Developing High-Performance Cross-Functional Teams: Understanding Motivations, Functional Loyalties, and Teaming Fundamentals

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*Developing High-Performance
Cross-Functional Teams: Understanding
Motivations, Functional Loyalties, and
Teaming Fundamentals*

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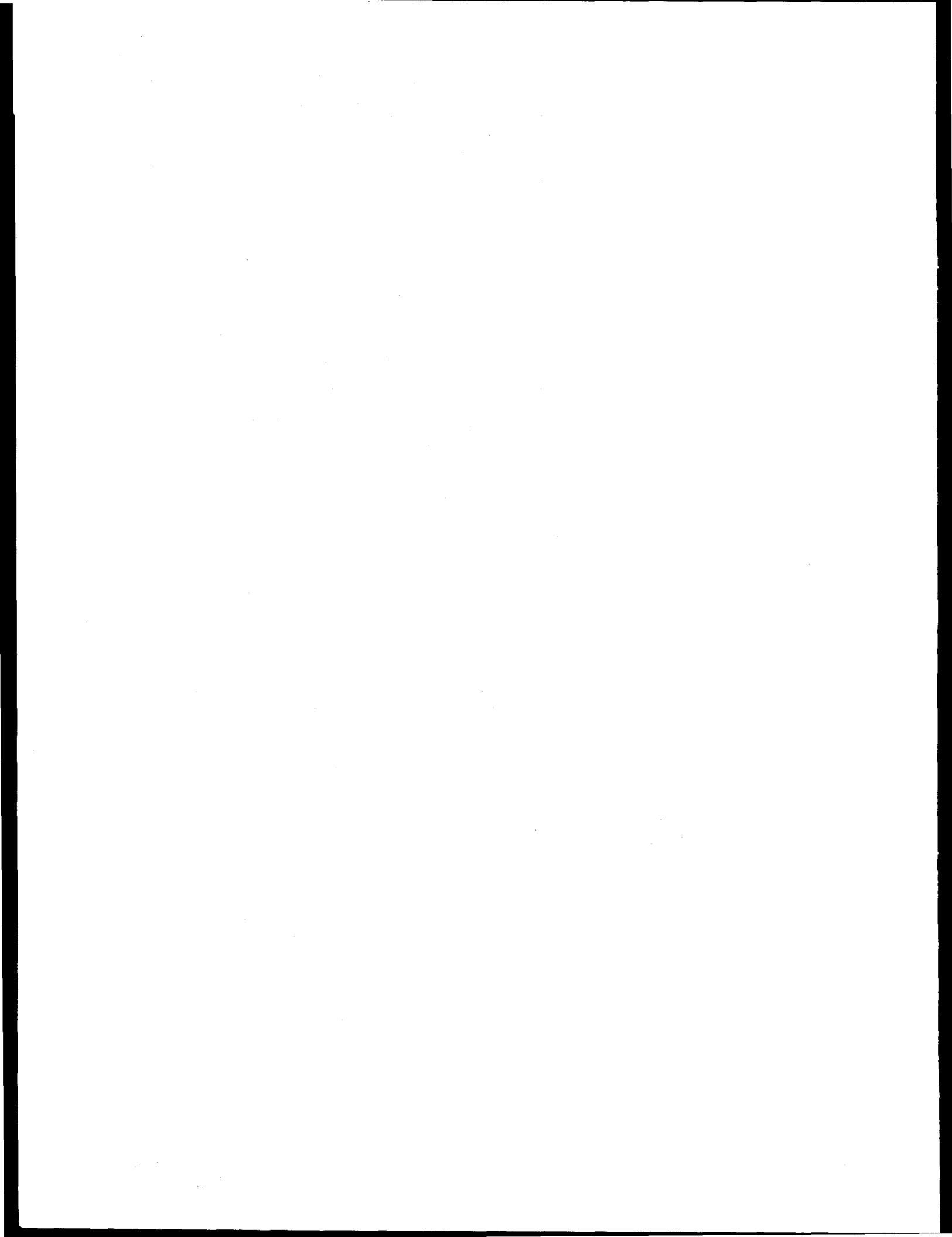
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ABSTRACT

Teamwork is the key to the future of effective technology management. Today's technologies and markets have become too complex for individuals to work alone. Global competition, limited resources, cost consciousness, and time pressures have forced organizations and project managers to encourage teamwork. Many of these teams will be cross-functional teams that can draw on a multitude of talents and knowledge. To develop high-performing cross-functional teams, managers must understand motivations, functional loyalties, and the different backgrounds of the individual team members. To develop a better understanding of these issues, managers can learn from experience and from literature on teams and teaming concepts.

When studying the literature to learn about cross-functional teaming, managers will find many good theoretical concepts, but when put into practice, these concepts have varying effects. This issue of varying effectiveness is what drives the research for this paper. The teaming concepts were studied to confirm or modify current understanding. The literature was compared with a "ground truth", a survey of the reality of teaming practices, to examine the teaming concepts that the literature finds to be critical to the success of teams. These results are compared to existing teams to determine if such techniques apply in real-world cases.
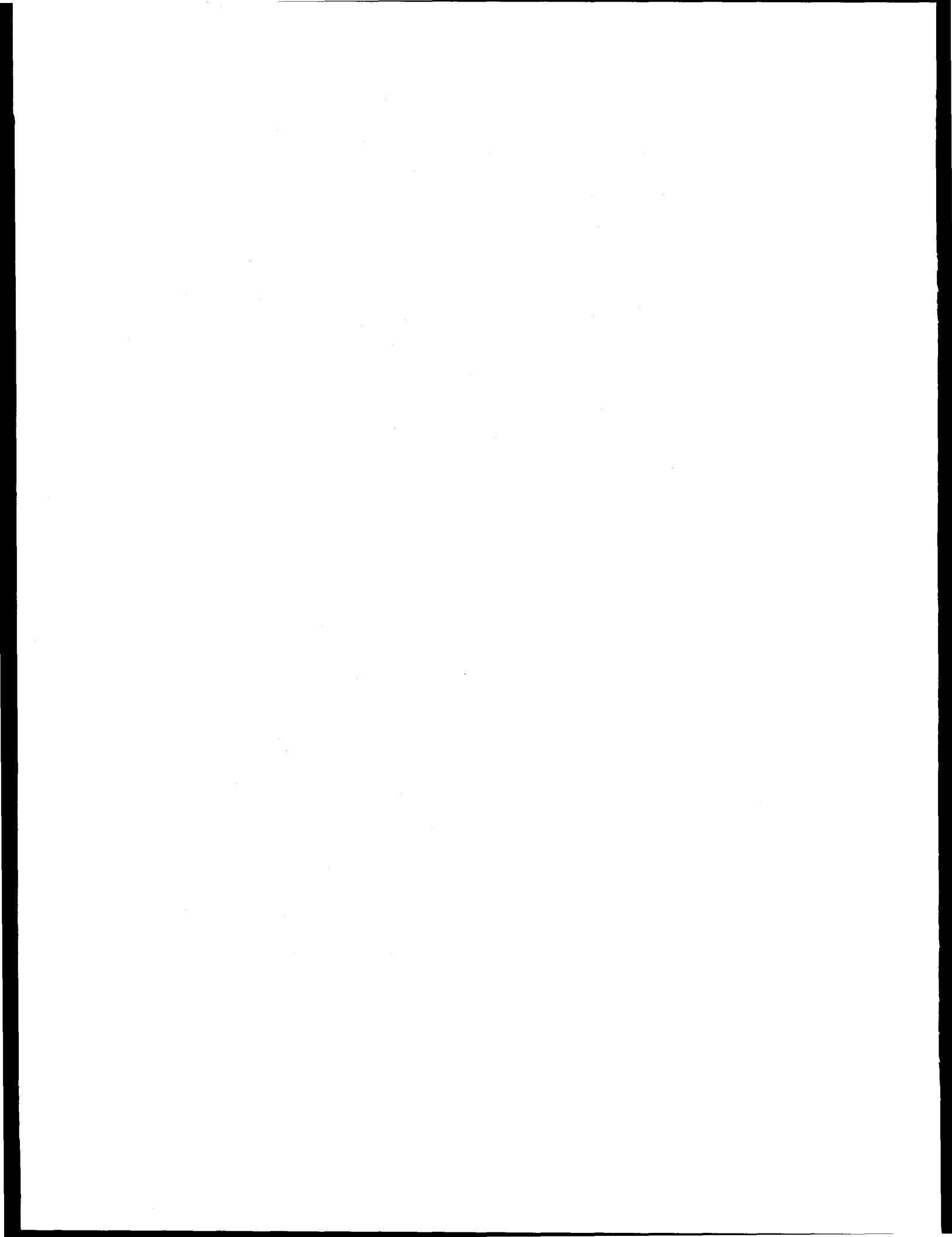
PREFACE AND ACKNOWLEDGMENTS

Teaming has always been an important part of my job and my life. I believe that working with others and helping each other ensures success in any endeavor. As a result of working at the Los Alamos National Laboratory, I have experienced teaming first hand. Since its inception, Los Alamos has assembled multi-disciplinary teams to meet complex problems or great importance to the United States. For example, during World War II the government brought some of the greatest minds together to help with a national security issue, and these people pulled together and successfully accomplished their objective. This tradition of teaming continues at this Laboratory today.

Working at Los Alamos, I have been involved in many teams, and many cross-functional teams, most of which have been outstanding experiences and successful ventures. For this paper, I studied several cross-functional teams to determine why people are able to succeed and team so well together. I wanted to understand why people are motivated to team together, when so many performance standards are based solely on the individual. Writing this paper proved an exciting opportunity to study something that I find extremely interesting; it also allowed me to work with people truly concerned with the spirit of teamwork.

I would like to thank the three teams that allowed me to interview and study them. They were great interviewees and

outstanding teams! I would also like to thank the Marketing and Commercialization team at Los Alamos for their inspiration as a truly high-performance team, and for their encouragement and support over the last two years.

I would like to thank Sarah Hayes, Jim Shipley, and Tom Baca (my management), for supporting me in this program, and thanks to Donna Berg at the library for her support and assistance. I especially would like to thank David Lux, my advisor, who I am convinced can read my mind.

EXECUTIVE SUMMARY

At the Los Alamos National Laboratory, multi-disciplinary teams have been used for 50 years, with technical people joining forces to solve technical problems. Now, with the end of the Cold War, and the introduction of new customers (industry, Department of Commerce, etc.), and new aspects of developing new products, a new component has been added to these cross-functional teams: a marketing and business component. Along with this component comes different backgrounds, functional loyalties, and motivations.

Managers must be able to understand these differences and issues in order to put together high-performing teams. When studying the literature to learn about cross-functional teaming, managers will find many good theoretical concepts, but when put into practice, these concepts have varying effects. This issue of varying effectiveness of concepts in the literature is what drives the research for this paper.

This paper is based on testing the understanding of three key principles found in the literature:

- the effects of rewards on teaming
- the effects of training on teaming
- the effects of management support on teaming

These principles were studied to confirm or modify current understanding of these teaming concepts. For this study, structured, open-ended interviews were conducted with members of three new product development teams at the Los Alamos National Laboratory to study these cross-functional teaming issues.

The outcome of this paper is to classify teaming issues that arose out of the interviews into a taxonomy of seven nominal categories. These factors are based on the perceptions of the interviewees regarding motivation, training, and management support as they apply to cross-functional teaming.

A. INTRODUCTION

"Motorola, recently acclaimed for surpassing its Japanese competition in producing the world's lightest, smallest, and highest quality cellular phones with only a few hundred parts versus over a thousand for the competition, relied heavily on teams to do it. So did Ford, which became America's most profitable car company in 1990 on the strength of its Taurus model. At 3M, teams are critical to meeting the company's well-known goal of producing half of each year's revenues from product innovations created in the prior five years. General Electric has made self-managing worker teams a centerpiece of its new organization approach."[1]

The future of technology management belongs to effective teamwork because today's technologies and markets are too complex for individuals to work alone.[2] Global competition, limited resources, cost consciousness, and time pressures have forced organizations and project managers to encourage teamwork. In the average organization, more than fifty percent of employees are members of some type of team.[3] With this large number of individuals involved in teamwork, teaming is an important issue for managers and an important issue to study.

The methodology to develop an effective team infrastructure is a crucial component of a successful team. In the last decade, this and other teaming issues have come to the forefront of critical study by researchers and management consultants. The literature on the subject of teaming is plentiful, and the subject of cross-functional teams is beginning to be addressed as well. The goal of much of the literature is to tackle and attempt to resolve many of the underlying barriers to developing and implementing successful teams. This paper will review the literature and compare the teaming concepts and suggestions to the actual case studies of teams developed and implemented at the Los Alamos National Laboratory.

The Los Alamos National Laboratory was built on a foundation of cross-functional teaming not found many other places. The mission of the Laboratory to develop the first atom bomb was a race to the finish in competition with other countries for a power beyond comprehension. The teamwork demonstrated by the scientists, engineers, machinists, etc., during that time was what gave the United States the advantage, and what helped to end the war.

The advantages that this team had over other teams (Germany also had worked on similar weapons without success) were its unique balance, a common goal, and its dedication to creating a final quality product. This type of multi-disciplinary teamwork is what Los Alamos prided itself on 50 years ago, and is what Los Alamos prides itself on today. This Laboratory has a unique culture and the human resources to develop cross-functional teams.

In the last several years a new dimension has been added to the scope of work for Los Alamos scientists. The Cold War ended and new challenges presented themselves to these scientists, such as working with industry. The scientists have been asked by their funding agencies to develop new products and commercialize these products as a requirement for funding. In addition to this new scope of work, a new dimension was added to the multi-disciplinary nature of the Los Alamos teams, this was a marketing and business component. In order to work effectively with industry, marketing and business representatives have been required to perform the business aspects of the partnerships. It has formed a type of comparative advantage for the Laboratory by allowing the scientists to continue to do their technical work, while the business and marketing representatives perform their function.

The transition to these new cross-functional teams has not been easy, and it is by no means complete. Many at the Laboratory see marketing as a "soft" function, one without "real" meaning; others have embraced the concept wholeheartedly. As one technology consultant, Robert K. Carr, said, ." . . if the federal laboratories want to compete in the commercial marketplace of ideas, they must practice more aggressive marketing." To create an atmosphere in which marketing is seen as an important or necessary function for the Laboratory, marketing representatives must work on a one-by-one, person-by-person basis.

These "new-styled" teams at Los Alamos have achieved varying degrees of success. Some teams have done extremely well, others have struggled. Several teams have adapted to the changes and are working towards successful new product development. Scientists who have adapted now take advantage of these new, effective marketing and business functions. Although some researchers may never change, preferring to concentrate on pure research or academic pursuits, those scientists who have changed are already reaping the rewards associated with product commercialization.

Managers at the Los Alamos National Laboratory, as well as managers in other organizations, must deal with the issues that arise when trying to implement cross-functional teams. By under-standing some of these issues (such as motivations, functional loyalties, and team commitment) managers can build more effective, higher performing teams whose objectives and individual motivations are coordinated or at least similar. Understanding these issues is crucial to building an effective team.

Managers in many organizations have started to realize that using cross-functional teams can alleviate some of the concerns that they were facing, such as increased competition, the need for faster turnaround times, and more cost-effective methods for achieving their goals. Cross-functional teams use specialists from different functional areas and can respond better to market needs by faster product development, better design, increased quality, decreased rework, and lower costs. By combining various functional areas to solve a problem, the whole becomes greater than

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the sum of its parts. "Face-to-face interaction of the perspectives and knowledge of different disciplines result in a more complete, testable, manufacturable and supportable product."[4]

A cross-functional team consists of a group of people representing different functional areas of an organization that have come together to work on a project. Glenn M. Parker defines cross-functional teams as

> "a group of people with a clear purpose representing a variety of functions or disciplines in the organization whose combined efforts are necessary for achieving the team's purpose. The team may be permanent or ad hoc and may include vendors and customers as appropriate."[5]

Each team's unique combination of skills and experience can yield many benefits, but their differing backgrounds, loyalties, and nomenclature also present a challenge. Once these issues are overcome, however, the diversity of the skills and experience each team member brings can become a true asset.

A high-performance cross-functional team requires the right people willing to produce a common end goal. It is important to bring together the appropriate functional roles as well as people interested in the project. Team members come to a project with their own objectives and motivations in mind; these objectives must match or complement the team's objective to get each individual to buy-in to the common

goal of the project and become truly committed to the team. This commitment to the project is critical to project success.

Members often come to a group and struggle with conflicts between team loyalty, functional loyalty, and self-interest. Over time these difficulties can lessen as the team becomes cohesive and committed to a common objective. However, it is important to understand that these internal struggles exist—each individual has his or her own interests. The individual must be interested in becoming a part of the team and delivering his or her part of the overall objective. People usually perform better and achieve better results if they can see some benefit to themselves in performing the task. Team members who become engaged in the project and its objectives tend to make up high-performing teams.

Developing high-performance cross-functional teams requires understanding individual and group motivations, functional loyalties, and general teaming issues such as the effects that rewards, training, and management support have on these teams. Understanding these issues will increase an organization's productivity and save time and resources.

For this paper, the management literature will be looked at and compared with a "ground truth," a survey of the reality of management practices, of three existing cross-functional teams at the Los Alamos National Laboratory. This ground truth will serve as a basis from which to examine teaming concepts that the literature finds to be critical to the

success of teams. These results will be compared to existing teams to determine if such techniques apply in real-world cases. The analytical categories that will be examined in this paper are

- performance measures
- management support
- team training
- team commitment
- motivations for teaming
- cross-functional loyalties
- growth of team functionality

B. LITERATURE REVIEW

Many articles and books that address teaming concepts have appeared over the last decade. This literature has covered topics such as teambuilding and the principles that make up a high-performance team. Only in the last few years has the subject of cross-functional teaming appeared in the literature. Companies have learned that forming teams composed of all of the necessary functions to get a new product to the marketplace can significantly reduce costly rework, minimize lost time to market, and prevent loss of competitive advantage.

Although many articles and books address these teaming concepts, teaming has been a part of business practices for a very long time. It is not that management has failed to practice teamwork fundamentals, it is that these concepts have only begun to be broadly studied in the management literature over the last decade. With the abundance of literature presently available, it is crucial that its recommendations and

findings be compared to techniques and procedures presently used in practice. This paper examines critical teaming issues in the literature and compares these issues with the reality of practice taking place at Los Alamos.

The literature reviewed for this paper covered teaming in general, cross-functional teaming specifically, and some review of the marketing/R&D interface as relating to new product development. Both theoretical and empirical studies were examined in this review.

General Teaming Issues

Theoretical Literature on Teams

One of the best books on general teaming issues combines theoretical frameworks for teaming with case studies of teaming implementation. This book, The Wisdom of Teams, by Jon R. Katzenbach and Douglas K. Smith, proved to be an excellent source of information on teaming and the components essential to develop high-performance teams. Katzenbach and Smith provide an effective definition of a team: "A team is a small number of people with complementary skills who are committed to a common purpose, performance goals, and approach for which they hold themselves mutually accountable." There is also an excellent graphic from this book that depicts this team definition:

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Focusing on Team Basics

Performance Results
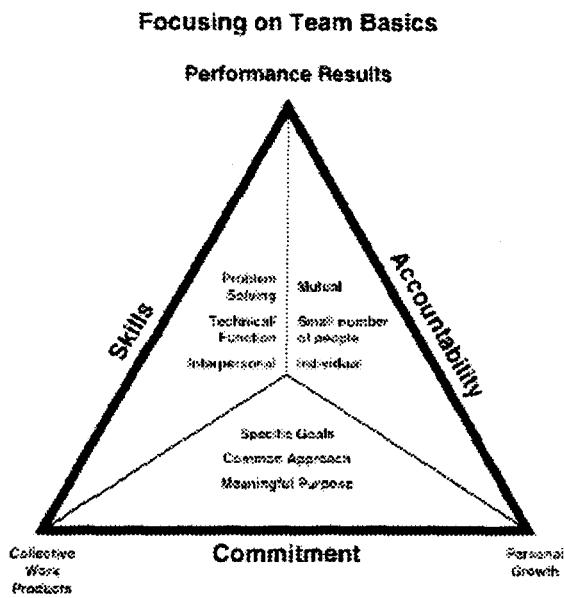
Source: Wisdom of Teams, by Jon R. Katzenbach and Douglas K. Smith.

Katzenbach and Smith have also produced an important article on the same subject, a condensed overview of the subjects contained in their book. Their article, "The Discipline of Teams,"[7] is a very good overview of teaming, what constitutes a team, and the key issues that affect whether the team becomes a high-performing team.

Another overview of teaming concepts and principles is touched on in Teamwork: What Must Go Right/What Can Go Wrong, by Carl E. Larson and Frank M. J. LaFasto.[8] Larson and LaFasto present an overview of many critical teaming issues and spend one chapter each on some very important topics such as goals, commitment, and building a collaborative environment.

One of the best articles on the subject of rewards for teaming is "Rewarding Technical Teamwork," by Judith C. Mower and David Wilemon. Mower and Wilemon discuss the many types of rewards that members of a technical team would appreciate, not simply monetary rewards. The authors state "despite these appearances, we maintain, along with others, that money for what it can buy is not as important, either to scientists or to engineers, as money for what it can mean. Psychologically, it is often equated with respect, for being valued or admired."[9]

An important article that gives a good perspective on corporate teaming is "Work Teams: How Far Have they Come?," by Jack Gordon.[10] This article points out that "in the average organization that has any 'teams' at all, more than half of all employees (53 percent) are members of one."[11] The following chart depicts the types of teams:

45%	belong to permanent work teams
30%	are assigned to temporary project teams
18%	are members of long-term cross-functional team
1%	other

Source: "Work Teams: How Far Have They Come?" by Jack Gordon.

A book that gives a how-to approach to developing high-performing teams is written by Steve Buchholz and Thomas Roth. Creating the High-Performance Team[12] offers suggestions on how to conduct team meetings, encourage creative and talented people, and build communication and trust.

Empirical Literature on Teams

One of the most frequently cited works in this body of literature is, Groups That Work (and Those That Don't).[13] J. Richard Hackman takes a descriptive approach to accounts of actual work groups intertwined with theoretical concepts to study teaming issues and their implications for research and practice. The book covers topics such as rewards and management as well as many other important teaming characteristics.

One of the best examples of literature describing a team and how it works is "How a Band of Technical Renegades Designed the Alpha Chip," by Ralph Katz.[14] This article describes how a team from Digital Equipment Corporation developed a chip that has been hailed as one of the more significant technical developments in the microprocessor industry. This team had all the attributes written about as the keys to high-performance teams, and it is an exciting story as well.

Another excellent account of a successful team and its keys to success is "Teams: Dedicated Players," by Robin Yale Bergstrom.[15] This article cites several

teaming issues discussed in many of the books and articles mentioned previously, but it is told by the General Manager of Medium Engine Products at Caterpillar's Engine Division. His team had sole responsibility for an entire engine launch project. The General Manager has very definite ideas about teaming and has a tough point of view about many of the issues; he believes that it is "very important: team members must be 100% focused. The team's objectives must be the individual's objectives. Membership isn't a 2–4 P.M., every-other-Friday kind of thing."[16]

Cross-Functional Teaming Issues

Theoretical Literature

One of the best overviews of cross-functional teams is found in Cross-Functional Teams: Working with Allies, Enemies & Other Strangers, by Glenn M. Parker.[17] This seems to be one of the only books in the literature that focuses specifically on cross-functional teams. Parker gives advice on empowering teams, appraising teams, and leading cross-functional teams. Parker also offers an excellent definition of a cross-functional team. Parker defines a cross-functional team as "a group of people with a clear purpose representing a variety of functions or disciplines in the organization whose combined efforts are necessary for achieving the team's purpose. The team may be permanent or ad hoc and may include vendors and customers as appropriate."[18]

Glenn M. Parker also gives a good but shorter overview of cross-functional teaming in his article, "Cross-Functional Collaboration."[19] This article discusses the diversity issues in a team that can benefit or hinder a team's performance. In this article, Parker lists the six benefits of cross-functional teams: "speed, complexity, customer focus, creativity, organizational learning, and single point of contact."[20]

In one of the few articles that discusses motivations for teaming, Henke, Krachenberg, and Lyons addressed the "people" considerations of cross-functional teaming. In "Perspective: Cross Functional Teams: Good Concept, Poor Implementation," by John W. Henke, A. Richard, Krachenberg, and Thomas F. Lyons[21], the authors devote almost a page to discussing the selection and motivation of team members. These authors especially emphasize the importance of the individual in the team mix.

An effective article on the structure of cross-functional teams and how they fit in the organization was written by Robert C. Ford and W. Alan Randolph. In "Cross-Functional Structures: A Review and Integration of Matrix Organization and Project Management,"[22] the authors discuss how the cross-functional team is structured within an organization and the effect that influence and decision making has on such structures.

A work that discusses how to build a successful cross-functional team is "Making a Team Work: Techniques for Building Successful Cross-Functional

Teams," by Deborah S. Kezsbom.[23] This article provides several steps to developing a high-performance team. The article also discusses some of the key elements for developing high-performance, cross-functional teams.

Mary Beth Pinto and Jeffrey K. Pinto are two authors cited repeatedly in the cross-functional and general teaming literature. One article that these authors collaborated on discussed the cooperation among functional areas to enhance project success. This article, "Project Team Communication and Cross-Functional Cooperation in New Program Development," states that "recent research has demonstrated that teams exhibiting higher levels of cross-functional cooperation have a significantly higher incidence of project success than do teams with low cross-functional cooperation."[24]

Another article written by these authors (Pinto and Pinto) in collaboration with John E. Prescott, "Antecedents and Consequences of Project Team Cross-Functional Cooperation," discusses the pros and cons of cross-functional teaming. The article discusses that although many companies are moving towards cross-functional project teams for the cooperation of individuals from various functional areas, with these different individuals comes "differing orientations towards goals, interpersonal relations and key external constituents."[25]

The importance of training is mentioned in several articles reviewed for this paper.

One that stresses the importance of training is "Overcoming Common Pitfalls When Using Cross-Functional Teams," by A. H. Jaehn. In this article Jaehn states "training is a critical component of the continuous improvement process, as the effectiveness of cross-functional teams depends on it."[26]

One article that focuses on the linkages between marketing and other functional areas is "Vital Cross-Functional Linkages with Marketing," by Jeen-Su Lim and David A. Reid. This article discusses the importance of cross-functional linkages between marketing and other functional areas, and how a firm can benefit from becoming cross-functionally integrated.

Empirical Literature on Cross-Functional Teaming

A good article on dealing with implementing cross-functional teams is "Implementing Technological Change With Cross-Functional Teams," by Robert A. Lutz.[27] This article outlines Chrysler's efforts to implement cross-functional teams. The author gives a good description of how Chrysler broke down their functional silos and implemented cross functional teams. Once they accomplished this objective, their productivity and product lines greatly improved.

One of the best articles that focuses on rewards and metrics for teams and individuals and gives an example of a real team is "Oil Company Learns to Measure Work-Team Performance," by Jack Zigon.[28] This example discusses the

need for companies to develop with a process that enables a team to create performance measures that will allow for both team objectives and individual objectives that directly support team results. This article gives an example of an oil company's endeavors in this area.

A good "lessons learned" article that relates Motorola's experience with implementing cross-functional teams is "Cross-Functional Teams Improve Manufacturing at Motorola's Austin Plant," by Sanjoy Kumar and Yash P. Gupta.[29] The authors present a good overview of Motorola's implementation experiences, including team composition, team training, and the benefits reaped from the teams.

A very detailed article of a case study of a cross-functional team was written by Linda Loehr. This article, "Between Silence and Voice: Communicating in Cross-Functional Project Teams,"[30] provides a detailed look at a cross-functional project team in a small manufacturing firm. This article presents a good overview of trust issues on these teams as well as the equity of individuals on the team.

Marketing/R&D Interface

Theoretical Literature

One of the best articles on credibility as related to the marketing and R&D interface is, "The Credibility–Cooperation Connection at the R&D–Marketing Interface," by Ashok K. Gupta and David Wilemon.[31] This article focuses on the idea that if the

R&D personnel do not believe that the marketing personnel are credible or that they provide credible marketing data, the R&D side had a less than favorable perception of marketing. This perception can raise serious barriers to the movement of information, and destroy cooperation between the two groups.

One of the best articles on dealing with the relationships between marketing and R&D has been written by William E. Souder, "Managing Relations Between R&D and Marketing in New Product Development Projects."[32] This article presents a good description and analysis of the different states of harmony that exist between the two functions.
In addition, the article gives a number of suggestions for how to overcome some of the pitfalls associated with relationships between the two functions.

An article that discusses some of the benefits for marketing and R&D to work together is "Marketing the Technical Imagination: A Partnership Between Marketing and R&D is a Utility's Best Approach to the Competitive Environment," by Susan McChesney.
In this article, McChesney points out that "the two disciplines must reach an early understanding of the thoughts, dreams, and visions of their company as well as each other. Instead of competing to secure limited company resources, they must cooperate to increase the return on those resources."[33]

Empirical Literature on the Marketing/R&D Interface

Although the literature on this issue is weak, a good article that looks at

Goodyear's experience in integrating marketing and R&D is "Responding to Change," by Stanley C. Gault.[34] This article discusses that for Goodyear to respond to its customers, the company had to make some changes, and that having R&D at one end and marketing at another failed to work.

Summary

The literature found on teaming and cross-functional teaming is much stronger in the theoretical concepts than in empirical research. This emphasis on theory and apparent lack of empirical studies offers an interesting area to pursue and study. The literature needs to be compared with the reality of practice at the Los Alamos National Laboratory and other organizations to determine if the theoretical concepts are indeed useful in practice.

C. RESEARCH STRUCTURE

The focus of the research in this study rests on comparing the management literature on teaming to a ground-truth look at three cross-functional teams currently working at the Los Alamos National Laboratory. The applied management question driving this research: **"How do individuals from different functional areas, with different motivations and loyalties, form a high-performance team to work toward a common objective?"**

At the Los Alamos National Laboratory technical cross-functional teams have existed since the Laboratory's inception. But with new changes in Los Alamos'

scope of work to include partnering with industry, a business and marketing component has been added to cross-functional teams. This has required another look at how to develop and manage high-performance, cross-functional teams.

Factors that can greatly impact the performance of a team include the ability to understand the effects of individual motivations, the loyalties they have to a functional area, and the effects of various teaming fundamentals, such as reward systems, training, and management support. Gaining this insight into the impact these issues have on an individual's ability to be an effective team member can give management a much better understanding of how to develop teams that can produce better results. This information can assist management in assigning members to teams and providing the type of management support required for cross-functional projects.

One of the most important findings in the literature on teaming involves the need for managers to pay special attention to the human side of new product development. The people component is what will make a project a success. By understanding the motivations of the people on the team, managers can build more effective, higher performance teams whose objectives and individual motivations are coordinated—or at least similar. Information on how people are motivated to work on teams can also help existing teams to perform more effectively. This information on individual motivation and functional loyalty could help these teams strengthen

themselves by fostering mutual understanding, thereby ensuring that a common goal exists.

This study's purpose is to look beyond the literature in order to understand how individual motivations, functional loyalties, and team fundamentals apply to teams at Los Alamos, as well as to explore how team members at Los Alamos can come together to achieve a common goal. This study will examine what motivates these people, what their level of commitment is to the project, and how individual commitment affects the performance of both the individual and the team. This research will attempt to answer the question of how these issues impact cross-functional teams and their achievement of a common objective.

To understand motivations and loyalties, a series of unstructured interviews were conducted with three cross-functional teams at Los Alamos. These interviews serve to produce qualitative information on how these teams came together to achieve a common objective, even while their individual motivations may have differed. These interviews have assisted in clarifying some concepts from the literature, as well as challenging some of the ideas.

During the literature review and initial research that led to the research methodology, several issues were raised regarding team commitment and motivations for teaming. The following propositions were developed from the literature reviews, and they serve to guide this research project.

Proposition 1: Team members have individual motivations that are as important, or more important, than team objectives.

Members of cross-functional teams are likely to have other motivations for participating in a project, in addition to meeting the project's objective. Individuals participate on a team because they have a complementary skill that will enhance the effectiveness and productivity of the team. Along with the different skills that these members bring to the table, there is also a tendency to bring different motivations for why an individual is interested in a project. These motivations could be that the work is interesting or that it is a change of pace, but the motivations are different from the project's objective.

Proposition 2: The importance of individual goals decreases as teams become more focused on the project's goals.

Over time, the importance of individual goals decreases, while the focus on the project's goals increases. As teams begin to develop their common vision and pursue their objectives, individuals are more likely to become committed to the project's success. Team members come to a project with their own individual goals and motivations, which can be different from the goal of the project. Once these individuals have bought-in to the project, their individual goals tend to become less important than the project's goals and its success. Their individual goals become unified with those of the project.

Proposition 3: Personal commitment is the single most critical factor that drives success in high-performance, cross-functional teams.

Personal commitment to the success of the project grows over time, once team members buy-in to the objective of the project. Team member commitment is a very critical component for the success of a project. Once team members become committed to the project and its objectives, they become more focused on making the project succeed. Individuals committed to a team will give "110%" of their effort to the project to achieve team success. Team members not committed to a project and its objectives will not put forward the effort needed from their functional area to assist in project success.

Proposition 4: Functional area differences may appear to be a barrier at the beginning of a project, but such barriers are overcome once the team members understand each other's roles.

The organizational operations of teams change across time. At the beginning of cross-functional projects, individuals may not know each other, respect each other, or understand each other's functional role. This lack of understanding can cause tension in the preliminary stages of the project. Over time, as team members get to know each other and understand each other's roles, this tension fades. Effective teams must understand each team member's role, how individual functional roles can help the team achieve success, and that each member is competent in his or her role.

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In each of the propositions for this paper there is a time element: It takes time to overcome functional barriers; it takes time to understand and respect other team members; and it takes time to become committed to a project. The results of the analysis and interpretation of the research will show that there is a time dimension to each of the nominal categories that will be defined for cross-functional teams.

D. RESEARCH METHODOLOGY

During the review of the literature for this paper, many questions arose as to how individuals were motivated to work on cross-functional teams. Many teaming concepts referred to in the literature seem like good concepts in theory, but when applied to the cross-functional teams that I am involved with at the Los Alamos National Laboratory, these concepts failed to work in practice. It was very difficult to directly translate the teaming literature into workable management practice at Los Alamos.

The literature is essential, however, for identifying and isolating key principles that could be readily put into practice to discover if they worked for these cross-functional teams. Once the realization was reached that these teaming concepts did not seem to work in practice, the literature review provided additional support. The literature enabled the identification and isolation of key principles to test in structured, open-ended interviews for this field research project. These interviews were based on a protocol developed to examine the teaming concepts found in the literature

in real cross-functional teaming situations. The Interview Protocol is attached (please consult the Appendix).

The objective of these interviews was to test the understanding of three key principles discovered in the literature review. The three key principles examined for this paper are

(1) the effects of rewards on teaming
(2) the effects of training on teaming
(3) the effects of management support on teaming.

These principles were studied to confirm or modify current understanding of these concepts.

For this study, structured open-ended interviews were conducted with members of three new product development teams at the Los Alamos National Laboratory. These interviews were used to study cross-functional teaming issues. These teams were

- The Contaminant Analysis Automation Team
- The Advanced Ignition Team
- The Polymer Filtration Team

Twenty team members were interviewed. Each interview ranged from approximately one hour to one hour and a half to conduct. There were approximately 30 hours of baseline interviews. Follow-up interviews were conducted as necessary, and about 20% of the sample were contacted for follow-up interviews.

The desired outcome of this study and the interviews is to put the factors that were discovered into nominal categories

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and classify them. The factors are based on the perceptions of the interviewees regarding motivation, training, and management support as they apply to cross-functional teaming. The nominal categories that were identified for these factors include

- norms
- leadership
- individual motives
- group motives
- "purposing"
- goals
- objectives

These categories will be discussed in further detail in the Research Results, Analysis of Results, and Interpretation of Results sections of this paper.

E. RESEARCH RESULTS

This section compiles the results achieved from interviewing several members of new product development teams on their individual background and the team's background. Three teams were examined: (1) the Contaminant Analysis Automation Team; (2) the Advanced Ignition Team; and (3) the Polymer Filtration Team. Each team is working to develop a new product at the Los Alamos National Laboratory.

These teams were chosen because they meet the following criteria: they are a cross-functional team that consists of a carefully selected array of specialists who work together to make decisions and to achieve an overall objective. Each team functions effectively and is working successfully at achieving its goal.

The following are the results from the interviews held with each team member of the three teams.

Contaminant Analysis Automation Team

Project Background

The Contaminant Analysis Automation Project is a consortium of several government laboratories (Los Alamos National Laboratory, Idaho National Engineering Laboratory, Oak Ridge National Laboratory, Pacific Northwest Laboratory, and Sandia National Laboratories), several universities (University of Florida, University of Tennessee, and University of Texas), and several private companies (SciBus Analytical, Inc., Hewlett-Packard, and Varian). Los Alamos National Laboratory personnel head the team. This large team has been assembled to work on solving problems that face both industry and government with respect to characterizing and remediating Department of Energy sites potentially contaminated with radioactive and hazardous wastes.

This team's objective is to design and fabricate automated systems that standardize the hardware and software of the most common environmental chemical methods. Continued chemical characterization and analysis methods are tedious and potentially dangerous to the chemist because of the hazardous materials that are being sampled. The Contaminant Analysis Automation system would reduce this danger and significantly increase accuracy as a result

of its standardization. A robot arm or other system linked to a central computer would move a sample from module to module. One module would prepare a sample, the next would conduct the analysis, and another would interpret the data.

Team Composition

Although the overall Contaminant Analysis Automation team includes many different laboratories, universities, and companies, for this research project only the Los Alamos National Laboratory personnel were studied. This component is a cross-functional team that consists of chemists, engineers, marketing professionals, computer software developers, and administrative personnel. The members of this team that were interviewed include

- Project Leader, B.S. Biology, MBA
- Marketing Specialist, B.A. Marketing
- Administrative Assistant, Administrative Training
- Deputy Project Leader, M.S. Computer Engineering
- Analytical Chemist, Ph.D. Analytical Chemistry
- Software Developer, M.S. Computer Science
- Technician, Machinist Apprentice Training

Team Background

The previous and present team leader assembled the Contaminant Analysis Automation Team by bringing in members who had expertise in a key component, such as analytical chemistry,

and an interest in working on the project. The team leader was looking for both expertise and interpersonal skills in identifying and recruiting team members.

Team Goals and Objectives

The members of this team have reached consensus on the overall objective for the project and the team. The objective is to automate chemical analysis processes and to commercialize them. Several members have talked about an overall objective and then the objective "right now." There are many small tasks that lead to achieving the overall goal. Each team member has his or her own individual tasks to accomplish; they are all held mutually accountable by the team to get these tasks done on time and on budget.

Merle C. Crawford lists the stages of new product development as strategic planning, concept generation, pretechnical evaluation, technical development, and commercialization.[35] According to Crawford's new product development process, this project is in between the technical development phase and the commercialization phase of the process. Most of the team considers the project to be a success, or at least well on its way. They have experienced some small successes and failures along the way, but these experiences have served to draw the team closer together.

Team Organization and Operation

The entire team is in agreement as to whom the team leader is for this project. They feel that although this person is the leader, he allows others to lead when their area of expertise is the subject of a meeting or technical evaluation.
They have developed a team approach to their meetings. The team leader and his administrative assistant call the meetings and prepare a preliminary agenda. They try to get through the agenda, but do allow for other subjects to be addressed; every member is allowed to speak and decisions are made by consensus. Although these meetings are not highly organized or formal, they do have a facilitator attend most of the meetings. This is an outside person, not a member of the team. No one on this group has attended any formal team training courses, nor have they done any teambuilding exercises. There is management support for this project.

Team Dynamics

The respect levels vary from team member to team member; some of the team believes that respect is unconditional, while others are not sure that this is true. A couple of the team members believe that there is some degree of prejudice on the team against other functional areas. For example, several members mentioned that there is a degree of prejudice between the chemistry and software development functions on the team. Each member interviewed believes that the others are competent in their roles and that each member is an important part of the team.
The members also believe that this is a very cohesive team.

Individual/Team Motivations

Most of the members of the Contaminant Analysis Automation Team were committed to the team's common objectives. The individual motivations of each team member appeared to have changed over time. The team members believed that their motive for being on the team had not changed, but it seemed from the interviews that their individual motivation may not have been as important as overall project success.

Advanced Ignition Team

Project Background

The Advanced Ignition project is investigating two approaches that would change the way that jet engines are ignited. Conventional commercial and military turbo-jet aircraft engines use a capacative discharge ignition system to initiate fuel combustion. It is possible that an engine may have a "flameout" during flight, meaning the engine would stop. In this instance, it would be necessary to re-ignite the engine during the flight. The requirements for reignition, in fact, set the maximum safe altitude for most commercial flights.

The current type of ignition system requires fuel-rich conditions to ensure engine re-ignition. Because of this constraint, aircraft must fly at lower altitudes (around 30,000 feet) than they would otherwise. Flying at this lower

altitude reduces the fuel efficiency of the aircraft; it also generates considerable pollution from the exhaust.

The Advanced Ignition team at the Los Alamos National Laboratory is collaborating with BF Goodrich's aerospace division and LaserFare, Inc., a small business, to develop two new approaches to ignite jet engines. These approaches are a microwave-based approach and a laser-based approach. Replacing conventional systems with either of these two systems would yield combustion using leaner jet fuel/air mixtures. As a result, the aircraft would operate at higher altitudes with lower engine maintenance and with significantly higher fuel efficiency.

The benefits of this technology could be significant, and it has the potential to affect every military and commercial aircraft engine in the world. The commercial benefits for this technology are that it will allow longer flights by flying at higher altitudes due to the higher fuel efficiency, and there would be less emissions as a result. The benefits to the military would be longer flights and fewer detectable emissions during the relighting process, which can be picked up as a heat signature by enemy surveillance.

The team does not believe that this project is a success yet, at least in the technical sense. This project is in the technical development phase of Crawford's new product development process. This team has encountered several challenges along the way and has achieved some small successes that have encouraged them to continue with the project. This project has the support of management, but no involvement by management.

Team Composition

This Los Alamos cross-functional team consists of a diverse group of individuals that include physicists, marketing specialists, chemical dynamicists, technical writers, program developers, and others. The members of this team that were interviewed for this paper include

- Project Leader, Program Developer, Ph.D. Chemical Engineering
- Physicist, Ph.D. Solid-State Physics
- Physicist, Ph.D. Physics
- Marketing Specialist, B.A. Communications
- Metallurgist, Ph.D. Metallurgy
- Chemical Dynamicist, Ph.D. Physical Chemistry
- Technical Writer, B.A. English
- Laser Scientist, Ph.D. Physics

Team Background

The marketing specialist assembled this team. An industry partner called the Laboratory seeking to work with Los Alamos in creating an advanced ignition project. The marketing specialist pulled together some people who were interested in working on this project to meet with the industry representatives. The industry representatives were excited by both of the technical opportunities and wanted to pursue both laser and microwave methods for ignition simultaneously. The marketing

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specialist worked with both factions to pursue funding opportunities, but it became apparent that the only way to get them both funded was to join them together. This combination of personnel working on the two approaches then became the Advanced Ignition Team.

At first the team had a very parochial attitude towards the project. The microwave side thought that their way was best, while the laser side knew their approach was best. But this parochialism was put aside fairly quickly when the challenge of getting the projects funded and putting together a partnership agreement with the industry partner was underway. Eventually, team members realized that there was a possibility that the microwave technique could solve some of the weaknesses in the laser technique, and the laser technique could solve some of the microwave problems. The two techniques may eventually be combined.

Team Goals and Objectives

The team members agree on the overall objective for the project. The objective is to collaborate with industry to develop an advanced ignition system for jet aircraft. There are many goals that must be achieved to meet the objective, such as achieving funding to perform the work. These goals must be accomplished by working together, even though this team is made up of two factions. These two technical factions must function as a team to successfully develop a final product that industry and government can use.

Team Organization and Operations

This team developed an interesting team approach. The marketing specialist or the team leader would call the meetings and announce the subject. There would be no formal agenda published, and no member of the team would RSVP. The members would just show up at the meetings. Every member of the team was included and involved in the plans for the project (even if it was not their functional specialty). For instance, every member participated in writing funding proposals, writing a joint work statement for the Cooperative Research and Development Agreement (CRADA), and were invited to participate in the CRADA discussions with the industrial partner, even though these are activities that typically the marketing specialist and team leader might handle.

The leadership within this team is very interesting. One person is considered the project leader and another is considered the technical leader. The team agrees that this is how the leadership is structured; however, others may lead the team during meetings that relate to their functional specialty. For example, during the first year of the project, the marketing specialist led the team (for the most part) to secure funding and develop the partnership agreements. Once this part of the project was in place, the technical and project leaders became much more prominent in the technical phases of the project.

Team Dynamics

Members of the Advanced Ignition team believe that it is a very cohesive team and that all the members have a high level of respect for each other. There is some rivalry between the two technical sides, the microwave and the laser, which provides a source of competition that team members believe is a good catalyst. Most of the rivalry was in the early stages of the project, before people really got to know each other. But as they got to know each other, and their level of technical expertise, there developed a high level of respect among the members for each function that is needed for the project. People on this team respect each other and feel that they are respected. This team almost unanimously believes that individual status plays no role on the team. Even though there are some senior technical members on the team, every member feels like an equal part of the team.

Individual/Team Motivations

The individuals on this team, as well as the team as a whole, are very motivated to make this project succeed. These individuals are committed to the project's common objective. Because this project does not bring in enough funding to support any one of the team members for a year, many people would stop pursuing the project. But this team feels so strongly about the success of this project and the benefits that this technology will have, that they are willing to continue pursuing it even though others might consider it too difficult to ensure success.

Polymer Filtration Team

Project Background

The Polymer Filtration team at the Los Alamos National Laboratory is developing a technology that couples water-soluble polymers with ultrafiltration to remove metal ions from waste streams. At present, technologies that remove metal ions from waste streams are expensive and barely meet present Environmental Protection Agency discharge limits. As regulations become more stringent, many of these processes, such as ion exchange and precipitation, will be less than effective.

The polymer filtration technique uses a homogeneous solution in which the polymer binds with the metal ions. After the polymer binds to the metal ions, the polymer-metal association is filtered and concentrated using a method known as ultrafiltration. The resultant metal can be recycled, and the water meets all regulatory requirements. This process produces no additional waste, and is many times faster than the conventional ion-exchange methods.

This technology can also be used to selectively extract metal from a waste stream, so for instance, if you were trying to remove just the silver from a waste stream the process could be accomplished with this technology. The conventional techniques cannot do this. This team is working with an industrial partner to commercialize the polymer filtration technique for an electroplating application. Several other potential

markets exist for this technology, including precious metals, textiles, and mining.

Team Composition

This team consists of several different chemistry disciplines, marketing specialists, and licensing personnel. The team members interviewed for this paper include

- Project Leader, Ph.D. Chemistry
- Scale-up Chemist, Ph.D. Organic Chemistry
- Marketing Specialist, BBA Marketing
- Polymer Chemist, Ph.D. Organic Chemistry
- Licensing Executive, M.S. Chemistry

Team Goals and Objectives

The Polymer Filtration team generally agrees that its objective is to develop a new technology for metals separation using water-soluble polymers and an ultrafiltration membrane. In addition, the team's objective is to work with an industrial partner to commercialize the technology. The members that are more interested in the commercialization aspects of this project tend to put more emphasis on the commercial aspects of the project, while the more hard-core technical members emphasize the technical challenges of the project. This team has several goals that they must achieve to reach the overall objective, and it hopes to modify and refine the technology so that it applies to other areas.

This project is in between technical development and commercialization in Crawford's new product development process. The team considers this project a success. They have exceeded their commitments, met all their technical milestones, and are working with an industrial partner to commercialize the technology. They believe that there have really been no barriers for this project.

Team Organization and Operations

Members of the Polymer Filtration team agree on who the team leader is, although there is some disagreement on the interactions between the team leader and other members of the team. Several members, including the team leader, feel that the team leader is the overall leader of the project, but as applications of the technology develop, however, that individual members should emerge as leaders for these applications. Other members felt that the team leader should always be the team leader and that there would be no emergent leaders.

There is general consensus on the team approach developed by the team. The meetings are informal and are usually called by the team leader or the marketing specialist; everyone has an opportunity to speak and communication is good. The team feels, however, that so much is presently taking place that communication is becoming more difficult. Sub-team meetings are held to discuss in more detail specific technical or business aspects of the project. This team has had no formal team training, and most of the individuals have had no team training.

Team Dynamics

Respect is an important component of this team. Many members believe that if they did not respect each other the team would not function as effectively. Some members mentioned that at first there was not a high degree of respect for the members of the team dealing with the business aspects of the project. But as the commercialization issues became more important, the team realized what was involved and began to understand the importance of these roles. The respect level for these members has increased significantly and is equivalent to other members of the team. It appears that there was a learning curve for the technical members to understand what the business member's roles were.

At this point, team members define their team as a cohesive unit and claim that everyone values each other's contributions, both technical and non-technical. Individual status does not seem to play a role on this team; everyone is considered equal. This team believes that management does support this project, but maybe only as long as the team continues to support themselves financially.

Individual/Team Motivations

This team is very committed to the project's objectives. The team members believe that this project's success will benefit the nation and industry. Almost every member of the team stated that what they would like to personally gain from this project is to transfer the technology to industry and see it used commercially.

F. ANALYSIS OF RESULTS

This research provides an important window to examine attitudes toward teaming and the organizational dynamics of cross-functional teams. The results of the interviews produced some expected answers, but also revealed new and thought-provoking findings.

Motivations for Teaming

To develop a high-performing team, it is important to understand the motivations for teaming from a management perspective. In addition to traditional motivations – the project is part of the job, it pays the bills, and the boss told you to do it – other factors and motivations drive the effectiveness of each team member. Common sense tells us that problems can arise if a project is not interesting to us, if we do not want to work on the project, or if we do not get along with other team members.

An individual's motivations for working on teams and participating to his or her fullest extent are based on whether the project benefits the individual. "Simply designing a system of teams, and then assigning a mix of functional personnel to them is not enough to make the system work. An individual's commitment to a team and its job depends on the extent to which the outcome will be instrumental in satisfying one's needs."[36] In interviewing each team for this project, several important common themes began to emerge regarding commitment, motivations, and project success.

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Commitment to the Team

Commitment to a team and a project is the key to project success. Each team member must put forth his or her best effort to help the team and the project succeed. To accomplish this objective, individuals must "buy-in" to the project and believe that it is a worthwhile effort. For most teams the beginning of a project can be difficult. To ease such difficulty, the team must develop a common goal, with each team member contributing to its conception. A common goal will help ensure not only a final quality product, but a successful team effort.

In addition to buying-in to the team and the project's goals, an individual needs to see that he or she will benefit from the project's success. People usually perform better and yield better results when they can see a benefit to themselves. In the teams that were studied, most members were asked to join the team (not forced) or volunteered to work on a project.

In the interviews each member was asked to identify his or her motivations for joining the team. In every case, the answers were about the work involved. The responses revealed that the work was technically challenging and interesting, it was a business challenge, the people were enjoyable to work with, or it was a change from what they had been doing. The type of work was what initially motivated the members of the three teams to become involved in the teams, but it appears that the motivation may have changed over time.

The last two questions asked in the interviews were "what do you personally hope to gain from the project and team?" and "has your motive for being on the team changed over time?" The responses are intriguing. With respect to personal gain, team members had different individual goals, although the team goal remained the same. In almost every case, team members stated that their team motive had not changed over time.

As mentioned earlier, the response to what motivated the team members to join the team was the challenge of the project. When asked what they hoped to gain, each member of the three teams responded that personal growth and project success were important success factors. What the team members hope to gain from the team and what motivates them to be on the team are different, yet team members do not believe that their motivations changed.

The interviews revealed that once the individuals become engaged in the project and the team process their motivations are no longer individualistic —they change to a more team-driven motivation. Once the team members buy-in to the project, their individual goals become secondary to the project success. Team members believe the project's success would yield personal gain. Many team members believe that seeing a product that they helped to develop applied to the "real" world would bring them a great sense of accomplishment. In the Advanced Ignition team, many members stated that they would like to ride in an aircraft that used the system they had helped develop.

Project Success and Commitment of Team Members

The interviews revealed an interrelationship between project success and team members' commitment. Poor team member motivation can contribute to project failure; inversely, if team members are committed to developing a successful project, the project will succeed. In interviewing the three teams, some issues remained constant.

Lack of commitment often contributes to a team's ineffectiveness. Understanding and describing team commitment is difficult. Carl E. Larson and Frank M. J. LaFasto define commitment as follows: "Certainly it is 'team spirit'. It is a sense of loyalty and dedication to the team. It is an unrestrained sense of excitement and enthusiasm about the team. It is a willingness to do anything that has to be done to help the team succeed. It is an intense identification with a group of people. It is a loss of self."[37]

Team commitment is essential to project success. To get this commitment, each team member must buy-in to the goals and objectives of the team. In the literature and from experience, it is apparent that to get this type of commitment requires each team member to participate in setting the goals and priorities for the project. In all three teams the members were involved in this process, and this seems to have led to the maintenance of team commitment.

Most of the authors agree that to have high-performance teams requires a common objective and shared goals.

"Our research has convinced us that successful teams have two critical things in common. They are committed to a shared purpose and specific performance goals. The right combination of purpose and goal is what creates the most effective team environment."[38] The common objective is the overarching purpose of the team, the "big picture" for the project. The performance goals are the steps that the team members must take to achieve the objective. In many cases, the performance goals are collective work products that a team subgroup must perform.

For a project to succeed, team members must develop a clearly defined common objective and set of performance goals. All team members must understand and buy-in to the objective. Changes in the team's goals do take place, and to maintain commitment, these changes must be developed and understood by all team members. "The best teams invest a tremendous amount of time and effort exploring, shaping, and agreeing on a purpose that belongs to them both collectively and individually. This 'purposing' activity continues throughout the life of the team."[39]

During the interviews, each team member was asked if he or she participated in developing and establishing team goals. In most cases team members participated in these decisions and many others. This participation will aid these teams in keeping team members committed to the project, which in turn will lead to project success.

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Almost every individual interviewed for this study believed that his or her project was a success or that it would succeed; each team member was committed to the project's success. The Advanced Ignition team has worked very hard to secure funding for the project and has received only enough to get them started. They must continue to look for funding to keep the project alive. The incentive for participating on this team is certainly not that it will keep them employed; each team member must have other projects to fund them each fiscal year.

This team's incentive is that the project is exciting and they believe that it will succeed. This is what has kept the members involved in this team. This project is not mandated by management, is not going to financially sustain any member of the team, and requires hard work to keep it going. But the drive to see this project succeed is so important to this team that they will continue to work on it and pursue future funding to maintain project momentum.

In some cases, an individual may not be committed to the team, which could lead to potential discontent by that member for the project's goals. It seems that when a team member is not committed to the project, he or she tends to believe that it will not succeed. This belief tends to lead to an increase in the level of discontent with the project, and a decrease in productivity and commitment to the team and the project. This cycle is not productive and should be addressed if it is beginning to occur.

This type of discontent is occurring in one of the teams studied for this paper.

In the Contaminant Analysis Automation Team, one team member believes that the project has changed direction – and not for the better. This individual believes that the original objective that he/she bought-in to at the start of the project has changed in such a way that the project cannot succeed based on the original objective. In this case, the individual did not buy-in to the change in direction that the project is going. Because of this lack of buy-in, the individual does not believe that the project will succeed. Perhaps because the project cannot be a success in this person's eyes, it has decreased his/her commitment. This individual is no longer motivated to make this project a success.

Much of this lack of motivation appears to derive from the individual's personal goals. The individual's goals of participating in a team and a project in which the work is a technical or business challenge may have stayed the same while the goals of the project changed. This could be due to the individual's function losing some of its importance in the project, the tapering off of that functional role, or simple lack of interest for the new direction the project has taken. Whatever the reason, it appears that there is a relationship between project success and commitment:

- If the individual is committed to the success of the project, he or she will be highly motivated to work on the project.

- If the individual is not committed to the project, he or she may not believe that the project will ever succeed.

- If the individual believes that the project can succeed, he or she is usually more committed to the project.

Changes in Motivation

What motivates team members, or what they believe motivates them, is a core issue in developing high-performance teams. Toward the beginning of the interviews, the team members were asked to describe why they were motivated to participate on the team. Their answers mostly focused on the technical or business challenges that the project and the team provided. These answers were expected. These people are interested in what they like to do, and the project provides that for them. If the work on the project were not of interest to them, they probably would not be on the project.

When team members were later asked what they hoped to gain from the project, their responses were much different than their responses with respect to motivation. Most of the responses to this question addressed the project. They hoped that the project would succeed and that is what they wanted to gain from being a part of the team and the project. Their personal gain was secondary to the project succeeding, or their personal goals reflected the project's success factors.

To put this concept into perspective, it is important to discuss what gain means to the team members. The Laboratory setting is different from an industrial setting in how personal gain is perceived. A comparison of the three teams and

their responses of what personal gain means to them includes

- Providing value
- Recognition–being an expert in a field
- Recognition–for career growth
- Growing and learning
- Answering technical questions
- Satisfaction of taking a technology from initial concept to final product

Each team member hopes to learn and grow intellectually, not financially, from working on these projects. Most of the team members hope to gain some recognition from the work, enabling them to become an expert in their field and thereby enhancing career opportunities. But in talking to them, none really expect great "kudos" from their management for their work. Most of them are not relying on management for the satisfaction that they will receive from working on the project. These people truly believe that the satisfaction will come from seeing the project succeed.

In the Polymer Filtration team, every member of this team responded that what they hoped to gain from the project was taking the technology to market. There were other motivators, such as learning and career and expertise recognition, but these were secondary to seeing the project succeed.

When starting this project, it seemed that the individual's motivations for being a part of the team would be the same or very similar to what they hoped to gain from the project. But after interviewing the team members, this does not appear

to be true. What motivates the individuals is either different than what they hope to gain from the project, or the motivation has changed over time. When asked if they believed that their motive had changed for being on the project, however, the overwhelming response was "no."

Although motivations may have changed, team members remained unaware of such changes. When they began the project, their individual goals were what motivated them to be on the team, but after they have bought-in to the project and have become committed to the project's success, their motivation has changed. It is interesting to discover that none of the team members thought that he or she was motivated by project success, but it seems that success is what he or she hoped to gain from the project.

Understanding the Motivations of Others

In studying teams it seems important not only to look at the individual, but also what the other members are doing. In this study, team members were asked to discuss what motivated other members of the team. The responses were compared with the actual answers given by each individual for what motivated him or her. Some team members claimed to know what motivated the others, others claimed not to know.

This information revealed that the motivations of other team members were not very important to any member of the team. The real concern to team members was not what motivated the others, but rather that they were pulling their weight and were committed to the project.

Factors of concern to other team members were if the person was dedicated, did his or her job, and worked toward project success. Their personal motivations were secondary to each member's overall project success motivation.

When beginning this study, it seemed that the motives of each team member might be important to others working on the project. This does not seem to be the case after interviewing these teams. As was discussed earlier, a team member's motivations may not even be clear to him or her, so it does not seem to be a clear indicator of whether the team member will be committed to the project. If the motivation is other than working toward the success of the project, other team members would be aware of this personal agenda and take the necessary steps to ensure that this would not affect the project outcome.

Summary

Motivation plays a crucial role in a team's success. Team members must commit to the project; contributing a clear vision and clear team goals will enable each team member to buy-in to the project and the team. Once a member buys-in, his or her individual goals in some cases become secondary to the project's success.

To maintain team member motivation, all team members must concur when a change in direction or goals takes place. If an individual becomes disconcerted with the project's objective or with the team's motivations, he or she may

become more motivated by his or her own personal agenda and may no longer be a productive and effective team member. This often leads to clashes between the disconcerted team member and the rest of the team; as a result, the team member loses motivation and the project's success is placed in jeopardy.

Over time, individual motivations change. Individual goals become secondary to the project's goals and success. In many cases, team members are unaware that this shift has taken place. Although team members are not concerned with other member's personal motivations, they are interested in each team member's dedication to the project as a whole. As long as each team member contributes and actively participates in the team, other team members are satisfied with the project's direction. Personal agendas and motivations are acceptable as long as they do not interfere or hinder the overall project.

Cross-Functional Loyalties

This study focused on three cross-functional teams composed of various technical representatives, marketing specialists, business specialists, administrative assistants, and others. These teams were significant to focus on because of their multi-disciplinary nature. It is fascinating to learn about team members who come from different functional areas and to observe them attempt to put aside their functional loyalties to develop a successful cross-functional team. In most cases in these three teams, this goal was accomplished. Team members put aside not only their

functional loyalties, but also their personal goals to pursue the success of the project.

Team members successfully worked together to achieve a common goal. It is important to examine the factors that enable individuals to team in cases where functional specialties are different. The following section examines these factors.

Functional Differences

An examination of cross-functional teams revealed that the loyalties each team member had to his or her own functional area might be very difficult to overcome. It seemed that each individual would pursue his or her own agenda, which had the greatest benefit to his or her functional or individual goals. For the most part, this did not take place in the three teams studied for this paper. There may have been one or two individual cases in which this was true, as mentioned earlier, caused by lack of buy-in to the goals and directions of the project. But the majority of the team members seemed to check their functional loyalties at the door and became a team representative rather than a representative of his or her individual functional area.

Not only did team members have to get past their functional loyalties, they had to understand and pay attention to other team member's functional areas as well. In each team there seemed to be an initial lack of trust for the other members from different functional backgrounds. Over time, this distrust and the differences people felt for the other functional areas began to disappear.

It seems that rather than looking at the team as a group of different functional areas, the team saw themselves as a team of functioning members.

The reason for the feelings of difference at the start of these teams and projects was caused by a lack of respect. The team members generally did not know each other and had no background to draw upon with other members; therefore, there was a lack of respect and trust for these members. Over time, as the individuals began to get to know each other and participate in the team, they easily made decisions about whether they should respect and trust one another.

The fact that team members did not know each other's capabilities was another issue to be addressed. To learn to respect and trust one another, team members wanted to know that other team members were capable in their functional area and the area that they would be responsible for on the team. These teams are composed of all the functions necessary to get the job done, and team members wanted to be sure that each individual was capable of doing his or her part of the project.

For example in the Advanced Ignition Team, there was a split between the laser and microwave researchers. Each side was convinced that its technique was the best method to achieve the goal of the project, which was to develop an advanced ignition system. When the project first began, each side was wary of the other. These people had never worked together before and were unsure what to expect from each other. After

some time working together to write proposals, achieve funding for the project, and begin the technical development of the project, this wariness wore off. In its place is mutual respect for the work that the individuals are performing.

Another issue in decreasing the differences between functional loyalties and developing an effective team is that it is essential for team members to understand the importance of each functional role. Once team members can understand the importance of the function, they can begin to respect it and see the capability of the team member performing this duty. If team members do not understand the importance, the functional walls will remain intact and those individuals will maintain that their role is the only important role. This can be a great barrier to the success of a project.

Several team members on the Polymer Filtration team experienced this difficulty when the marketing specialist and licensing executive joined the team. Their roles were unclear and not well understood by some of the technical team members. It did not take long for this problem to be solved, however. Once the technical representatives became aware of what these members brought to the team and what they could do for the project, their roles became very clear. Not only did the technical members see the value of their contributions, they were also very happy that they did not have to perform those tasks themselves.

It is crucial in a cross-functional team for the team members to understand why each function is represented on the team. It is important for each function to be understood in the context of the project's goals. Once the functions are understood, then team members can assess each other's capabilities and begin to respect and trust each other. These elements are extremely important for the success of the project.

Functional vs. Team Goals

The interviews revealed that each team member had a personal bias toward his or her own functional role on the project. The team members did not believe that their role was the most important but that their role was of most importance to them. Although the individuals see their own functional role as most important, this does not affect the team as long as the individuals work toward the team goal. The goal of the team must remain the highest priority to every team member, no matter what they are focused on at a personal level.

Team members were selected (or volunteered) to participate on the team because they had something to offer and a role to play. It is what each member brings to the table that makes them valuable to the team. As a result there are no problems that arise by having each team member focus on his or her functional area. It is important for all team members to participate in team discussions, as one function can play a devil's advocate role to another and stimulate ideas for project improvements. This is a crucial aspect of cross-functional teaming – it makes them valuable to an organization. Members ask questions and raise concerns that can be resolved before a problem arises at a critical stage in the project.

As long as team members agree as to what the overall objective of the project is, it does not seem to matter if there are slight variations in goals or where the emphasis of the project is placed for each individual. People tend to focus on their own specialty because it reflects their competence. This works for cross-functional teams because individuals are selected based on their functional specialty.

Individuals also tend to emphasize certain aspects of the project in different places. Some believe that the most important aspect is that it has a Department of Energy (DOE) benefit, others believe that sheer technical creativity is what is most important, and others believe that the commercialization of the eventual product is where the emphasis should be. This does not appear to be a problem as long as all the different ideas of importance are consistent with the goals of the project. In these cases, all the above-mentioned ideas of importance are consistent with the goals of the projects, which are basically new product development projects funded by the DOE to have great technical development and eventually be commercialized.

These differences in emphasis seem to come from the varying backgrounds of the cross-functional team members. Some have worked at the Laboratory for many years and believe that the DOE benefit should and will always be the

most important. Those members who have more of a business background believe the emphasis is on the commercialization aspects. The team members should be accepting of each individual for having different areas of emphasis and focus.

Although team members do not resent each member focusing on his or her own functional specialty, team members are critical of those members who appear to be out solely for their own personal gain at the expense of project success. This is not acceptable behavior for a team member. In one of the teams studied for this project, several members believed that one of their teammates was looking to benefit him/herself and was not looking at what was in the best interest of the project. These team members were very displeased with the behavior exhibited by their teammate.

Team members were highly complimentary of teammates that were most focused on project success. Team members gave high praise for any member who seemed to go above and beyond his or her own responsibilities to achieve success for the project. In the Contaminant Analysis Automation team, many members spoke highly of the deputy project leader. They felt he was very committed to the success of the project, and they were very appreciative of his efforts. This is the type of behavior that should be looked to as a role model for the rest of the team, and such team members should be looked upon very favorably.

In addition to being a role model for the rest of the team, these individuals have more in their favor. From interviewing these individuals, it seems that they have linked their personal success to the success of the project. So if the project is a success, then the individual can be a success as well. The more an individual puts into the team and the project, the more the individual will benefit from the project once it is successful. Even if the project does not succeed, the individual earns credibility from other team members and from management for contributing his or her best effort on the team. In the long run, being committed to a project and a team and focusing on the success of the project will benefit all members of the team.

Summary

Cross-functional differences are overcome after team members get to know each other and understand each other's capabilities. It is crucial for team members to understand the importance of each functional role on the team so that they can readily assess the capability of the team member and develop respect for that individual. As this respect grows and individuals are understood, other team members are accepting of each other's views of their functional specialty. Individuals understandably relate most closely to their functional area and find this of most importance to themselves. This is not a problem as long as it does not affect the overall goal of the project and the team.

Team members are highly complimentary of individuals who are very focused on the success of the project, and there is a high level of

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dissatisfaction for those who appear to be more focused on their own goals to the exclusion of the success of the project. Team members who are focused on project success can function as a role model for the others, and at the same time enhance their individual success. The success of the project will benefit individuals in their careers by enhancing their credibility with other team members and management. This can also be a benefit even if the project is not successful.

Team members can focus on their own functional specialty and have a different belief about what the most important aspect is for the project. As long as they agree to the overall objective of the project, it does not seem to matter that there are slight variations in where the emphasis was placed—technical, commercialization, or otherwise. These differences are based on the different backgrounds of the cross-functional members of the team and are generally accepted by the other team members.

Cross-functional teams are of great benefit to organizations because of their varying backgrounds and their ability to reduce costs, time, and add value to a project. But there are many issues that must be addressed and understood in order to be a successful, high-performance team. Other cross-functional teaming issues have been raised by the interviews conducted with these three teams and will be discussed in the next section.

G. INTERPRETATION OF RESULTS

Cross-Functional Teaming Issues

Introduction

The literature reviewed on cross-functional teams and teams in general carries definite themes on how to best develop a high-performance team. A review of this literature and the interviews for this project, however, shows that interviewees from teams that show success would not necessarily agree on what makes for high-performance teams. Indeed, on several issues interviewees disagreed strongly with some of the most basic points in the theoretical literature on key elements for successful cross-functional teams. The most important issues for which the "ground truth" shows results that vary from what appears in the theoretical literature involve: team training issues, management issues, and performance appraisal issues.

This section reviews the themes identified in the literature and compares them to the responses found in the interviews. These issues seem to be truly important components of teams and how they function. Although the responses may be different from the general thoughts on these issues, it is important to understand how they affect a team and its behavior.

Team Training

The literature on teaming stresses the importance of team training for high-performance teams. Several authors, in fact, define training as crucial to the

success of the teams and to the success of projects. Bergstrom for example, states that "without training, groups are just groups, not teams."[40] Parker emphasizes the need to provide "training that focuses on working with a diverse group of people."[41] Many other articles promote this idea of team training being an important aspect for developing a high-performance team.

In the interviews that were conducted with the three teams at Los Alamos, team training did not appear to be an important or critical aspect for team members at all. In the twenty interviews conducted, only three of the team members had been involved in any type of team training on an individual basis, and none of the teams had been through any team training as a group.
The Contaminant Analysis Automation team had enlisted the support of a facilitator for some of their team meetings at critical periods in the development process, but other than this, none of the teams had been through any team training programs or any formal team-building exercises.

When asked the question of whether they had been involved in any team training, most of the team members thought that the question was meant as a joke. These individuals believe that they can perform their job and their role on the team without going through a formal training process. The Contaminant Analysis Automation team had planned to attend a team-building program in Pecos, New Mexico, but were unable to do so because of budget and time constraints. Many members of the team were glad that this session was canceled

because they believed that it was unnecessary and a waste of their time.

Although none of these teams have attended a team training session or program, their projects and the teams themselves appear to be proceeding very well. The team members respect each other and are committed to the projects, and they continue to contribute what they are supposed to contribute. The literature states that training should be a critical component, while most team members believe that it is unimportant.

Management Support

Another aspect of teaming and cross-functional teaming that the literature stresses as a vital component is that of management support for the project and the team. Many articles reviewed for this study claim that top management commitment is an absolute requirement for having a successful team. Hills for example, states that "to foster this teamwork management must support the team approach and encourage commitment and equality among team members."[42]

Management support is not a critical factor in the minds of the members of the three teams interviewed for this study. When asked if management supported the team, most thought that management supported the team only in the sense that they allowed them to work on the project. The team members believe that management was not involved in the project to the extent that they knew what was going on with the project or the team. Most teams believed that as long as they continued to find their own

funding for the project, management would support them. This claim on management support is far different from what the literature sets as a norm for motivating team success and commitment.

In the literature, the articles implied that high-performance teams needed management support not only for allowing the team members to pursue a project, but also for financial, resource, and political backing as well. In one article, Glenn M. Parker states that lack of management support is a "killer barrier" to effective cross-functional teams. Parker defines effective managerial support as

- providing such resources as time, training, funds, people, and equipment

- "talking and walking" teamwork through verbal and visual actions

- recognizing and rewarding teams and team players

- communicating a vision, charter, or broad goals

- breaking down such barriers as old paradigms and procedures

- modeling teamwork, in that management itself works as an effective team[43]

Managerial support does not seem to play a role in these three teams at Los Alamos. The team members find their own funding and as long as they can support themselves financially, as well as be aware of the politics, then management seems to take a hands-off approach. Having management support for a team in the sense that the literature states would definitely be a benefit to a team, but at least at Los Alamos this does not seem to be the type of support that is given to project teams; instead the hands-off management approach seems to empower the teams to make their own decisions regarding the projects.

Performance Evaluation and Rewards

According to the literature, performance evaluations should furnish a strong driver for successful cross-functional teams (and other teams). Many authors discuss the need to motivate team members to do well on teams by including their teaming performance in their performance evaluation. Although this seems to be a theme running through many of the articles, many also concede that this is not done well in most companies. Most companies review and reward individual performance.

There is a fine line that must be walked when rewarding an individual for work performed on a team, as well as rewarding an entire team for work that all the individuals may not have contributed to equally. There is a sort of paradox to rewarding teams and individuals that many managers believe in: "When you reward the team as a whole, you demotivate the best performers in it. When you reward the best performers more, you demotivate everyone else on the team."[44] Managers must define a plan to reward teams in a

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balanced manner, and therefore, move the team forward.

It does appear that historically employees have been trained that it is individual performance that counts when it comes to performance evaluations. This type of attitude does not encourage teaming or working towards a team goal in which an individual's performance could get lost in the team's accomplishments. It would seem that a change in the way managers evaluate their employees would be in order, and indeed some companies have done this or are working on changing this currently.

At Los Alamos, however, teaming is not evaluated in performance appraisals. Each person is evaluated on individual performance. I would recommend that the management of Los Alamos change their performance appraisal system to encourage teaming and develop some metrics for evaluating teaming as part of the rewards system.

The three Los Alamos teams have not been influenced by performance evaluations in the development of the teams because teaming is not reviewed and rewarded in their appraisal process. But these teams are still performing and successfully developing projects. It would seem that although performance appraisals would encourage teaming, it is not a strong motivator for team success. Again, this is something that could potentially encourage better team performance, but is not something that needs to be relied upon to achieve high-performance teams.

Nominal Categories

During the course of the literature review and the subsequent interviews, several important themes emerged for understanding how participants define success criteria in teaming and planning effective management strategies. These issues overlay those identified in the literature, but the interviews with the Los Alamos teams revealed enough variation from the literature's categories to give special attention to the definition of variables for research.

The most important factor to emerge from the Los Alamos interviews is a strong time-specific component of attitudes toward leadership, team "purposing," and group norms. The interviews also revealed another important factor from the group-specific way that the Los Alamos teams describe their operations, group dynamics, and normative behaviors to define "successful" working environments. The interviews with twenty Los Alamos team members revealed that the three teams followed distinctly different paths in their development.

The significance of the "ground-truth" interviews—the basis of this research—lies in what they reveal about definitions of success among the interviewees. Although these interviews have shown the importance of the teaming literature in approaching these issues, they suggest the need for expanding the scope of the conceptual categories used to understand cross-functional teaming. The research presented here has concentrated on isolating and identifying the issues that participants in cross-functional teams

define as most important to achieve the team's definition of success.

The ground-truth interviews suggest the importance of seven distinct issues, or themes, that emerged consistently in the way individuals define their motivations, commitment, and definitions of success. These seven themes involve the importance of (1) group norms, (2) "purposing" (ongoing redirection of motivations, commitments, goals, and objectives), (3) leadership, (4) individual motivation, (5) group motivation, (6) objectives, and (7) goals. Although in several cases the nominal categories defined in this list would appear to reinforce the significance of the existing literature on teaming, the specific use of the concepts among the teams examined shows enough difference from what is conveyed in the literature that each of the seven categories deserves special attention. The consistency of these themes in the interview material suggests that they provide a basis for a set of nominal categories in organizing future research.

Norms

The Los Alamos interviews revealed that teams develop group-specific norms and expectations. Team members use these group dynamics to judge the performance of fellow team members. These statements by the interviewees on norms are important and suggest that these teams have formed their own culture in which adherence is a strong bond for team members and a means for social control. These group specific norms occur over time, and new members joining a team need time to adjust their behavior to the group norms. Team members appear to uses these norms as an important motivational tool and as a means for evaluating their peers. The development of these norms is linked to the team's "purposing" activities and to the ways in which these groups define the importance of leadership.

"Purposing"

In each team, collective goals and objectives, as well as individual motivations, had clearly shifted from the beginning of the team activity to the moment of the interviews. It appears that a continual redirection, or "purposing," occurs in each of the teams. As described by the interviewees, this shift in "purpose" appears to be a critical factor in successful cross-functional teams. Although the research design adopted here will not allow detailed analysis of "purposing," the interviews completed to date suggest that this activity plays a crucial role in the development of team norms and in the development of accommodations between individual motivations and collective goals and objectives. "Purposing" plays a role in the discussions that build respect across disciplinary boundaries, as well as an important role in leadership changes.

The appearance of "purposing" in the interview results offers support for the importance of distinguishing cross-functional teaming from more general teaming. "Purposing" appears to be the natural mechanism for enabling teams to incorporate unfamiliar functional specialties into the scope of work and

to extend the team's activities into unfamiliar territory. Continual "purposing" appears to offer a mechanism for allowing individual team members to adjust their commitments to the team's objective and goals without feeling challenges to their individual commitments to a project. The consistency with which "purposing" has been discussed in the Los Alamos teams, and the close correlations with attitudes towards norms, leadership, motivations, goals, and objectives, suggests its role in cross-functional teaming deserves further study.

Leadership

Interviewees at Los Alamos express the kind of strong opinions about the importance of project leadership that the literature on teaming would lead us to expect, but for these interviewees the nature of leadership is something different from what appears in the literature. Leadership of these teams has tended to shift over the course of the projects. In each of the teams studied, the designated project leaders have remained in place since the formation of the team. In each case, however, those designated leaders have deferred to various members of their teams as functional issues have arisen for special attention. Again, this research has proven more suggestive than definitive.

The interviews conducted for this research again go beyond what is offered in the literature and suggest that this leadership issue is a unique quality of cross-functional teams. The interviews suggest that shifts in project leadership occur to accommodate the shifting nature

of the work in the various functional areas involved. The interviewees agree that it is important to have strong and confident leadership. Confidence in the project leader will allow the leadership roles to shift among representatives of various functional specialties.

Individual Motivations

The possibility that individuals on a cross-functional team could hold motivations that are separate and distinct from the team's formally stated goals and objectives provided the original idea for this research. This disjunction between the individual and the group clearly occurs with successful cross-functional teams. Individual motivations appear to be a critical factor in successful teaming, even when a collective assessment of those individual motivations across the team members shows them to be at odds.

Besides identifying the existence of differing individual motivations, the most significant issue to emerge from the interviews is that individual team members believe that their original motivations for joining the team have stayed the same, even though the team's "purposing" activities have shifted the projects goals and objectives. It appears that individuals join a team based on individual motivation, but over time these individuals buy-in to the team's objectives and the success of the project becomes the motivation. In many cases, the individuals do not seem to recognize the changes between their initial motivations and their new motivation for project success.

Group Motivations

The idea that group motivations can be different from individual motivations emerged clearly in the interviews conducted at Los Alamos. While the individual is motivated by his or her own interest, hopefully the group is motivated by the objective of the project and the success of the project. It is important when attempting to develop a high-performance cross-functional team to understand that there is a difference in these motivations and to be aware of what they might be. These motivations can become the same or closely prioritized over time. Once an individual becomes committed to the project and its objective, he or she tends to become motivated by seeing the project succeed.

Objectives

From the Los Alamos interviews it became apparent that a clear and common objective is critical to the success of the team and the success of the project. The common objective is the overarching purpose of the team. Each member must clearly understand what is trying to be accomplished by the team; in other words, what the overall objective is for them to become committed to working toward project success. One of the critical areas for teams and team leaders is to develop the objective of the project together so that everyone is clear and together on what the objective is and how it should be achieved.

Goals

The literature on both teaming and cross-functional teaming emphasizes the importance of clearly defined goals. The issue that has emerged from the interviews on the importance of goals complements the literature. The team members stated that overarching goals played a crucial role in directing activities, even though sub-groups working on collective work products actively refine these goals at a lower level.

The results of these interviews suggest that although overarching goals can be set at the beginning of the project, a constant reassessment and adjustment of the goals needs to be allowed. Members of these teams describe that consensus building in defining goals is a critical element in forming team norms, introducing new members into the team, and allowing for changes in leadership.

Propositions

Each of the seven themes that surfaced during the Los Alamos interviews addresses issues found in the literature on teaming and cross-functional teaming. These themes have furnished the basis for the propositions that guided the research presented here. The four propositions derived from these themes represent both theoretical and applied qualities. This research is preliminary, derived from the ground-truth examination of teaming principles found in the literature on teaming. The themes that emerge from the Los Alamos research show enough difference from

what appears in the literature to suggest the need for further research for understanding teaming issues.

At the applied level, the results of identifying the seven themes defined above gives managers a set of principles for use in planning, staffing, and controlling the activities of cross-functional teams. Although these propositions do not necessarily contradict the findings in the literature, they do stand on their own as a distinct set of principles.

Proposition 1: Team members have individual motivations that are as important, or more important, than team objectives.

From the information gathered in the interviews, this proposition appears to be the most important to examine. The team members all had individual motivations that drove them to become involved in the team. These motivations varied from being interested in the technical or business challenges to wanting to work with the other members on the team. These motivations, more so than the team objectives, seemed to be the primary reason for participating on the project, at least in the beginning. Understanding that these individual motivations exist and recognizing them can help managers develop more effective teams.

Proposition 2: The importance of individual goals decreases as teams become more focused on the project's goals.

This proposition provides an important corollary to Proposition 1. As the projects progressed in the teams studied, team members became more committed to the objective and goals of the project, and their individual motivations became secondary to achieving the objective of the project and yielding project success. As the team members work together to develop the common objective and the performance goals, and as they continue "purposing," the individuals become more committed to the project and see project success as success for themselves.

Proposition 3: Personal commitment is the single most critical factor driving success in high-performance cross-functional teams.

Once team members buy-in to the project's objective and goals, an individual's personal commitment to working toward project success increases. Once team members become committed to the project, they become more focused on making the project succeed. As seen in one of the teams studied, when even one member is not committed to the objective of the project, it can affect the entire team. When one member does not work toward project success, the other team members tend to look unfavorably on that team member, which can cause loss of respect for that individual. This concept of team member commitment offers a key to effective management of cross-functional teams.

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Proposition 4: Functional area differences may appear to be a barrier at the start of a project, but are overcome once the team members understand each other's roles.

When individuals from different functional areas first join a team, there tends to be skepticism and perhaps even some prejudice from the other functional areas team members. But over time, as these individuals begin to participate in the team and their role and its importance are understood by the rest of the team, this prejudice and skepticism are replaced with understanding and respect. Team members must understand the roles and their impact to the team to respect and depend on each other.

In each proposition, time is an important element. It takes time for team members to get to know and respect each other, to become committed to the team's objective, and for individual motivations to become secondary to the goals of the team. It will take time for the team to become cohesive and work well as a high-performance team, but it can happen. Managers and team leaders must understand these concepts to develop effective teams.

Summary

A number of teaming issues play a crucial role in developing high-performance teams. The issues discussed in this section are the most commonly identified in the literature, as well as those most commonly addressed during the interviews. By identifying these

issues and placing them into nominal categories, managers can begin to understand and synthesize the information, which in turn will better enable them to develop effective teams.

Although training is a useful tool to encourage team building, it does not appear to facilitate the development of successful teams and projects. The role of management at Los Alamos differs from its role outlined in the literature. For example, the type of financial and political support suggested in the literature does not seem to exist for the teams at Los Alamos; however, the teams still managed to achieve success.

Performance evaluations could function as a more useful motivational tool for promoting better teaming. For this to happen, performance appraisals should include teaming performance, as well as individual performance.

H. CONCLUSIONS

Cross-functional teaming can be an important method for organizations to solve complex problems, reduce costs, reduce resources, and increase competitive advantage. It is critical for managers working with cross-functional teams to understand the impacts of individual and team motivations, commitment, training, management support, and other teaming fundamentals in order to develop cross-functional teams that produce results.

By studying the cross-functional teaming literature, it becomes apparent that empirical literature is scarce on this

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subject. There is a definite need for the kind of ground truth conducted in this study to be expanded upon in other organizations. Examining how the theoretical concepts in the teaming literature apply to actual cross-functional teams will help management and team leaders to understand what is necessary and reasonable behavior for developing cross-functional teams.

The research done for this paper enabled the establishment of seven nominal categories of teaming factors. These factors are based on the perceptions of the teams interviewed regarding motivation, training, and management support as they apply to cross-functional teaming. These categories appear, from the literature and the ground truth examination of teaming concepts applied to actual teams, to be the most important and relevant issues relating to teaming. The nominal categories that have been established include

- norms
- "purposing"
- leadership
- individual motives
- group motives
- objectives
- goals

Further research in this area might include the establishment of the order, scale, and values for these seven nominal categories.

The research conducted to this point is sufficient to identify some important concepts for management and team leaders at the Los Alamos National Laboratory. It appears that even though

there is no formal organizational approach to cross-functional teaming at Los Alamos, the people in the organization believe that this type of teaming is an important and effective method of solving problems and achieving objectives.

The management at the Los Alamos National Laboratory should encourage cross-functional teaming. The Laboratory has gone through many changes in the last several decades and continues to adapt to new charters and changes in the way that they have done business. There are many transitions that must occur and these cross-functional teams can support the transitions.

Management at Los Alamos should recognize teaming in performance appraisals. From the literature and from the interviews it appears that performance appraisals may not have much influence over what motivates an individual to participate in a team. However, including teaming in a performance appraisal has no negative impact and could enhance teaming at Los Alamos. It is important to keep in mind that there is a fine line when rewarding teams, individuals need to be rewarded as well.

Furthermore, Los Alamos managers need to be cognizant of individual motivations among team members and help them to meet their individual needs as well as the team's objective. The individual motivation seems to become secondary to the team objective over time and the individuals will be driven by project success.

These issues should be addressed and will enhance projects and teams at the Laboratory. These types of teams with their different functional backgrounds and motivation may seem difficult at first, but with patience and with time, these teams will yield great benefits for the Laboratory and the people involved.

APPENDIX

INTERVIEW PROTOCOL

Individual Background Information

What is your educational background and training?

What is your function on this team? (describe in 1–3 words)

What motivates you to be on this team?

What do you hope to gain from this project?

Has your motive for being on the team changed over time?

Team Background Information

What is the objective of this team?

Who are the team members?

What motivates them to be on the team? (list each person's motivations)

How did this team come together?

Does management support this team?

Has this team been given any formal team training?

Is this a cohesive team? Why or why not?
Who is the team leader?

Has the team leader changed at any point in the project? Does leadership vary?

Has the team developed an approach to the way the team functions?

Is there any prejudice on the team against any functional area?

Do team members have respect for each other? If yes, was it immediate or over time?

Do team members value each others contributions?

Is individual status (management level, functional specialty, etc.) an issue on the team?

Have there been successes and failures during the process of this project?

Have these successes and failures helped or hindered the progress?

Do you consider your project a success?

What stage in the product innovation process is the technology? [strategic planning, concept generation, pretechnical evaluation, technical development, commercialization (Crawford, 1994)]

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