

Accelerated Learning in New Product Development Teams

by

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Abstract

Speed-to-Market is cited as being vital in today's competitive, uncertain and turbulent environments. Scholars and industry professionals alike assert that companies can achieve competitive advantages by launching their product faster than their competitors. However, this paper presents a slightly different perspective on speed-to-market by considering another aspect of the speed equation - speed-to-learn or fast learning in new product development (NPD) teams. We assert that although speed-to-market can increase the probability of new product success, speed-to-learn is one of the critical factors that allows teams to get to market rapidly and be more successful.

In this study, we propose a model for fast team learning in new product development based on constructs borrowed from accelerated learning models or suggestopedy in the individual learning scholarship. We then empirically test the model on 171 new product teams. We argue that 1) fast-learning teams launch new products quicker with an increased probability of success. And 2) specific mechanisms that are within the teams' control can help teams learn faster. Mechanisms uncovered include: vision clarity, learning from customer and competitor, and information coding.

Introduction

The complexity of today's business environment is such that a company cannot survive unless it is flexible, adapts and learns. One-third of Fortune 500 companies disappear every fifteen years due to inability to change and renew themselves and do so quickly [21]. Companies that continuously learn and reinvent themselves on a timely basis are better able to take advantage of emerging opportunities in fast-paced competitive markets [79]. Maira and Scott-Morgan [107] state that organizations are starting to compete on their ability to change faster and more effectively than their rivals. De Geus [21] asserts that learning, and more importantly, learning faster than competitors is vital for a

company's survival. Schein [104], who has researched organizational learning for many years, notes that organizations must learn to adapt quickly or be weeded out in the economic evolutionary process.

Fast or accelerated learning is important for many functions within an organization, but it is vital in new product development where teams must respond quickly to rapidly changing technologies, customer needs and competitive actions [81]. However, the new product development literature has yet to produce a framework for *accelerated learning* in new product teams. In their future research suggestions, Meyer and Wilemon [81, p. 87] also note "How might conditions that facilitate individual learning accelerate or hinder team learning?" Interestingly, educational psychology and individual learning literature have developed several models and methods to explain how individuals or students learn faster. However, these models have yet to be empirically tested in the context of new product development teams. Thus, the purpose of this research is to explore the practices and mechanisms for rapid learning based on individual learning scholarship (e.g. suggestopedy ([69, 100])) and cognition literature and then apply them (with some modifications) to new product teams to see if these factors can explain how new product teams can help quickly, reach the markets faster, and be more successful.

Accelerated Learning

For the last 20 years, many scholars and practitioners alike have discussed the importance of learning (e.g [5], [107]) and fast learning in organizations [21]. Since scientific and technological breakthroughs are occurring almost on a daily basis [67], and market and customer needs are changing quickly, organizations are required to learn faster and faster to respond to these turbulent and uncertain environmental dynamics. For instance, Purusak [97] notes, a firm's competitive advantage depends on what it knows and how fast it can learn something new for corporate success. Similarly, Dandrea and Buono [17] state that organizations should speed up their learning processes and adapt faster to the

changing global business world. Maira and Scott-Morgan [79] state that fast learning organizations become more and more responsive to fluctuations in their industries and signals from their customers and suppliers. Guns [33, p.25] defines the fast learning organization as figuring out faster than the competition what works and what works better. He identifies the possible benefits of being a fast learning organization as: quickly acquiring knowledge about customers' values, using new technology more effectively, reducing cycle time of innovations, being flexible, and supporting changes in the organizations.

Although fast learning is important for an organization as a whole, it is vital for technological new product development teams because the rapid pace of change in products, competitors, customer bases and suppliers forces new product development teams to learn and do so quickly. For instance, Dodgson [22] argues that ability to learn quickly regarding technological opportunities and changing patterns of competition is important for uncertain and rapidly developing technological industries, such as biotechnology. In this vein, as Maani and Benton [77] express, teams should pull ideas from inside and outside the organization to produce innovative solutions in a short period of time and accelerate the learning process. Similarly, Meyers and Wilemon [81] note either fast paced industries (i.e. micro-processors) or established industries with mature products should learn faster for their new product offerings.

However, before we conceptualize accelerated learning, a review of traditional team learning may help us to understand this concept.

Traditional learning versus accelerated team learning

New product development team learning has been receiving great attention in practice as well as in academia in the last ten years (e.g. [11], [24]). Nonaka and Takeuchi [92], and Leonard-Barton [65]

assert that organizations learn via cross-functional teams. Since, new product development requires integration of a broad base knowledge [31, 59] by acquiring, processing, storing, manipulating and reducing the information and knowledge, a new product team is perceived as a process of organizational learning [86]. However, as Kasl, Marsick, and Dechant [52] assert that organizational literature neither defines nor clearly describes team learning. Additionally, Meyers and Wilemon [81] and Edmonson [24] note that studies about learning in teams are limited.

Brooks [11, p. 215], for instance, defines team learning as the construction of collective new knowledge, involving the following processes: problem-posing, sharing knowledge and ideas, integrating new knowledge, gathering data, disseminating new information. Edmonson [24] defines team learning as processes and outcomes of group interaction activities through which individuals acquire, share and combine knowledge, including following processes: asking questions, seeking feedback, sharing information, experimenting, discussing errors, or unexpected outcomes of actions. Kasl, Marsick, and Dechant [52] present a research-based model of team learning. By demonstrating two-case studies in petrochemical and manufacturing industries, they identify team learning processes and conditions (e.g. appreciation for teamwork, individual expression, common goals, values, and beliefs). They define team learning as a process through which a group creates knowledge for its members, for itself as a system and for others, and including the following processes: perception of issues based on inputs or past experiences, transforming those perceptions into new understanding, experimenting, seeking and/or disseminating information with other individuals or units. Lynn, Reilly, and Akgün [76] identify team learning as a knowledge generation, dissemination, and implementation process. By studying 281 teams, they show that team learning processes involve; recording, filing, and retrieving information, and developing common, stable, and supported goals for projects.

The above empirical team learning studies demonstrate that team learning is a collective knowledge generation and dissemination activity involving information gathering, interpreting, and disseminating to achieve the common goal of team as well as organization. Through this logic, we can define accelerating team learning as construction and dissemination of collective new knowledge *faster*. The distinction between traditional team learning and accelerated team learning is that accelerated learning considerably speeds-up learning through the process of doing, acting and sharing information and knowledge *quickly*. Features or processes of accelerated learning which were derived from traditional learning for teams are: adapting and responding to environmental changes quickly, acquiring information about customers and competitors fast, processing and disseminating that information rapidly, and using technology and other methods more efficiently for a successful new product development project.

Consequences of accelerated learning

As we mentioned earlier, since rapid changes and turbulence in market and technologies obsolete the previous information and knowledge (e.g. electronics) quickly, new product development teams should speed up their learning processes to cope with fast paced information flow [77]. Maani and Benton [77] note that since teams are operating under the pressure of budget, time, competition, and information explosion, they are required to learn rapidly. They also note that rapid learning contributes to the success and improved cycle time of teams by making an analogy between new product development teams and Team New Zealand (i.e. sailors). Similarly, for example upon careful reading of Morone [88] and Lynn [72] in their study of GE's development of computed axial tomography (CAT) scanners, it can be seen that accelerated learning by the development team was critical to the success of this effort. As background, when GE launched its first CAT scanner (a breast scanner) in

January 1975, it failed miserably in field trials. The images were poor and the machine could not differentiate between healthy tissue and malignant tumors. In April 1975, GE responded with a head CAT scanner that it acquired from another company named Neuroscan. Unfortunately, this too had severe problems and was shortly withdrawn from the market. Then, in 1976, GE developed a whole-body scanner called the 7800. However, this scanner also failed because the images were unsatisfactory and mysterious rings appeared on the pictures. If there is truth to the saying that you learn from your mistakes, then GE was one of the smartest companies in the CAT business at that time. GE parlayed their knowledge quickly and in 1978 GE launched its fourth major CT initiative the 8800. The 8800 corrected many problems experienced on the 7800, and the market reacted accordingly. GE's market share jumped from 20% to 60% and GE became the dominant CAT supplier.

“Several cases have been written about the history of CT, but they don't describe anything that I recognize. They tend to project what ought to have been rather than was. There is a tendency to assume that a lot more occurred by planning than what actually occurred. . . . In fact, one thing tended to follow from the next. There were a lot of curves on the road that we hadn't anticipated. We took things as they came. A lot of people think of product development as involving a lot of planning, but I think the key is learning and an organization's ability to learn.” [88, p.61]

For GE, it was not simply learning, but fast learning from the past failures that helped GE win. In each round of product development, GE moved quickly to fix failures by learning rapidly from past mistakes. Microsoft is another example of a fast learning organization. The company's strength is not on producing revolutionary “Version 1.0” products, but rather in its teams ability to rapidly develop and commercialize version 1.1, 1.5, 2.0, 2.1, etc. Fast learning from customer feedback and previous versions help Microsoft's teams succeed. Sitkin [100, p. 245] also notes that “Making strategic failure feasible and useful involves insuring that action and feedback happens fast enough that data is quickly generated for evaluation and feedback, so that learning can occur expeditiously”

Based on this discussion, we can conclude that if new product teams learn quickly, they will have a greater probability of launching products faster and being more successful. Therefore, we can hypothesize:

H₁: Fast team learning is positively associated with launching a new product rapidly (i.e. speed-to-market).

H₂: Fast team learning is positively associated with new product success.

Speed in new product development is not new. Increased competition, rapid technological improvements, and quickly changing customer needs and wants force organizations to respond to these market and technical factors by developing new products faster than their competitors. Speed-to-market has become a priority (if not the highest priority) of many companies large and small. Rapid new product development is becoming essential in today's turbulent environments. Gupta and Wilemon [34, p. 25] state that "Companies are finding that they need to develop better new products and they need to do it faster." Wheelwright and Clark [120] state that firms who get to market faster create significant competitive leverage. Smith and Reinertsen [112] assert that if a product is introduced earlier, the company gains more customers, increases its market share, enhances its profit margins, extends its sale life, and obtains a more secure competitive position. Copper [13] states that speeding products to market yields competitive advantage and higher profitability. Uttal [118] asserts that in industries profoundly influenced by technological change, like electronics, reaching market 9 to 12 months late can cost a new product half its potential revenues. In the pharmaceutical industry, each day a drug is delayed to market can cost as much as \$1 million, and in the semiconductor industry, getting to market a few months earlier can produce over \$1 billion in additional revenue for a company [49, p. 311]. And, Lynn, Reilly, and Akgün [76] empirically found that speed-to-market is positively associated with new product success. Therefore, we hypothesize that:

H₃: Speed-to-market is positively associated with new product success.

Antecedents of accelerated learning

Background

Over the past several years new product development literature has provided insights into several factors that can help new product professionals innovate/develop new products faster. Significant clusters of techniques or methods include: using cross-functional teams ([15], [34]), securing top management support ([51], [78]), employing concurrent development techniques ([89], [117]), using technological tools (e.g. CAD/CAM) ([84], [91]), and cultivating external relationships (e.g., licensing, contracting) ([30]) to name a few. Although, we know a great deal about how to speed-up new product development processes, we know surprisingly little about how to speed-up or accelerate new product development learning processes. However, there is a rich body of knowledge in the individual learning literature on tools and techniques to help individuals learn quickly (see Table 1). The accelerated individual learning literature was built on the seminal works of Lozanov who developed techniques called suggestology to improve memory and brain capacity of individuals [69, 100]. Accelerated learning methods emphasize multisensory approaches, music, colorful visual displays, interaction in classroom settings, games, relaxation, etc. to help students to learn faster [100].

Because of the extensive research that has been completed on accelerated individual learning, perhaps this scholarship can provide a foundation for building an accelerated learning or fast learning new-product-development model. Several organizational theorists, however are skeptical about applying individual learning models to an organizational setting. Weick [119] and Argyris and Schön [5], for example, state that organizational learning is fundamentally different from individual learning.

They assert that each requires a different conceptualization [96]. For instance, Daft and Weick [16] state that organizations do not have brains unlike to individuals, rather they have cognitive systems and memories (norms, culture, filing and documentation systems). Simon [109] emphasized that an individual's learning ability is more restricted than the organization's (e.g. bounded rationality). He states that individuals learn within the context of organizations and this context impacts their learning. Stata [113, p.64] explains that organizations can learn only as fast as the slowest link learns (organizational learning builds on past knowledge and experience or memory) and hence is fundamentally different than individual learning.

On the other hand, several scholars have demonstrated a link between individual and organizational learning. For instance, Kim [58] developed a conceptual model that links individual and organizational information with mental models to transform individual learning to organizational learning. He demonstrated a conceptual model called OADI-SMM -- Observe, Assess, Design, Implement, Shared Mental Models -- to transfer learning among individuals to enhance organizational learning. Other scholars, such as Hedberg [38, p. 6] state that “. . . in fact no theory of organizational learning is based primarily on observations of organizations' behavior. Instead, experiments with individual humans, mice, and pigeons provide the bases upon which theories of organizational learning are mostly built.” Popper and Lipshitz [96] postulate several similarities between individual and organization learning. They state that individuals have cognitive systems that enable them to think, reflect and act, which are similar to (although not exactly the same as) organizations. Laszlo [63] asserts that there are many operational similarities between the human brain and organizations in their information-processing systems. Lynn and Akgün [75] modified individual learning constructs – declarative knowledge (knowing *what* to do) and procedural knowledge (knowing *how* to do) -- and tested these constructs on 137 new product teams. They found that declarative and procedural knowledge significantly impacted

new product success. And, Garud and Kotha [26] developed a model based on the workings of the human brain and applied it to flexible manufacturing systems within an organization. Even though the human brain and flexible manufacturing systems are fundamentally different concepts, Garud and Kotha [26] demonstrated the theoretical and operational similarities between the two concepts.

We used a similar methodology of Garud and Kotha [26] to link individual learning and team learning based on the theoretical similarities between them. Garud and Kotha [26] used three levels of comparisons in their conceptual study to link two different domains (source and target) including: metaphorical level, analogical level and level of identity. Metaphorical level shows the abstract and insightful similarities of source and target. Analogical level shows the operational similarities between source and target. Level of identity supports the analogical level with a theoretical basis. In this study, we used individual learning as metaphor for team learning same as had other scholars including Morgan [87], Dodgson [22] and Hedberg [38]. For our study, the analogical level demonstrates the operational similarities between accelerated individual and team learning (for instance, individuals have clear goals before performing any task -- similarly teams should have a clear goal before starting a project. Individuals should have support from parents and/or teachers for fast learning -- similarly teams need support from top management).

In this study, we first adapted several antecedents of fast team learning from the accelerated learning scholarship (see important factors in Table 1). We then clustered them into groups to formulate a more parsimonious model that includes: 1) motivating factors, and 2) information gathering, processing and transferring factors. This model – accelerated learning is consistent with the work of Rose and Nicholl [100].

Motivation factors:

Motivation factors are the primary conditions to help individuals learn faster. These factors are: having a clear learning goal, support from parents and teachers and an urgent need to learn faster.

The individual learning literature argues that if individuals have clear goals or vision, they can learn their tasks faster. Lucas [71], for example, states that a clearly defined vision helps individuals arrange their various priorities and keeps them focused on the task, enabling the individual to learn faster. Russell [103, p. 22] states that “there is no learning, accelerated or otherwise, without a clear understanding of the scope of the need.” In a similar sense, having a clear team vision should help team members focus better on changes in the market, technology, and environment that can be obstacles for rapid team learning. Several scholars (e.g. [18], [33], [81]) have also discussed the importance of having a clear vision on an organization’s/group’s ability to learn. Kessler and Chakrabarti [53], for instance, argue that teams without a clear vision (having ambiguous project concepts) promote suspicion and conflict on a team about what should be produced, which can result in time-consuming readjustments and debates. Also Jeris, May and Redding [46] drew conclusions by studying three groups at a graduate level course that when team members have the concern about the direction of team activities, speed of team learning increases. However, they did not empirically test their proposition yet.

Although organizational/group theory scholars have not directly addressed the impact of vision clarity on fast team learning, given the literature in individual learning, we hypothesize:

H₄: Vision Clarity is positively associated with fast team learning.

The individual learning literature asserts that having clear goals or a clear vision is not sufficient for fast learning. Support from parents and teachers also impacts the ability of individuals to learn quickly

[10, 100]. Support from parents and teachers provides motivation for students when they are trying to learn a new task. This finding is consistent with Butty [12] who states that each student needs to be motivated to learn. In a team setting, top management assumes many of the same roles as the parent or teacher. Top management is responsible for helping to create a stimulating, nurturing and supportive environment [33]. Top management can promote motivation in several ways: 1) by providing sufficient funds and resources for the teams, 2) by empowering team members with the necessary authority, 3) by mentoring team members and team leaders and 4) by removing obstacles during the project. In light of the findings from the individual learning scholarship of the positive association of support on rapid learning and the role that top management plays in this support for new product development, we hypothesize:

H₅: Top management support is positively associated with fast team learning.

Another motivating factor is urgency. Urgency in the classroom has been shown to stimulate fast learning. For example, Rose and Nicholl [100] state that making problems urgent motivates individuals to learn quickly. A similar sentiment is also emphasized in the management literature. Schein [104], for example, asserts that organizations should create a sense of urgency, guilt or anxiety to speed-up learning. He states that management should create an atmosphere that the organization is in trouble, that profits are declining, and competition is getting more intense. Andy Grove at Intel tries to instill a sense of paranoia in his employees so that they will learn and act faster [108]. His mantra “only the paranoid survive” is well known throughout the company. Similarly, Bill Gates believes his role as CEO of Microsoft is to create a sense of urgency. He states that “As an act of leadership, I created a sense of crisis about the Internet in 1994 and 1995. Not to leave people paralyzed or unhappy, but to excite them into action.” [28, p. 181] However, in the new product development teams, a sense

of urgency can be created in many different ways. One technique to create urgency is by having an aggressive launch date. Jarvenpaa, et al. [45] state that a sense of limited and explicit time increases team performance. Meyerson, et al. [82, p.190] mention that a limited time in the groups reduces jealousy, misunderstanding and ambiguity in the team member activities, because there is not enough time to waste. And, Cooper [13] states that deadlines are critical in new product development and they must be aggressive, causing team members to stretch a bit. Thus, we hypothesize that:

H₆: Aggressive launch dates are positively associated with fast team learning.

Information gathering, processing and transferring

The second cluster of factors is information gathering, processing and transferring. Information is an input in the learning equation. Information gathering gives people the opportunity to learn and therefore act on that information faster [4]. For instance, Anderson [4] states that individuals should first gather information (e.g. declarative knowledge) to develop an interpretive mechanism (e.g. mental models [47] or schema) which can be used in different contexts to increase speed of learning and generate new knowledge. In this vein, information gathering helps people to learn faster to perform new tasks. For instance, Kieras and Bovair [55] tested whether information gathering can accelerate learning. In their experiment, they divided subjects into two groups. The first group learned the set of operating procedures for the device by rote and another group learned the device model before the identical operating procedures training. Results showed that the second group learned procedures faster and more accurately than the rote group, implying that information gathering accelerates learning.

For new product development teams, gathering information from customers, competitors, and the environment should enable a team to learn and to act faster [77]. Guns [33] states that benchmarking

from customers and competitors is essential for fast organizational and team learning. Slater and Narver [111, p. 67] state that the ability to gather information from customers and competitors gives companies an advantage in the speed and effectiveness of their responses to opportunities and threats. Day [20] argues that when firms learn from customers and competitors, they will have the ability to sense events and trends in their markets ahead of their competitors. Iansiti [44] asserts that during the development stage of a product, continuous acquisition of customer and competitor information and continuously incorporating this information into prototypes and models help teams to learn faster about changing customer needs and competitive reactions. And, in their study of boundary spanning, Ancona [1], and Ancona and Caldwell [2] demonstrate that actively observing external environments increases team performance. They empirically found that when teams (i.e. probing teams) scan market and technical environments, communicate with outsiders and initiate programs with them, teams perform internal activities better, and increase long-term success. However, they did not test the direct impact of boundary spanning on fast team learning. Therefore, we hypothesize that:

H₇: Learning about customers is positively associated with fast team learning.

H₈: Learning about competitors is positively associated with fast team learning.

Another technique to aid in gathering information is using past learnings. Holyoak and Thagard [41] mention that individuals who try to match past learnings with new conditions are faster learners. Similarly a new product team that reviews past lessons learned should be able to learn faster. Team members can do this by reviewing past project files and by meeting with members of other teams both informally and formally. Karagozoglu and Brown [51, p. 213] state that “a commitment toward continuous and frequent improvement driven by a rich repertoire of past experience reduces technical

difficulties and NPD delays.” Past product reviews thus provide a cumulative learning base that can help managers and team members to learn faster. Therefore, we hypothesize that:

H₉: Past product reviews are positively associated with fast team learning.

After team members have gathered information, the information must be processed before it can be meaningfully shared with others on the team for effective team learning to occur. However, information that makes sense to one person may be confusing to another. A situation of student notetaking is a case in point [36, 57]. If one student takes notes and gives them to another who missed class, the recipient is likely to have difficulty understanding them if he/she simply copies them word-for-word [56]. To increase the knowledge-transfer, the recipient must re-state and re-code the information so that he/she can internalize the data and turn it into usable information. In a team setting, organizing or coding information into meaningful clusters can impact the effectiveness and the rate at which teams learn. Coding information encompasses labeling, indexing, sorting, abstracting and categorizing [121]. Davenport and Prusak [19] explain that codification organizes information and knowledge making it easier to understand and communicate. Tidd [116] mentions that the speed and extent knowledge sharing between members of an organization is a function of knowledge codification. Therefore, we hypothesize that:

H₁₀: Information codification is positively associated with fast team learning.

The final factor to accelerate learning is frequent review of the material that the team has collected. In the individual learning environment, if parents and teachers frequently inquire about what students have learned during the day, individuals can learn new tasks faster, because frequent reviews of past events keep individuals’ short-term (working) memories active [4]. An active short-term memory

helps individuals to use less effort to recall thoughts because having a larger short-term memory makes it easier to establish links between the new information and long-term memory [4]. The analogy is similar to using computer RAM (short-term information in memory) versus a computer's hard drive (long-term) -- accessing RAM takes far less time [100]. In a similar fashion, individuals can learn new tasks faster by having a larger and more active short-term memory. In a new product team setting, conducting daily reviews can help keep knowledge and information in short-term active memory and thus increase fast learning. For instance, analyzing the previous day's meeting reports and action items, reviewing information about customers, competitors, suppliers, and available technologies as well as technical reports can help team members to keep this information active in their short-term memories. Therefore, we believe:

H₁₁: Daily reviews are positively associated with fast team learning.

Figure 1 demonstrates our hypotheses in a graphic format.

Methodology

Sample

To test the above hypotheses, a questionnaire was developed based on previous research from several disciplines including: new product development (e.g. [7], [14], [51], [80], [84], [91]), marketing (e.g. [20]), knowledge management (e.g. [18], [74], [101]) and psychology (e.g. [62], [68]).

After designing and refining the questionnaire, we selected a contact person in a variety of technology-based companies in the Northeast to participate in this study. The selected projects must have been commercialized and launched into the marketplaces.

The targeted respondents were predominantly product/project managers and senior level people in teams¹. We selected these respondents because Lukas and Ferrell [70], and Podsakoff and Organ [95] found that managers rely on their own self-reports and provide reliable and objective data. As Huber and Power [43] note, simply averaging multi sources is less likely accurate than when using a key informant.

After we selected the respondents, each was informed that his/her responses would remain anonymous and the responses would not be linked to a company or product name. As Huber and Power [43] stated this approach increases the motivation of informants to cooperate without fear of reprisal.

Of the 420 people asked to participate, 350 of them completed and returned a questionnaire (an 83% response rate). However, we did not use all the surveys; we performed a survey and data purification procedure. First, since the range of project duration (2 months to 15 years) can impact results, we selected projects that occurred over the last 5 years to reduce recall loss. Second, due to single-source response, we used the surveys whose respondents were on the project from project go-ahead to product launch. To increase internal validity, we asked the same questions using different words in different parts of the survey to make sure responses were reliable. For instance, we asked “The pre-prototype design goals remained stable through launch” on one page, and on another page we asked, “The design goals remained stable from pre-prototype through launch”. If the response to these questions was not the same or not close to each other, we deleted that survey from our analysis.

After purification we had 172 available projects that met all screening criteria and these were used as our sample. We then augmented the questionnaires with personal interviews of team members involved in the projects to gain a deeper understanding of the dynamics of the projects and to validate

¹ The sample of respondents in this study was similar to samples used in prior studies on innovation (e.g. [25], [61], [98], [115]).

and clarify responses. In many instances several people on teams were interviewed. In total, 276 interviews were conducted lasting on average 30 minutes. We incorporated the insight we received from interviews into the discussion and implementation sections. Several industries were represented that included: telecommunications, computers and electronics, fabricated metal products, information services, pharmaceuticals, chemical manufacturing, food manufacturing, and machinery manufacturing.

Measures

To operationalize the constructs, we used 0 to 10 Likert scale multi-item questions (0=strongly disagree to 10=strongly agree). Questionnaire items are shown in the Appendix. Since, most of our variables were adapted from literature, we explained the new variables and some pre-developed variables broadly.

Fast Learning: Six questions were asked to measure fast learning including fast information gathering and dissemination as well as stupendous performance in the new product development process and the product. Fast information gathering, sharing, and dissemination items were modified from research on traditional team learning of Brooks's [11] to accelerated team learning format.

The stupendous job of discovering market, technical, and customer problems items were modified from Lynn et al. [73]. In their study, Lynn et al. [73] showed that fast learning from failures (probing and re-probing) is important for new product development teams. Their case studies demonstrate that teams discover technical and market shortcomings of products in each round of probing and incorporate new learnings into the new version of products. Sitkin's [110] conceptualization about fast learning from past failures also demonstrates that outstandingly discovering the problems is a component of speed

learning. After we identified fast learning questions, we tested these items with 54 project managers, with whom we had familiarity and personal contacts. All items demonstrated high inter-item reliability (i.e. Cronbach's alpha) and the mean of these items was used as our measure for Fast Learning.

For aggressive launch date, we used three questions including if there was a tight schedule and an aggressive launch date. These items were developed based on the personal communications with project/product managers in the industry. These items had high inter-item reliability and therefore, the mean of these items was used as the Aggressive Launch Date measure.

Daily Reviews were operationalized by asking two questions. This construct was developed based on the personal communications with project/product managers in the industry. The mean of these items was used as Daily Reviews measure.

For new product success, 11 items were asked that included: meeting or exceeding managerial, cost, profit, and technical expectations of the new product. These items were adapted from Copper and Kleinschmidt [14]. The means of these items were calculated and then used to measure for New Product Success.

For speed-to-market-- the ability of a team to develop and launch a new product rapidly, the question items were adapted from Meyer and Purser [80], Millson, Raj, and Wilemon [84] and Kessler and Chakrabarti [54]. Since we used a multi-company and multi-industry sample, we tried to control for speed-to-market differences in the nature of projects by using relative speed measures. The approach and item content we used was similar to that of Kessler and Chakrabarti [54] to measure speed-to-market. Speed-to-Market was assessed relative to pre-set schedules, company standards and similar competitive projects. All speed items showed high inter-item correlation and their mean was used as our Speed variable.

Measure Reliability and Validity

Before doing any further analysis, the reliability and validity of our constructs were tested. The diagonal of Table 2 shows Cronbach's alpha for each construct. Alpha coefficients of all 11 constructs are equal to or greater than 0.65, which indicates good reliability as suggested by Nunally [93].

We performed a Confirmatory Factor Analysis (CFA) by using EQS 5.7 [9] to assess the discriminant validity for the 11 measured variables recommended by Anderson and Gerbing [4] and Bagozzi et al. [8]. Since endogenous variables (i.e. fast learning, speed-to-market, and success) seem like have similar items, a series of two-factor models was estimated in which individual factor correlations, one at a time, were restricted to unity. The fit of the restricted model was compared with that of the original model. In total we performed 3 models -- 6 pairs of comparisons. Chi-square change ($\Delta\chi^2$) in each model was performed by constrained and unconstrained and were significant at $p=.001$ level which suggests that fast learning, speed-to-market, and new product success constructs demonstrate discriminant validity. For instance, for the model of fast learning and new product success, unconstrained χ^2 was 171.26 with 89 degrees of freedom, while constrained χ^2 was 257.08 with 90 degrees of freedom.

The measures were subjected to further confirmatory factor analysis through EQS 5.7 [8]. All 11 factors were investigated in one CFA model. During the CFA analysis we used subscales for confirmatory factor analysis instead of individual items as recommended by Drasgow and Kanfer [23], Schmit and Ryan [105] and Schmit, Ryan, Stierwalt, and Powell [106]. These researchers noted that goodness-of-fit measures are affected when the number of items used to identify a small number of factors is relatively large. Consistent with this approach, two subscores for each scale were created, each consisting of a randomly divided subset of the items in the scale. The CFA produced a good fit with a normed fit index of .93 and a comparative fit index of .99. Table 1. also shows the correlation

among all 11 variables. The relatively low to moderate correlations provide further evidence of discriminant validity.

Analysis and Results

A data screening procedure was performed as suggested by Tabachnick and Fidel (1996). A frequency analysis was used to detect univariate and multivariate outliers. No univariate outliers were found. The criterion for multivariate outliers is Mahalanobis distance at $p < .001$ [114]. In this logic, we checked the Mahalanobis distance for each case. We found one case that had a high Mahalanobis distance and we deleted that case in our sample reducing our sample size to 171. Skeweness and Kurtosis of each variable were checked. We then normalized the variables that had high Skeweness and Kurtosis, including: learning from customers (kurtosis=1.56) and aggressive launch date (skeweness=1.8, kurtosis=-1.10). Since the correlation coefficients among some variables were around .5 as shown in Table 1, we checked the variance inflation factor (VIF) to find out whether multicollinearity existed among the variables. We used success as a dependent variable and ten other variables as independent variables. Then we regressed success on all independent variables. VIFs were under three which demonstrates that multicollinearity was not a problem as suggested by Neter et al. [90].

After data screening, a Structural Equation Model (SEM) was performed using AMOS 4.0 to test our hypotheses. Since we assumed that our variables were normally distributed, we used the Maximum Likelihood (ML) method for the structural equation model [50].

The results indicate that the conceptual model fits the data (see Table 3). Normed fit index (NFI) and comparative fit index (CFI) are all equal to or exceed 0.9 as suggested by Hatcher (1994).

Hypotheses 1 and 2: Hypothesis 1 and 2 show the consequences of fast team learning. Consistent with H₁, cycle time is influenced by fast team learning (t=4.58, p<0.001), as is new product success (t=4.10, p<0.001, supporting our H₂).

Hypothesis 3: Consistent with H₃, success of the new product is influenced positively by launching a product into market faster (t=7.02, p<0.001).

Hypotheses 4 through 11: In H₄ to H₁₁, the antecedents of fast team learning were tested. Table 3 shows the impact of each antecedent variable on fast team learning. Results show that vision clarity (H₄; t=4.86, p<0.05), learning from customers (H₇; t=1.71, p<0.1), learning from competitors (H₈; t=6.28, p<0.001), and information coding (H₁₀; t=4.41, p<0.01) are significant and positively associated with fast team learning, supporting corresponding hypotheses. However, management support (H₅; t=0.96), aggressive launch date -- deadlines (H₆; t=1.13), past product review (H₉, t=1.51), and daily reviews (H₁₁; t=.43) are not significant for fast team learning. Therefore H₅, H₆, H₉ and H₁₁ were not supported.

Table 3 shows the coefficient of determination (R^2) of fast team learning (35%), speed-to-market (11%) and new product success (36%). Indicating that using this fast team learning model, we can explain a significant portion of the variance in each of the exogenous variables.

Discussion and implementations

This study shows that fast team learning is associated with a greater probability of commercializing new products quickly (H₁) and being successful (H₂). This study also showed that several factors are associated with fast learning for new product development teams. These include a clear project vision at the beginning of a project (H₄), learning from customers (H₇) and competitors (H₈), and coding information and knowledge (H₁₀).

New product teams should strive to establish a clear vision early in the project to identify required product futures, target markets, and sales objectives. This assertion is consistent with prior scholarship. For instance, Davenport, Long, and Beers [19], by studying 31 projects in twenty-four companies, found that clear goals lead to higher knowledge management and success.

Teams should capture external information, such as by having a rapid and continuous flow of information by sales people and marketing research personnel about customers and competitors. This finding is consistent with the boundary spanning studies of Ancona [1], and Ancona and Caldwell [2]. Their studies show that when teams scan and learn from external environments, they perform better with a high probability of success rate. Also our interviews with team members and managers reveal that top management can foster this by forming a knowledge team to monitor and capture this information. Schein [104] suggests a ‘transition group’ and Rothberg [102] mentions a ‘shadow team’ that monitors external environments to capture information about customers and competitors, and integrates intelligence to create new learning. There can be a person known as a linking pin (gatekeeper) between new product teams and the knowledge team, transition group, or shadow team. In this way, team members can obtain current external information. This knowledge management effort should be augmented with training for team members on where information is and how to access it.

After capturing information about customers and competitors, teams should codify or classify this information into meaningful clusters so that people can understand and internalize it. This finding is consistent with literature of schemata and scripts. When information is congruent with the mental model or schemata, individuals, teams, and organizations make sense of that information faster, leading to speedy learning. In this vein, an individual or small team, such as a knowledge team, can be formed for the purpose of codifying and clustering information into topics, sources, types, or importance levels

to create congruency with current understanding [27]. Then, these information clusters should be entered into a central database that everybody can easily access [27]. Again, training on using this information is critical, or else companies may find it has storehouses of information that are unused.

Interestingly, we did not find any significant relations between management support and fast team learning. This is surprising given the individual learning scholarship that indicates the importance of parental and teacher support on fast learning. One explanation may be how we operationalized management support; it was based on the moral support of the team members. Another explanation for this surprising result may be the level of uncertainty present in the new product teams we studied regarding the technology and the market. Jolly [49], for example, states that top management involvement and product champions are generally correlated with success but *not* under the conditions of high technological uncertainty. Because, our research sample consisted mainly of high-tech industries as defined by Joint Economic Committee of the U.S. Congress [48], that involves greater degrees of uncertainty, moral support from top management is rarely forthcoming for high-tech, high-risk projects.

Also, we found past product reviews were not associated with fast team learning. One explanation of this finding may also be related to the types of projects and environments. Under turbulent conditions, past lessons learned may not impact fast team learning, due to quickly changing industry dynamics. Past product review and fast team learning merits future research for different types of environments (turbulent, stable, etc.).

For H_{10} – daily meetings, the explanation of this finding may be due to the need for daily reviews at different stages of development. At the beginning of a project, daily reviews may be helpful in formulating the project vision and charter, but as the project becomes more solidified, daily reviews may slow down learning, because team members know what to do, they have their “orders” and need to

be given the time to accomplish them. Also, our interviews with project managers and discussions with scholars show that teams with formal daily meetings tend to be those that were not effectively communicating information on an ongoing, informal basis in the course of their daily work.

Interestingly, we could not find any association between fast learning and an aggressive launch date. A tight deadline forces teams to gather, create and disseminate information quickly and work intensely. However, a tight deadline coupled with fast learning may have some deficiencies. Since project duration is limited, teams use the information that is quickly gathered. However, that information might be wrong. For instance, simulation studies of Herriott, Levinthal, and March [40] and Levinthal and March [66] showed that fast learning may lead to premature information, because the first signal might be wrong. In this sense, aggressive launch date reduces effective fast team learning. Besides the impact of gathering wrong information due to a tight deadline, our interviews also show that if teams want to learn faster to be successful, a tight/aggressive deadline should be determined by team members not from the top management. If top management imposes a deadline, team members just perform to fulfill the top management wishes, not fast learning for the benefit of the project.

Conclusion

This paper makes three contributions to current knowledge on speed learning in new product development teams. First, it emphasizes the importance of fast learning on new product development demonstrating that fast learning is a critical component of new product development. Second, it empirically demonstrates that fast learning is positively associated with the ability of teams to 1) launch a new product to market quickly and 2) improve success. Third, it operationalizes and empirically tests the antecedents of accelerated learning on new product teams. This study shows that having a clear

vision of the project at project go-ahead, using learnings from customers and competitors, and codifying customer and competitor information will have a positive impact on fast team learning.

Study limitations and future research

There are several limitations in this study notably; single sourcing, self-report and retrospective reporting. Gupta and Beehr [35] and Aviolo, Yammarino and Bass [6] note that studies employing single-source methodology may be biased by artifactually high intercorrelations because of an overall positive. Aviolo, et al. [6], noted, however, that simply assuming that single-source data is less valid than multi-source data is overly simplistic. In addition, much of the research on the effect of single-source bias has been done with instruments that involve social perception (e.g., ratings of the performance of peers or supervisors). While it is not our intent to minimize the potential effects of response bias, the kinds of information sought in the present survey tended to be more objective in nature than many surveys used in research in the social sciences. Implicit theories and other cognitive frameworks applied by respondents to social-perceptual stimuli, may not apply to the same extent with our survey. For example, responding to questions regarding the speed with which a project is finished should be based on objective data. Likewise, information coding in a project should be less affected by biasing influences than other types of information. Also, confirmatory factor analysis demonstrates high fit indexes indicating less of a common method bias problem. And the path model is based on a set of hypothesized relationships that are supported by the literature and provide a reasonable fit to the data.

To reduce the possible problem with single sourcing, we sampled product/project managers and senior level people in teams as the key informant. Houston and Sudman [42] found that informants respond differently to the same questions concerning role-related aspects of their positions. Kumar, Stern, and Anderson [60] also note that “response error is likely to be higher for informants whose

roles are not closely related to the concepts under study.” Since, product/project managers in teams view the bigger picture of projects than other team members, they provide more reliable and objective data. Podsakoff and Organ [95], and Zahra and Covin [122] also found that managers rely on their own self-reports and provide reliable and objective data.

Since we use retrospective reports, we checked the halo effect on our variables by following the procedures of Henik and Tzelgov [39]. During the analysis, we created a dummy variable showing the difference between the time the project started and when the survey was completed. A series of multiple regression models were run involving the dummy variable as a suppressor. The least square weights of the independent variables were less than correlation coefficients showing that the suppressor was not capturing a halo effect. Also, Miller, Cardinal, and Glick [83] suggest that retrospective data is an acceptable research methodology, when reported measures are reliable and valid. And they [83, p.189] state “Retrospective reports should neither be rejected nor used indiscriminately.” For this research, we found that our measures demonstrate reliability and validity. We also predominately used measures that were well established in the literature.

In future studies, direct impact of exogenous variables on speed and success can be tested. In this paper we showed that exogenous variables have an impact on speed and success by way of fast team learning.

In this study, we operationalized some of the suggestopedic variables. However, in future studies this model can be expanded. For instance, how visual communication (e.g. using video conferencing), new product development process simplification (e.g. using standard components), informal communications, experimentation, learning by doing (e.g. team improvisation), team autonomy, simulation tools, CAD/CAM, rapid prototyping, and team unlearning or belief changes impact accelerated team learning can be investigated.

One of the applications of suggestology is to improve the individual's intelligence and create a super-human [69]. With appropriate modification, we can develop some methods and models to help the new product development team to increase its intelligence or to create an intelligent new product development team. Also, using accelerated learning models, we can create links across people on a team by using the analogy of Linksman's [67] superlinks between the right and left brain.

This research just scratches the surface in this important, but understudied field. Future researchers will find this area of speed learning rich and fruitful.

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Figure 1.
Fast Team Learning Model

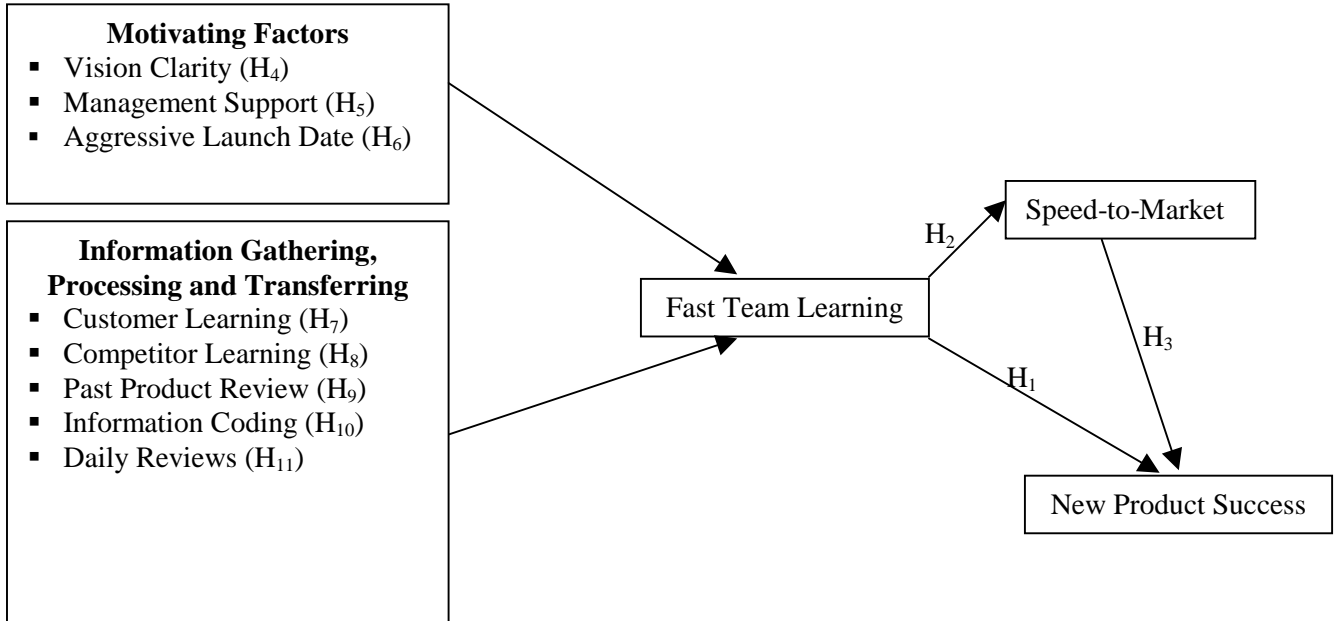


Table 1
Literature Review on Fast Learning

*: We used these studies to build up our theory and hypotheses.

Author	Study
Lozanov [69]*	<p>Developed new technique called suggestopedya to increase the memory and brain capacity and reasoning ability of individuals. He states that all instructions and training becomes pointless if the new knowledge, habits, and skills are not memorized and automated so that they can be used as a basis for future study (p.6). Suggestopedya started at a psychological experiment designed to increase memory capacities in the educational process (p.5) by creating learning conditions for speedy and automated (motor) actions. Suggestopedya makes it possible for individuals to use more direct paths than those normally used to penetrate into the mind for information acquisition, and information retrieval by paraconscious psychical activity. As a result, practices in suggestopedya intensively were applied to individuals in schools and hospitals. Its application in organizations has been receiving increased attention and many institutes try to apply this concept to individuals in an organization. Nevertheless, suggestopedya has not been applied to teams as a whole and critical factors were not tested empirically at the team level.</p> <p><i>Definition of fast learning:</i> Paraconscious mental activity which can create conditions to automate and effectively use memory, brain, and intellectual reserves of people.</p> <p><i>Important factors:</i> Sleep learning, hypnosis, motivation, intonation (music), interaction with environment, communication, non-directive authority, past experiences.</p>
Rose [99]*	<p>Described a step-by-step method for individual accelerated learning. He explores the role of memory and the brain on fast learning. Most of the accelerated learning factors he explained came from the suggestopedya of Lozanov.</p> <p><i>Definition of fast learning:</i> Setting up memorable visual and aural associations in the mind as well as subconscious learning (p.2).</p> <p><i>Important factors:</i> Visual images, music, rhythm, emotions, association and encoding of information, frequent reviews, motivation, imagination, learning by examples.</p>
Linksman [67]	<p>Demonstrated how individuals learn faster based on their learning types (e.g. visual, auditory, tactile and kinesthetic) and more active brain hemispheres (e.g. left and right).</p> <p><i>Definition of fast learning:</i> Making superlink between your left and right brain.</p> <p><i>Important factors:</i> Relaxation, motivation, clear objectives, documentation (note-taking), chunking and coding information, visual information, information acquisition, frequent review of past learnings.</p>
Rose and Nicholl [100]*	<p>Developed a six-step technique called MASTER to accelerate individual learning. These steps are: motivating an individual, acquiring the information, searching out meaning, triggering memory, exhibiting what individual knows and reflecting on how individuals learned. In their seminal study, they showed how individuals successfully complete each step to accelerate learning. They also emphasized the importance of accelerated learning for business and organizations. However, they concentrated on fast individual learning in organizations, not team learning as one unit.</p> <p><i>Definition of fast learning:</i> The ability to absorb and understand new information quickly and retain that information (p.18).</p> <p><i>Important factors:</i> Clear goals and objectives, deadlines, fast information acquisition, music, classifying and chunking information to remember easily, frequent review of past information, motivation, support, relaxation, sense of urgency, past experiences and analogies.</p>
Russell [103]*	<p>Explained how individuals learn faster in organizations. She focuses on the training site of accelerated learning in the work environment, and her assertions were based on how instructors can accelerate the learning of trainees. She suggested that instructors should develop different learning techniques for each intelligence type (e.g. visual, analytical, etc.) in the workshops. Her suggestions were extensively adapted from the seminal works of Lozanov.</p> <p><i>Definition of fast learning:</i> Changing behavior with increasing speed (p.4).</p> <p><i>Important factors:</i> Clear goals, prioritizing learning objectives, visual information, coding and chunking information (mnemonic), music, relaxed environments, communication.</p>
Lawlor and Handley [64]*	<p>Emphasized importance of learner-centered training by critiquing curriculum-centered training. They suggested tools, techniques and conditions for trainers to accelerate people's learning. The methods and techniques suggested to corporate trainers were adapted from the accelerated learning work of Lozanov.</p> <p><i>Definition of fast learning:</i> Adapting and learning new skills quickly.</p> <p><i>Important factors:</i> Goals, motivations, past learning experiences, attractive, and relaxing learning environment, interaction with people, knowing and understanding another perspective in the group, visualization, office yoga, note taking, and rehearsing.</p>
Gill and Meier [29]*	<p>Explored accelerated learning at Bell Atlantic as a new training method. They demonstrated a pilot application of accelerated learning on two customer-service-representative training courses and found that using an accelerated learning format reduced the cost of training courses more than 42 percent with improved employee productivity, job satisfaction, shorter training time and easier update of new courses. Their observations about accelerated learning on people were: higher team spirit, better problem solving ability, greater confidence, more accurate information to customers and higher sales rate.</p> <p><i>Definition of fast learning:</i> Providing effective training in a short period of time (p.63).</p> <p><i>Important factors:</i> Motivation and positive suggestion, metaphors and mnemonic devices, relaxation exercise, mind maps (information graphs), games, and collaboration.</p>

Table 2.**Correlation Matrix and Descriptive Statistics**

	1	2	3	4	5	6	7	8	10	11	12
1 Success	(.96)										
2 Speed-to-Market	.56*	(.87)									
3 Fast Learning	.50*	.37*	(.66)								
4 Customer Learning	.31*	.14	.33*	(.78)							
5 Competitor Learning	.28*	.16	.51*	.21*	(.88)						
6 Vision Clarity	.45*	.39*	.51*	.27*	.24*	(.82)					
7 Management Support	.30*	.41*	.31*	.20*	.10	.37*	(.85)				
8 Information Coding	.21*	.25*	.49*	.24*	.26*	.36*	.31*	(.79)			
10 Past Product Review	.27*	.09	.28*	.03	.19*	.32*	.19*	.18*	(.80)		
11 Aggressive Launch Date	.26*	.51*	.19*	.08	.06	.17*	.29*	.14	-.05	(.87)	
12 Daily review	.16*	.12	.20*	.16*	.18*	.08	.12	.19*	.20*	.17*	(.80)
Mean	6.68	6.59	6.96	5.46	4.96	7.86	7.15	5.39	4.81	7.75	3.64
Std. Dev.	2.82	2.47	1.51	1.85	2.56	1.56	2.13	2.33	2.43	2.17	3.09
Kurtosis	-.43	-.33	-.44	1.56	-.69	.003	.46	-.69	-.52	1.08	-.92
Skewness	-.81	-.57	.11	-.23	.12	-.63	-.87	.14	-.08	-1.10	.46

* P<.05 (two-tailed).

Alpha coefficients are shown in parentheses on diagonal.

Table 3.
Results of Structure Equation Model

Constructs	Hypothesis	Path Coefficient	t-value	Assessment (P≤0.1)
Fast learning → Speed-to-Market	H ₁	.33	4.58	s.
Fast Learning → New Product Success	H ₂	.27	4.10	s.
Speed-to-Market → New Product Success	H ₃	.46	7.02	s.
Vision Clarity → Fast Learning	H ₄	.30	4.86	s.
Management Support → Fast Learning	H ₅	.06	.96	n.s.
Aggressive Launch Date → Fast Learning	H ₆	.07	1.13	n.s.
Customer Learning → Fast Learning	H ₇	.11	1.71	s.
Competitor Learning → Fast Learning	H ₈	.39	6.28	s.
Past Product Review → Fast Learning	H ₉	.09	1.51	n.s.
Information Codification → Fast Learning	H ₁₀	.28	4.47	s.
Daily Review → Fast Learning	H ₁₁	.03	.43	n.s.

Note: Path coefficients are standardized.

s: significant, n.s: not significant

Learning from customers and aggressive launch date are normalized scores.

Fast Team Learning $R^2=.35$, Speed-to-Market $R^2=.11$, New Product Success $R^2=.36$

NFI= .93; CFI= .95

Appendix -- Measures

We used Likert Scale (0=Strongly disagree to 10= Strongly agree)

New Product Success ([14])

This product:

Met or exceeded volume expectations.

Met or exceeded sales dollar expectations.

Overall, met or exceeded sales expectations.

Met or exceeded the 1st year number expected to be produced and commercialized.

Met or exceeded profit expectations.

Met or exceeded return on investment (ROI) expectations.

Met or exceeded overall senior management's expectations.

Met or exceeded market share expectations.

Met or exceeded customer expectations.

Speed-to-Market ([54], [80], [84])

This Product:

Was developed and launched (fielded) faster than the major competitor for a similar product (for Gov. projects – than other organizations).

Was completed in less time than what was considered normal and customary for our industry.

Was launched on or ahead of the original schedule developed at initial project go-ahead.

Top management was pleased with the time it took us from specs to full commercialization (FUE for Gov. projects).

Fast Learning (New)

Information captured on customers' needs and wants was shared *quickly* throughout the team.

Test results on this product were shared quickly throughout the team.

When a new competitive product appeared on the market, the team was quickly informed of it.

The team did an outstanding job discovering technical shortcomings of this product.

The team did an outstanding job discovering marketing shortcomings of this product.

Overall, the team did an outstanding job correcting product problem areas with which customers were dissatisfied.

Vision Clarity ([68], [94])

The team had a clear vision of the required product features.

The team had a clear vision of the target market (user).

The team had a clear understanding of target customers' needs and wants.

The technical goals were clear.

Management Support ([74])

During team meetings, senior company management, if present, frequently made encouraging versus discouraging remarks.

When the team members asked for help from senior company management, they received it.

An executive champion/sponsor existed on this project.

Overall, senior company management helped surmount rather than create obstacles for this project.

Senior company management kept out of the way when their help was not solicited.

Aggressive Launch Date (New)

This project was completed on a tight schedule.

Senior Company management would agree that this project was completed on a tight schedule.

Overall, this project had an aggressive launch date.

Customer Learning ([7], [20])

During this project, there was a continuous flow of information about customer needs.

A customer council was formed, consisting of sophisticated users that meet regularly with marketing and engineering.

The team systematically monitored market needs.

The team created mechanisms (e.g. house of quality, QFD, etc.) for integrating customer requirements into product design.

Competitor Learning ([7], [20])

During this project, there was a continuous flow of information about competitive activity.

Team members had a thorough understanding of competitive products.

During this project, team members developed an appreciation for competitive intelligence.

The team compared costs and performances of competitive products at every step in the NPD process.

Past Product Review ([51], [101])

A formal analysis (written reports, memos, etc.) of relevant past internal projects was completed to build on past experience.

Team members had informal discussions with people who had worked on relevant, past, internal projects to build on past experience.

The project team members reviewed (formally or informally) information from past projects, during this project to build on past experience.

The past project review was filed with the central project file.

Information Codification ([18], [85])

Market information was summarized to reduce its complexity (if no marketing information, put "0" in blank).

Market information was organized in meaningful ways.

Technical information was summarized to reduce its complexity.

Technical information was organized in meaningful ways.

Daily Review (New)

From concept to prototype, the team held daily meetings to discuss the status of the project.

Through this project, the team held daily meetings to discuss the status of the project.