shows the time by plant.

## 4. Research results

To test the hypotheses, a causal modeling approach known as Partial Least Squares (PLS) was used to perform path-analytic modeling. PLS evaluates the measurement and structural parameters of a causal model in an iterative fashion

[17] Training time is included because aspects of ABC design (e.g. defining activity centers) are often started during training.

Table 3
Components of team process for ABC development teams descriptive statistics [based on 1–5 Likert Scales]

| Plant number | Task significance | Conflict resolution | Team cohesion |
|---|---|---|---|
| *Panel A: Company A* | | | |
| Plant A1 (Engine) | 2.79 (0.70) | 3.94 (0.24) | 3.83 (0.79) |
| Plant A2 (Engine) | 2.30 (0.42) | 2.88 (0.88) | 2.17 (0.24) |
| Plant A3 (Transmission) | 2.57 (0.83) | 3.82 (0.45) | 2.83 (1.24) |
| Plant A4 (Foundry) | 2.70 (0.92) | 3.75 ( . )[a] | 3.67 (0.47) |
| Plant A5 (Stamping) | 3.00 (0.73) | 4.50 (0.00) | 4.67 (0.00) |
| Plant A6 (Components) | 4.35 (0.75) | 4.46 (0.51) | 4.42 (0.39) |
| Plant A7 (Components) | 3.44 (0.48) | 3.78 (0.63) | 3.78 (0.69) |
| Plant A8 (Components) | 3.67 (0.49) | 4.31 (0.75) | 4.08 (0.83) |
| Plant A9 (Components) | 4.25 (0.12) | 4.38 (0.18) | 4.67 (0.47) |
| *All Plants Median:* | *3.00 [1.32]* | *3.94 [0.65]* | *3.83 [1.29]* |
| *All Plants Average:* | *3.23 (0.74)* | *3.98 (0.51)* | *3.79 (0.84)* |
| *Panel B: Company B* | | | |
| Plant B1 (Engine) | 3.42 (0.56) | 3.72 (0.52) | 3.89 (0.58) |
| Plant B2 (Engine) | 3.93 (0.61) | 4.15 (0.38) | 4.27 (0.55) |
| Plant B3 (Transmission) | 3.58 (1.00) | 4.00 (0.59) | 3.87 (0.69) |
| Plant B4 (Foundry) | 2.42 (0.12) | 4.00 ( . )[a] | 4.00 ( . )[a] |
| Plant B5 (Stamping) | 2.90 (1.27) | 3.00 (1.41) | 3.17 (1.18) |
| Plant B6 (Components) | 3.57 (0.33) | 3.62 (0.18) | 3.83 (0.24) |
| Plant B7 (Components) | 3.79 (0.16) | 4.19 (0.24) | 4.25 (0.32) |
| Plant B8 (Components) | 3.42 (0.12) | 4.00 (0.00) | 4.00 (0.00) |
| Plant B9 (Components) | 3.56 (0.10) | 4.50 (0.35) | 4.11 (1.02) |
| *All Plants Median:* | *3.56 [0.52]* | *4.00 [0.50]* | *4.00 [0.33]* |
| *All Plants Average:* | *3.40 (0.46)* | *3.91 (0.43)* | *3.93 (0.33)* |

Values in parentheses are standard deviations; values in square brackets are interquartile ranges.
[a] Because of missing items, only one respondent is represented.

using ordinary least squares regressions. By working with one construct and a subset of measures related to that construct or adjacent constructs, complex models are separated (Barclay, Higgins, & Thompson, 1995). This segmenting procedure makes PLS suitable for small sample sizes.[18] The model's path coefficients are standardized βs, which are interpreted in the same manner as β weights in OLS regression (Hulland, 1998). Bootstrapping provides a means to evaluate the empirical sampling distribution of parameter estimates (Efron & Tibshirani, 1993). Bootstrapping (1000 samples with replacement) was used to assess the statistical significance of the path coefficients.

### 4.1. Tests of research hypotheses

In this section the tests of hypotheses are reported. Table 6 provides a Pearson, product–moment correlation matrix across variables. Results are shown in Table 7 and the coefficients are superimposed on the path diagram in Fig. 2 for ease of interpretation.

The first set of hypotheses relates to determinants of conflict resolution. In Hypothesis 1a we

[18] Fornell and Bookstein (1982) note that meaningful PLS analyses can sometimes have a sample size smaller than the number of variables. Chin and Newsted (1999) describe an extreme case of a model with 21 latent variables, 672 indicators and a sample size of 20. The literature says little about sample size requirements, but estimates range from five cases per predictor (Tabachnick & Fidell, 1989) to formulas such as $N > 50 + m$ (Harris, 1975), or a specific number such as 100 (Nunnally, 1978). Such recommendations are driven by unstated assumptions of effect size and statistical power (Algina & Olejnik, 2000). For this study, a 2 (3) predictor regression will be able to detect, with a power of 0.8, an effect whose $R^2$ is 0.35 (0.38).

expected the ability to resolve conflicts would decrease as ABC team size increased. The link was marginally supported ($P<0.10$) but in the opposite direction to that predicted. Similarly, Hypothesis 1b predicted that as team heterogeneity increased, the team's ability to resolve conflicts would decrease. No support was found for this relation. We also hypothesized that the presence of an external consultant would be positively associated with the team's ability to resolve conflicts (Hypothesis 1c). Results indicate no support was found for this association.

Theory predicts that conflict resolution is an important determinant of project team performance where tasks are difficult and outcomes are ambiguously defined. We sought to identify antecedents of team conflict resolution skills that would have managerial implications for the selection and composition of ABC teams. Clearly we were unsuccessful in this effort, and must surmise that conflict resolution skills are the product of personality and individual characteristics that we have not measured. This suggests that team formation and the resulting "chemistry" of team members are not easily achieved by "cookbook" formulae employing optimal team size or skill mix. Clearly this question requires more investigation.

Table 4
Interrater reliability coefficients

| Plant number | Task significance | Conflict resolution | Team cohesion |
|---|---|---|---|
| *Panel A: Company A* | | | |
| Plant A1 (Engine) | 0.76 | 0.97 | 0.69 |
| Plant A2 (Engine) | 0.91 | 0.61 | 0.97 |
| Plant A3 (Transmission) | 0.66 | 0.90 | 0.23 |
| Plant A4 (Foundry) | 0.58 | 0.91 | 0.89 |
| Plant A5 (Stamping) | 0.73 | 1.00 | 1.00 |
| Plant A6(Components) | 0.72 | 0.87 | 0.92 |
| Plant A7 (Components) | 0.88 | 0.78 | 0.76 |
| Plant A8 (Components) | 0.88 | 0.72 | 0.66 |
| Plant A9 (Components) | 0.99 | 0.98 | 0.89 |
| *Panel B: Company B* | | | |
| Plant B1 (Engine) | 0.84 | 0.88 | 0.83 |
| Plant B2 (Engine) | 0.81 | 0.93 | 0.85 |
| Plant B3 (Transmission) | 0.50 | 0.83 | 0.76 |
| Plant B4 (Foundry) | 0.99 | 1.00 | 1.00 |
| Plant B5 (Stamping) | 0.19 | 0.00 | 0.30 |
| Plant B6 (Components) | 0.95 | 0.99 | 0.97 |
| Plant B7 (Components) | 0.99 | 0.97 | 0.95 |
| Plant B8 (Components) | 0.99 | 1.00 | 1.00 |
| Plant B9 (Components) | 1.00 | 0.96 | 0.48 |

The second set of hypotheses predicted that as the level of competition increased so would managerial discretion to increase ABC training (Hypothesis 2a) and team size (Hypothesis 2b). Results show no support for either of these hypotheses. While we find these results surprising, it could be the case that both Core and Non Core plants allocated similar resources due to plant-level constraints.

The next set of hypotheses focused on explanators of task significance. Beginning with Hypothesis 3a we predicted a positive relation between increased levels of ABC training and the perceived level of task significance. This hypothesis was strongly supported in the predicted direction ($P<0.01$). Hypothesis 3b predicted that ABC Teams facing a high level of competition will experience a higher level of task significance than ABC teams that face a low level of competition. This hypothesis also was strongly supported ($P<0.01$).

In turn, we hypothesized that as the level of perceived task significance increases, so would the level of team cohesion (Hypothesis 4a). This hypothesis was marginally supported ($P<0.10$). Another determinant of team cohesion was conflict resolution. In Hypothesis 4b, we expected that as the team's ability to resolve conflicts increases so would the level of team cohesion. This hypothesis was strongly supported ($P<0.01$).

Three variables were hypothesized to explain ABC model complexity. First, Hypothesis 5a predicted that as the team's ability to resolve conflicts increases, ABC model complexity decreases. We found marginal support for this hypothesis ($P<0.10$). Next, we posited that as the perceived level of competition increases, ABC model complexity increases (Hypothesis 5b). Strong support was found for this hypothesis ($P<0.01$). Finally, with Hypothesis 5c we predicted a positive association between the presence of a consultant and ABC model complexity. Results show support for this hypothesis ($P<0.01$).

In our last set of hypotheses, we linked model development time to the level of team cohesion

(Hypothesis 6a) and model complexity (Hypothesis 6b). We suggested that as the level of team cohesion increased, the time to develop the initial ABC model would decrease. Strong support was found for this hypothesis ($P<0.01$). No support, however, was found for the relation between an increase in model complexity and an increase in initial ABC model development time.

Table 5
Characteristics of ABC models developed descriptive statistics

| Plant number | Number of activity centers | Number of 1st stage cost drivers | Number of 2nd stage cost drivers | ABC model complexity (*Z*-scores) | Model development time (months) |
|---|---|---|---|---|---|
| *Panel A: Company A* | | | | | |
| Plant A1 (Engine) | 13 | 20 | 4 | −3.67 | 8 |
| Plant A2 (Engine) | 29 | 80 | 39 | 2.55 | 12 |
| Plant A3 (Transmission) | 10 | 16 | 7 | −3.80 | 12 |
| Plant A4 (Foundry) | 31 | 26 | 9 | −1.75 | 10 |
| Plant A5 (Stamping) | 13 | 23 | 14 | −2.76 | 4 |
| Plant A6 (Components) | 21 | 11 | 6 | −3.28 | 4 |
| Plant A7 (Components) | 47 | 8 | 6 | −1.53 | 9 |
| Plant A8 (Components) | 23 | 25 | 39 | 0.04 | 8 |
| Plant A9 (Components) | 42 | 42 | 26 | 1.00 | 4 |
| *All Plants Median*: | *23* | *23* | *9* | *−1.75* | *8.0* |
| *All Plants Average*: | *25.4* | *27.9* | *16.7* | *−1.47* | *7.9* |
| *Panel B: Company B* | | | | | |
| Plant B1 (Engine) | 40 | 53 | 21 | 0.87 | 5 |
| Plant B2 (Engine) | 21 | 38 | 10 | −1.94 | 10 |
| Plant B3 (Transmission) | 51 | 77 | 19 | 2.41 | 10 |
| Plant B4 (Foundry) | 32 | 54 | 13 | −0.30 | 8 |
| Plant B5 (Stamping) | 53 | 53 | 22 | 1.88 | 7 |
| Plant B6 (Components) | 47 | 74 | 36 | 3.37 | 7 |
| Plant B7 (Components) | 35 | 72 | 14 | 0.67 | 9 |
| Plant B8 (Components) | 43 | 82 | 20 | 2.10 | 8 |
| Plant B9 (Components) | 48 | 80 | 42 | 4.15 | 8 |
| *All Plants Median*: | *43* | *72* | *20* | *1.88* | *8.0* |
| *All Plants Average*: | *41.1* | *64.8* | *21.9* | *1.47* | *8.0* |

Table 6
Correlation matrix

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|---|---|---|---|---|---|---|---|---|---|---|
| 1. ABC training | | 0.351 | 0.352 | −0.225 | 0.248 | 0.628 | 0.417 | 0.479 | −0.171 | −0.044 |
| 2. Team size | 0.216 | | 0.478 | 0.129 | 0.140 | 0.581 | 0.280 | 0.308 | −0.219 | 0.008 |
| 3. Heterogeneity | 0.291 | 0.625* | | 0.203 | −0.238 | 0.317 | 0.230 | 0.390 | −0.200 | −0.262 |
| 4. Consultant | −0.107 | 0.189 | 0.172 | | 0.000 | 0.139 | −0.086 | 0.086 | 0.546 | −0.022 |
| 5. Competition | 0.214 | −0.002 | −0.282 | 0.000 | | 0.636 | 0.400 | 0.399 | 0.302 | −0.318 |
| 6. Task significance | 0.547* | 0.535* | 0.260 | 0.144 | 0.672* | | 0.570 | 0.696 | 0.091 | −0.347 |
| 7. Conflict resolution | 0.314 | 0.370 | 0.283 | −0.077 | 0.423 | 0.595* | | 0.883 | −0.193 | −0.349 |
| 8. Team cohesion | 0.331 | 0.345 | 0.391 | 0.117 | 0.418 | 0.696* | 0.857* | | −0.103 | −0.560 |
| 9. Model complexity | −0.160 | −0.155 | −0.227 | 0.603* | 0.299 | 0.114 | −0.264 | −0.139 | | −0.039 |
| 10. Development time | −0.017 | −0.198 | −0.331 | 0.023 | −0.304 | −0.497* | −0.446* | −0.695* | 0.036 | |

Pearson product–moment correlations are below the diagonal. Spearman rank-order correlations are above the diagonal. $N=18$.
* $P<0.05$, 2-tailed.

Table 7
Results of PLS: hypothesis testing path coefficients (*t*-statistics in parentheses)

| Path from: | Predicted sign | Path to: | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | ABC training | Team size | Conflict resolution | Task significance | Team cohesion | Model complexity | Development time |
| | | Adjusted $R^2$: | | | | | | |
| | | 0.00 | 0.00 | 0.17 | 0.62 | 0.79 | 0.60 | 0.48 |
| 1. Competition | +, +, +, + | 0.214 (0.838) | −0.002 (−0.010) | | 0.582** (4.602) | | 0.477** (2.896) | |
| 2. Team size | − | | | 0.337* (1.413) | | | | |
| 3. Heterogeneity | − | | | 0.101 (0.457) | | | | |
| 4. Consultant | +, + | | | −0.159 (0.671) | | | 0.570** (3.564) | |
| 5. ABC training | + | | | | 0.422** (2.273) | | | |
| 6. Task significance | + | | | | | 0.287* (1.747) | | |
| 7. Conflict resolution | +, − | | | | | 0.686** (4.003) | −0.421* (1.611) | |
| 8. Team cohesion | − | | | | | | | −0.703** (3.838) |
| 9. Model complexity | + | | | | | | | −0.061 (0.360) |

$N=18$.
* $P<0.10$, 1-tailed.
** $P<0.05$, 1-tailed.

## 5. Discussion

In this study we examine the ABC development process of 18 plants of two major automobile manufacturers in the US from the perspective of ABC development teams. From the theoretical framework, we tested six sets of relations among variables using PLS. The first set of relations linked the team input variables of team size, team heterogeneity and the presence of an external consultant to conflict resolution. We found a marginally significant relation between team and conflict resolution, but the direction of the effect was not as predicted—as team size increased, the ability to resolve conflicts increased. One explanation is that since many of the teams were relatively homogeneous, consisting of people from the finance staff, they all held similar views about the task and thus were able to resolve conflicts more expediently. We also expected a positive relation between having an external consultant as part of the team process and the level of conflict resolution. We found no support for this relation.

We hypothesized, but found no support for, a relationship between competition and the amount of ABC training and team size. The lack of support for these hypotheses was surprising, however, it could be the case that resources were limited across Core and Non Core plants and thus, no difference was observed.

We discovered that both the level of ABC training and the degree of competition affected task significance. In turn, task significance and the ability to resolve conflicts influenced team cohesion which ultimately was the major explanator of time to develop the first ABC model. We discuss this further later. The implications of these findings are that ABC training not only has the

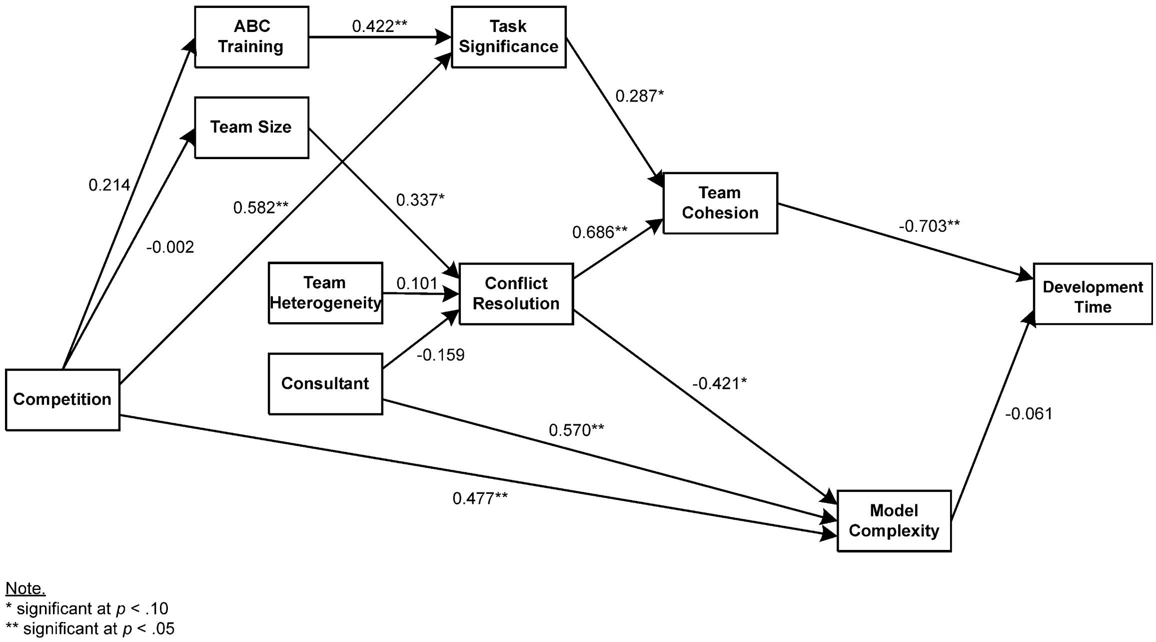


Fig. 2. Model fit. $*P<0.10$. $**P<0.05$.

obvious benefit of providing technical knowledge, it also influences how team members see the ABC model development task. Competition plays a similar role in affecting perceptions of the significance of the task at hand.

Two of the three factors we hypothesized would influence ABC model complexity were found to be significant. First, while we predicted a positive association between the presence of an ABC consultant and model complexity, we found that the presence of the consultant in Company B led to the creation of more complex models. This is probably a result of Company's B strategy of being a low cost producer and a corresponding need for more detailed cost information made possible by a complex ABC model. We also found support for the relation between the degree of competition and model complexity. As teams experience greater competition the need to focus on developing accurate product costs increases.[19] Greater accuracy in product costs is often achieved with more activity centers and cost drivers; in sum, more complexity.

As mentioned earlier, the most significant predictor of time to develop the first ABC model is team cohesion. Team cohesion, and the commitment of the team to the task, are critical factors for local management to develop for ABC teams. While we also predicted that increased model complexity would increase time to develop the first ABC model, no relation was found. It could be the case that the time it takes to develop more complex models is relatively low once the initial model design is completed. Unraveling this set of relations is a task for future research.

Previous discussions on ABC have suggested that ABC models can be successfully implemented by a team of heterogeneous, skilled employees, trained in cost system design and provided with adequate computing resources. In short, the focus has been on providing the right mix of inputs to a "black box" of cost system design. In this paper we have attempted to open the "black box", shedding light on how inputs influence team dynamics which in turn are related to cost system design decisions and the speed of project completion.

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