



**CIFE** CENTER FOR INTEGRATED FACILITY ENGINEERING

**Modeling & Monitoring Trust  
in Virtual A/E/C Teams**  
*A Research Proposal*

By

Roxanne Zolin, Prof. Raymond E. Levitt,  
Dr. Renate Fruchter, and Prof. Pamela J. Hinds

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If you would like to contact the authors, please write to:

*c/o CIFE, Civil and Environmental Engineering Dept.,  
Stanford University  
Terman Engineering Center  
Mail Code: 4020  
Stanford, CA 94305-4020*

# Modeling and Monitoring Trust in Virtual A/E/C Teams; A Research Proposal

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## Abstract

This research proposes to develop and test processes, criteria, language, concepts, models and tools that can be used by managers and workers to design, build, maintain, and repair trust in virtual teams.

With the trend toward globalization, information technology and E-Commerce services, Architecture, Engineering and Construction (AEC) teams are increasingly more likely to harness globally distributed talent and expertise. To design, plan and build a facility, a large number of individuals from a variety of nationalities, cultures, professional backgrounds, and from many different companies must have enough trust in each other to do their job and trust others to perform theirs.

Economists developed agency theory, based on the assumption that “agents” pursue their own goals—i.e., they are not trustworthy—and they need to be incentivized and closely monitored. In contrast, some propose the viewpoint that everyone should be viewed as trustworthy in relationships. Of course, both of these extremes – trusting too little, or trusting too much – can lead to costly failures. Errors in when to trust can result in deadline, budget and quality failures, lost opportunities, increased surveillance, increased stress, divided attention, increased error rates and more rework.

Although both business and academia agree that trust is a central issue, little has been done to operationalize the elements of the trust process.

Another, perhaps greater problem is finding the language to talk about trust in accurate terms. In English alone, the word trust is used to describe many different concepts, making precise communication about trust impossible.

For the purpose of this work, we have developed the following working definition of trust:

*Trust is the deciding factor in a social process that leads to a decision to accept a risk that another party will meet certain behavioral expectations.*

The objective of this proposal is to develop and test a model of trust development, maintenance and repair in A/E/C project teams. Future research will be needed to extend our trust research into areas of e-commerce and relationships that extend across organizational boundaries such as the general contractor to subcontractor relationship.

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## Chapter 1 The Challenge of Trust

*A global AEC firm with offices worldwide wins a competition to build a new hotel facility in Singapore worth over \$100 million. The Architect is assigned from the London office to team up with the Structural Engineer from their design group in the San Francisco office and build alliances with the General contractor and sub contractors in Singapore. In order to save time and money and better manage and track information, they will use the best information and collaboration technologies available – but there is no existing formalized process to help them build trust.*

The stakes are high; the hotel must meet performance requirements; and it must be delivered on time. Competition was fierce and the budget has very little slack. But the biggest challenge may not be producing creativity or ensuring safety or meeting deadlines or managing cost.

Each of the team members must face and overcome personal barriers to cooperation.

They must learn *how* to trust one another.

- ◆ Not the trust of familiarity. These people have never met each other before.
- ◆ Not the trust of similarity. These people work in different disciplines and come from different cultures.
- ◆ Not the trust of future necessity. These people may never work together again.
- ◆ Not even the trust of organizational security. These people may not work for the same organization or share the same organizational culture.

Virtual teams usually start fast; do non-routine work with heterogeneous membership within weak organizational structures. A member of such a team needs to learn how to trust in a swift, temporary, multidisciplinary, distributed workgroup: To trust when there is no previous relationship or history to go on, when you don't see things from the same perspective, when you have different goals, when you have no commitment to the relationship in the future and when there is no authority to protect you if it fails.

The challenge of learning this kind of trust is becoming more and more common in today's workplace, with faster project starts, greater professional specialization, and now, with the help of communication technologies such as the Internet, greater geographical dispersion of teams. Nowhere is this challenge more obvious than in the Construction

industry where global A/E/C/ (Architecture, Engineering and Construction) teams with numerous players are standard.

Possibly recognizing that unwarranted mistrust is an undetectable mistake, many popular management writers promote the adoption of more trusting relationships. This could lead to disaster if team members are not competent or trustworthy.

How can organizations rise to the trust challenge and bridge the widening chasm between the increasing need for trust and increasing difficulty to trust in distributed workgroups?

### *1.1 The Importance of Trust in Virtual AEC Teams*

Trust is a frequently mentioned topic in the construction industry, the Internet community, the business community, and the political arena (Enda, 2000) There is increasing recognition of trust as a social good or social capital that is fundamental to human interaction and cooperation (Putnam, 1995), (Paxton, 1999), (Child & Faulkner, 1998), (Fukuyama, 1995).

Some of the reported benefits of trust are better productivity and quality performance (Hagen and Choe, 1998).

These benefits may be attributable to removing the costs of reduced trust, which tend to be non-productive behaviors such as excessive checking and protective controls.

In the traditional design process the Architect designs the exterior and floor plan of the building and “throws it over the wall” to the Structural Engineer. The Structural Engineer designs the structural support system of the building and “throws it over the wall” to the Construction Manager. The Construction Manager plans the construction sequence and prepares the budget and time schedule. The problem with this approach is that if the structural Engineer identifies a structural problem, or the mechanical engineer identifies a problem such as a lack of space for risers, the plans must go back to the Architect to be corrected. This is likely to be a larger correction than if the Engineer was able to identify the problem contemporaneously with the Architect’s original design process. The same applies with the Construction Manager who may find that the building is costly to construct, costs too much, or will take too long to build. The Design/Build construction contracting process allocates responsibility for design and construction functions to one business entity—frequently a joint venture corporation created for a single project. By working together as a team, problems can be identified sooner when they are less expensive to anticipate than they



will be to fix. Moving from a traditional design process to the design/build process implies moving from a sequential to mutual interdependence.

With the introduction of the Internet, design teams in the construction industry, which always tended to be distributed across companies and space, more than ever fit Wong and Burton's (1999) description of the virtual team. Virtual Teams (Wong and Burton, 1999) have virtual context, composition and structure. Virtual context means that the team members often have no prior history of working together; the tasks tend to be non-routine and completed under time pressure; and the members of the team are not physically collocated. Thus team members are deprived of some types of information normally used to build trust. Virtual composition refers to the heterogeneous character of the team membership represented by different cultures and different disciplines. Thus team members are less likely to find similarities upon which to build trust and are more likely to have misunderstandings due to differences in basic assumptions. Virtual structure is represented by the weak lateral relationships that are characteristic of such teams. Thus the leadership, power and control provided by traditional hierarchy structures are not available. In summary, the context and composition of virtual teams discourage the development of trusting relationships while the virtual structure depends upon it. This suggests that the development of trust is critical to performance and satisfaction in a distributed workgroup.

Success in the construction industry depends upon the exercise of trust among project team members. This is due to the virtual nature of design teams in the construction industry, the interdependent nature of the tasks performed by fragmented project organizations, and the risks that interdependence entails (Thompson, 1967). Trust is required to facilitate cooperation between the specialized and consequently fragmented mosaic of disciplines required to build even a simple structure. Complicated and precise scheduling requirements require trust for delivery on time. The fast start of project teams requires *swift trust* (Meyerson, Weick & Kramer, 1996). The one-time nature of most AEC project teams removes the "shadow of the future" which motivates cooperation in longer-term relationships (Axelrod, 1984).

While the need for trust is high and demands upon trust are great, so too is the cost of failure of trust. Such costs include lower productivity, less creativity, more mistakes, lost opportunity, increased vigilance, increased surveillance, and time spent waiting for paperwork to go through channels to avoid risk. In addition, worry drains emotions and diverts attention from the job at hand (Kramer, 1999).

The current approach promoted by many team-building exercises merely promotes increasing trust. This simplistic view can lead to a failure in performance if the trusted person is not trustworthy. Trustworthiness is the extent to which the trusted person is ready, willing and able to meet the performance requirements. Trusting an untrustworthy person could lead to failure to perform and end future possibilities of trust.

These problems are exaggerated by the lack of any accurate language of trust. In the English language the word trust is used to mean many different things from the feelings associated with trust, to the behavior and the perceived trustworthiness of the other party. This confusion is compounded when different cultures try to enter a dialogue about trust because each culture has different expectations upon which they base their trust and different ways of evaluating another's trustworthiness.

## 1.2 Research Question

This research attempts to answer the following research questions:

*Of the many factors that have been proposed, what factors, when examined together, are the **most***

***important predictors of trust** in new and mature distributed teams? A formal, predictive, computational*

model could help us answer these and other questions:

- What is the process that builds trust in distributed teams?
- What promotes unwarranted trust in distributed A/E/C teams?
- What promotes unwarranted distrust in distributed A/E/C teams?
- How can we help distributed AEC teams build and maintain trust, avoid or recover from the consequences of trust failures?

## 1.3 The Model Building Rationale

A model building approach was chosen as a way to organize and simplify the vast number of variables involved in the trust process.

A model is a tool for projecting the results of hypotheses. Using a model as a predictive tool can assist both the inductive and deductive stages of research (Carley, 1999).

In its simplest form a model merely identifies the important variables and how they are related to produce an effect. To be useful, a model of trust development must be formal, general, predictive and dynamic with clearly defined

variables. This requires an accurate language of trust to refer to the different factors in the model. For example, the model must have a specific definition of trust (Hagen and Choe, 1998) and related concepts, such as perceived trustworthiness.

Conceptual validity requires the model to be based upon, and to incorporate and relate significant and accepted social theories about how trust develops and degrades. This requires a model with a richer conception of the human actor(s) than has been used in, for example, economic models.

To be testable we need accurate measures for the relevant variables.

Thus the model building process involves conceptualization of the referent system being modeled, definition and operationalization of the variables, specification of the interactions of the variables, building and validation of the model.

A model, like the theories it represents, is a formalization of reality that involves the selection of variables and the process by which they are associated. A criticism of the use of models in the social sciences is that a model is not as rich as human experience. Simplification is a weakness, but also the strength because human experience is too complicated to allow accurate understanding and prediction of human behavior without a simplifying mechanism like a model. In studying human behavior there are three main areas of simplification: simplification of the actor(s), simplification of the social situation, and simplification of the processes by which they interact. The goal is to incorporate enough complexity of humans, social situations and processes to make the model accurate and useful while maintaining enough simplicity so that the model is understandable and usable.

The need for complexity is determined by the purpose of the model. Our human capacity to comprehend, apply and test the elements of the model is limited by the quality of our theoretical concepts (language) and ability to test those models (methodology).

Computer models are used to predict the results of organizational theories because they can make accurate computational predictions of detailed, interacting phenomena. If successful the model can show more transparently the connection between the inputs and the predictions of the model. In order to develop a valid computer model of a social theory, the theory must be conceptualized and operationalized in a way that can be accurately represented by the computer program.

Models have been developed to predict performance in work that is routine and non-social, such as factory production. This is possible because the work being represented does not require high levels of intellectual and creative input that depend upon a rich representation of the human actor or rich social interaction.

Design work in an AEC team requires high levels of social interaction and creativity. In order to model and represent this type of work we need a higher degree of human and social richness in our theories and suitable techniques for operationalizing the theoretical variables

Since the objective of the trust development model is to predict trust, a model of trust development cannot employ only one theory of trust. It needs to, as much as possible, identify and combine theories of trust development. Two criteria were used for selecting theories; the theories were widely recognized in the trust literature and the theories explained the process of trust development. When theories are combined, a major consideration is the relative influence of the different independent variables in the prediction of trust. Hence calibration of the model is necessary to show the relative importance of the various factors.

### *1.4 Alternative Theories*

The most commonly proposed objection to such a model of trust decision-making is the belief that a phenomena as complicated, emotional and rooted in the unconscious, as trust appears to be, cannot be explained or predicted. This could be called the “theory of ineffable trust”.

It may be true that the social and psychological interactions that make up the experience that most people experience, recognize and call trust cannot be represented in their full richness, depth, and breadth. Even artistic representations, such as a good novel, which may touch on the richness of the experience, will probably never be able to plumb the depth and breadth of the phenomena we call trust. The difficulty of representing trust does not mean that we cannot predict the effects of trust, such as a trust failure.

The nature of the human condition, which includes free will and mistakes, makes it impossible to predict individual actions. Nevertheless, social science is based upon the prediction of the likely behavior of people as a whole. The difficulty of predicting an individual trust decision does not mean that we cannot predict the likely trust decisions of most people in a certain situation.

### *1.5 The Proposed Model Building Methodology*

The following steps are used to build the model of trust development:

1. Develop a definition of trust
2. Identify theories of trust development and deterioration
3. Combine the theories in a graphical model of trust development
4. Operationalize the relevant variables and collect data
5. Build a computational model of the trust decision making process
6. Test the model in predictive case studies.

As will be shown, there is no accepted definition of trust; hence we will state the definition we will use. The definition should reflect common and academic understandings of trust. Then we identify research-tested theories of trust development. We develop a formula to define relationships between the major variables of the different theories and show how the variables from the different theories interact. We then operationalize the independent and dependent variables using data from numerous qualitative and quantitative sources and triangulating the measurements.

Data from distributed AEC workgroups is used to build the model. Relationships between the model inputs and model predictions are discovered through correlation. The model is calibrated to make it compatible with the observed results. Thus the model is designed to retrospectively predict the results of the pilot study.

When, based upon the data collected, the model accurately predicts the development and deterioration of trust in the observed workgroups; it is used to predict trust in a number of case studies. The model's predictions will be compared to the actual results to test the model.

## Chapter 2 Developing A Definition of Trust

A clear, unambiguous definition of trust is especially important when trying to factor trust into a computational or mathematical model. (Lerch, Prietula & Kulik, 1997), (Muir, 1994), (Urban, Sultan and Qualls, 1999), (Marsh, 1994). We draw on many sources in the development of our definition of trust.

Business writers agree that trust is central to teamwork, leadership and organizational culture (Fairholm, 1994) (Nicholas, 1993), (Ryan, 1999). The business community recognizes the importance of trust implicitly as well as explicitly. The implicit recognition of trust is evidenced in writings about organizational culture, leadership and team building. The literature of the business community describes the operation of trust in the business environment, measures trust using surveys that are based upon untested “best guess” factors (Duarte & Snyder, 1999) and prescribes formulas based upon anecdotal material (Shaw, 1997). Rarely does it progress beyond the anecdotal level due to the lack of any theory or model to provide a level of analysis.

The academic research community agrees that trust is essential in relationships (Seligman, 1997), (Grovier, 1997), (Shapiro, 1987), (Hardin, 2000). Despite this fact, there is no agreed upon definition of trust (Hardin, 2000).

Researchers say that trust is a “**calculation** of the likelihood of future cooperation” (Williamson, 1993), “an **orientation** toward society and toward others” (Kramer & Tyler, 1996), “an **incorporation** of risk into the decision of whether or not to engage in the action” (Coleman 1990), “the **expectation** that specific others will reciprocate trusting behavior” (Kramer & Tyler, 1996), “a **state** involving confident positive expectations about another’s motive” (Boon and Holmes 1991), “the **confidence** that one will find what is desired from another” (Deutsch, 1973), “an actor’s **willingness** to arrange and repose his or her activities on [an] other” (Scanzoni, 1979), “the **degree of confidence** you feel when you think about a relationship” (Rempel and Holmes, 1986), “a confident **belief** in the integrity and reliability of the other person” (Zimbardo, 1970), “a more or less **consciously chosen policy** for handling the freedom of other human agents or agencies” (John Dunn, cited by Hardin, 1999).

### *2.1 Images of Trust*

Theorists and researchers have spoken of trust in many different ways. Kramer (1999) has categorized these divergent views of trust into a number of images that range from the social and ethical facets of trust to the strategic and calculative dimensions.

The view of trust as a psychological state focuses on the cognitive processes, and orientations associated with trust (Kramer, 1999). The mental states that are associated with trust include the perception of risk, an attitude of expectance and various affective and motivational states. Trust involves uncertainty and risk taking based on expectations of another person (Meyerson, Weick & Kramer, 1996).

In contrast, trust is also conceptualized in terms of choice behavior (Kramer, 1999). Writers taking this view, point to the conscious calculation of risk versus benefits and the importance of information in that process.

Finally, the rational choice models of trust assume the individual consistently makes rational choices about trust to maximize achievement of goals. Rational choice models contain two central elements (Hardin, 1992), the knowledge that enables a person to trust another and the motivations of the person being trusted. These models have been criticized for lacking the social and affective aspect of trust (Kramer, 1999).

*Conceiving of trust as part of social process unites these different images of trust into a holistic perspective that includes situational factors, such as the level of risk, state parameters, such as the current levels of trustworthiness, choice behavior within the constraints of the state and relational aspects such as history of the relationship and expectations for the future with their associated affective components. Trust is part of a social process that involves actors, psychological states, choice and learning behaviors.*

*Consequently, we propose the following definition of trust:*

*Trust is the deciding factor in a social process that leads to a decision to accept a risk that another party will meet certain behavioral expectations.*

## Chapter 3 Identifying Theories of Trust Development

### 3.1 Bases For Trust

Kramer categorizes theories of trust into six groups depending upon how they explain the conditions that promote trust and influence individuals to engage in trust (Kramer, 1999) (See Table 1). As Bigley and Pearce (1998) propose, different influences gain ascendancy in the trust decision-making process due to different situational and relationship factors.

Table 1– Categories of trust development theories

Category	Independent variable	Intervening variables	Process
Dispositional trust	Individual's personality		The individual's general predisposition influences trusting or non-trusting behavior.
History-based trust	Outcomes of dyadic interactions	Perceived trustworthiness	Dyadic interactions create information about perceived trustworthiness
Third-party conduits of trust	Rumour and gossip	Perceived trustworthiness	Third parties provide information about the trusted person.
Category-based trust	Shared membership	Perceived trustworthiness	In-group bias and attribution of favorable characteristics to the trusted person.
Role-based trust	Role occupancy	Perceived trustworthiness	Roles provide information about the other's perceived trustworthiness
Rule-based trust	Cultural rules, norms and schema	Risks and Rewards	Symbolic behavior creates, communicates, reinforces, or could destroy rules about when to trust.

Dispositional trust attributes trust to the individual's general predisposition toward trusting or non-trusting behavior (Rotter, 1970). Rotter developed a scale of "General Trust" that correlated significantly with his sociometric measure of interpersonal trust among college students. When surveyed individuals do display different attributes towards trusting others in general. Unfortunately the general nature of the questions used in the survey instruments tends to make it difficult to ensure that the reported attitudes refer to similar risk situations. For example, the questions often do not specify a specific person or the specific task. (See Table 1) Yamagishi and Cook and others have developed Rotter's scale of general trust and identified other salient personality characteristics such as prudence or caution (Yamagishi, 1995). The dispositional theory is that the higher the trustor's General Trust score, the more likely the trustor will make a positive trust decision.

History-based trust recognizes that trust develops over time as a function of individual interactions. Experience with the other party provides information about their trustworthiness and through a process of reciprocity creates obligations and expectations that facilitate or frustrate future trust interactions. The history based trust theory states



that the trustor evaluates the results of a trust decision and changes perceived trustworthiness based upon that analysis.

Third-party conduits of trust are recognized in other theories of trust, which emphasize the importance of rumour and gossip in providing information about the other party (Granovetter, 1985, p 490 – 91). Third-party theory of trust proposes that information from other people changes the trustor's perceived trustworthiness of the trustee.

Category-based trust theories propose that shared membership in a given category can provide the basis for low-risk impersonal trust and that due to in-group bias individuals tend to attribute favourable attributes to other in-group members (Brewer, 1996). Observations influence the trustor based upon assessments of the dimensions of trustworthiness, for example understanding and competence, and affective influences such as the degree of similarity with the trusted person (Kramer & Tyler, 1996, p. 19). For example, if the trusted person is in the same profession, the trustor assumes greater understanding and consequently has higher perceived. Category-based theory of trust proposes that the more similarity the trustor has with the trustee the easier it will be to trust.

Role-based trust theories propose that depersonalised trust is extended to individuals based upon their role occupancy. Roles create expectations about the individual's performance and intent to fulfil obligations that overcomes the need for personal information and relationship. Role-based trust implies that the more clearly roles are understood and shared the easier it is to trust.

Rule-based trust acknowledges the cultural basis for trust developed through shared understandings and expectations that are both tacit and explicit, formal and informal. Rule based trust is built through socialization processes and maintained through a normative system that operates at unconscious as well as conscious levels. Symbolic behavior creates, communicates, reinforces, or could destroy, this socially constructed and self-reinforcing dynamic.

*The theories of trust as are represented by Kramer's categories do not represent different types of trust but instead represent different factors that influence the trust decision-making process. In different situations one or another of these factors may be more salient than the others. Thus a model of trust would incorporate all these factors. The trust decision-making process is influenced by dispositional, historical, third-party, role based and rule based factors. These are the theories used to build the model of trust development.*

### 3.2 Dimensions of Perceived Trustworthiness

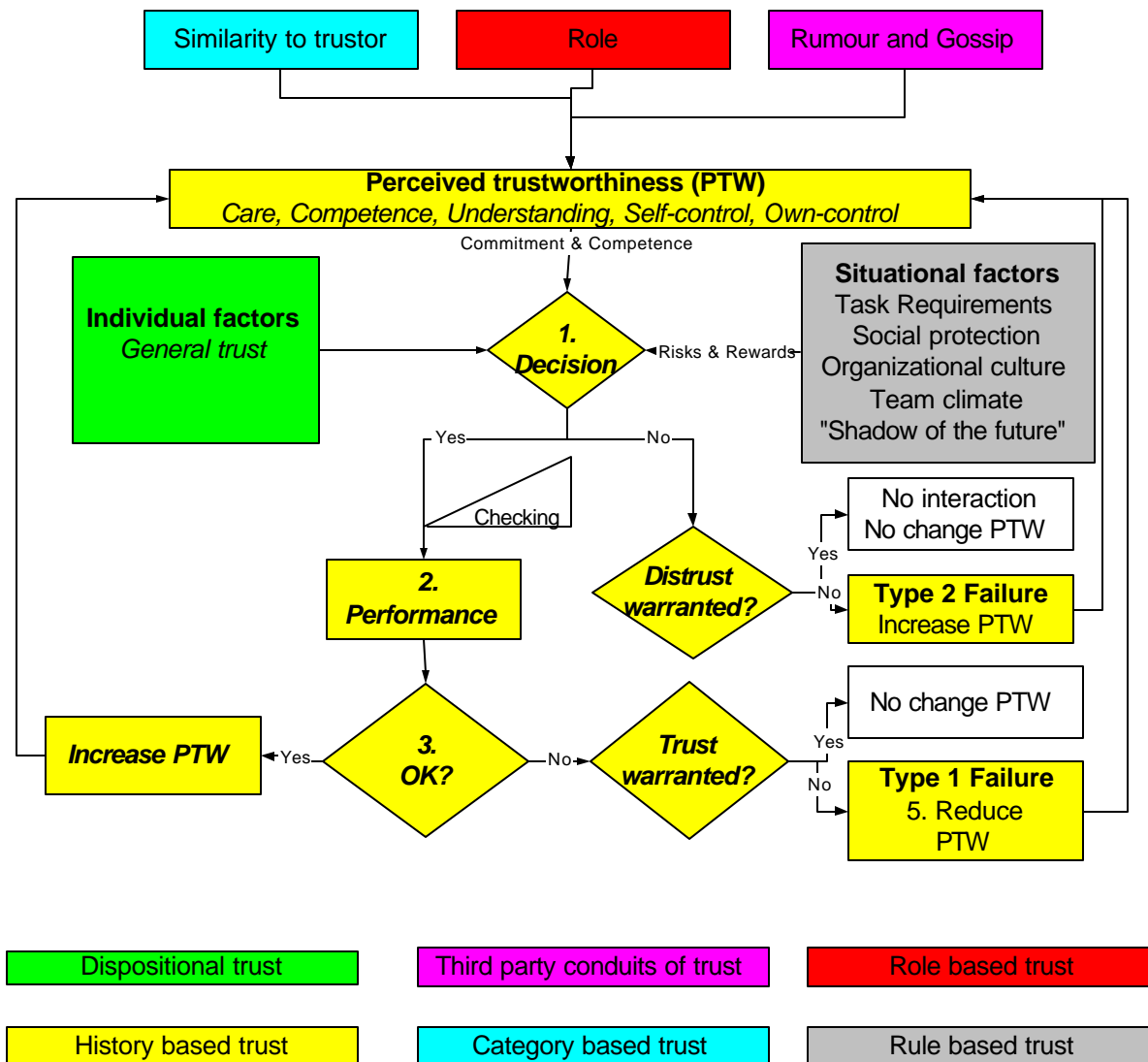
Perceived trustworthiness is the individual's assessment of how much and for what type of performance another person can be trusted (Hardin, 2000). We often use the word trust when describing perceived trustworthiness (Hardin, 2000). Mishra identifies the dimensions of Competence, Openness, Concern and Reliability (Mishra, 1996). Persistence, technical competence and fiduciary responsibility are Barber's dimensions (Barber, 1983). Rempel uses predictability, dependability and faith (Rempel, 1985). None of these taxonomies of perceived trustworthiness are comprehensive and consistent. For example Mishra and Barber could be criticized for not being comprehensive, as they do not include predictability. Because there is no logical basis for these dimensions it is not possible to assess if they have covered everything. Finally Rempel's dimension of faith is just as ambiguous as the term, trust, that it is attempting to define.

A Norwegian psychologist, Jan Smedslund, has developed a technique called "Psychologic", a language of Psychology based upon logic (Smedslund, 1997a). Using Psychologic Smedslund has defined the dimensions of trust as; *Care, Understanding, Competence, Self-control, and Own-control* (Smedslund, 1997b). *Own-control* means, "I can trust you because you are free to make your own decisions and take action". *Self-control* means that you are disciplined enough to control your behavior. *Competence* means that you have the skills, and resources that you need to perform the task. *Understanding* means that you know what my priorities and requirements are. Smedslund says that caring means that "You want good for me" – goal alignment or "encapsulated interest" (Hardin, 2000). *Care* means that your goals include positive outcomes for the other party. Smedslund claims that these five dimensions are all that is necessary and sufficient to create trust (Smedslund, 1997). One of the advantages of Smedslund's five dimensions of trustworthiness is that they all relate to the central problem addressed by trust – the freedom of the other party upon whose behavior an individual is dependent.

# Chapter 4 Combining Theories Of Trust In A Model Of Trust Development

Acknowledging that trust is part of a social process incorporates and unifies the many definitions of trust. The distinguishing feature of the trust process is that it results in a decision to adopt a particular type of behavior. The Trust Development Process Model predicts when an individual will make a positive or negative trust decision. (See Figure 1)

Figure 1 – The Trust Development Process Model



### *4.1 The Trust Decision*

The trust decision is the heart of the trust development process model and the theories used to build the model are combined and related at this point.

By describing trust in relation to the decision to accept a risk we can apply decision analysis to understand the process of trust development and its failure. In this research a decision to trust is called a positive trust decision. Conversely, a decision to not trust is a negative trust decision.

With no trust in the other person the trustor would decide to find an alternative to the other party's performance, for example they might ask someone else to perform the task, do it themselves or plan to do without. The reward of a trust interaction is the value of the interaction less the value of the next best alternative. In situations in which there is a low level of trust the trustor may make a positive trust decision, but then engage in self-protection behavior such as checking and hedging, thus reducing the value of the trust decision by adding additional costs.

A critical factor in a trust decision is whether the other person is trustworthy for the particular matter concerned (Hardin, 2000). Hardin and Kramer point out that trust is a three-part process such that "Person **A** trusts **B** to do **Y**." (Kramer & Tyler, 1996), (Hardin, 2000) The expected performance, the third part of the process, is often implied or left ambiguous. It includes all the characteristics of performance such as timing and quality and even subjective intangibles such as responsiveness or friendliness.

The trust decision is not a binary, "Yes" or "No", variable. The positive decision to trust is a continuous variable from unconditional trust to guarded trust. The closer the decision gets to a "No" the more self-protection the trustor uses. For example, if it is a close decision the trustor engages in vigilance such as checking the other trusted person's. A negative trust decision results in a range of behavior from non-interaction and performing some of the work in case of failure by the other party through to avoidance.

### *4.2 Dispositional Trust – Individual Factors*

The trust decision is influenced by trustor's personality characteristic for general trust, which inclines the actor toward trust or distrust (Rotter, 1970).

### *4.3 History Based Trust – The Dynamic Process Of Trust Development*

Trust is developed in the context of a relationship with the trustee. A major feature of that relationship is the outcome of previous decisions to trust. At certain key times trust decisions are re-evaluated and the trustor changes the perceived trustworthiness of the trustee based upon that analysis.

Step 1: the trust decision. The trust decision is based upon three major inputs, perceived trustworthiness, risk and reward for each person plus trust, the deciding factor.

If a positive trust decision was made, Step 2 is the performance by the other party. The trustor observes other party's performance.

In Step 3 the trustor compares the other party's performance to expectations and determines whether the expectations were met or not. If the expectations are met the trustor's perceived trustworthiness of the trustee increases.

If expectations are not met the trustor has an opportunity to consider whether the trust was warranted or not. If trust was warranted, in other words the failure was not the fault of the trusted person, there is no change in trustworthiness. If the trustor decides that trust was unwarranted perceived trustworthiness is reduced at Step 5.

In the event of a negative trust decision at Step 1, a step that is usually overlooked, is to consider whether the lack of trust was warranted or unwarranted. Thus the trustor may receive new information about the trustee's trustworthiness and reconsider the negative trust decision. The model assumes that this analysis is not overlooked and the potential learning is not lost.

#### **4.3.1 Iteration Through The Trust Process**

Because trust is the result of a social process, it is built, or degraded as the individual performs successive iterations through the trust process.

The faster the interaction between the two parties progresses through the trust process, the sooner trust can develop or degrade.

Because the trust process is based upon the trustor's perception of the other person and the situation, the better the quality of information that the person has to work with the faster the trustor will progress through the trust process.

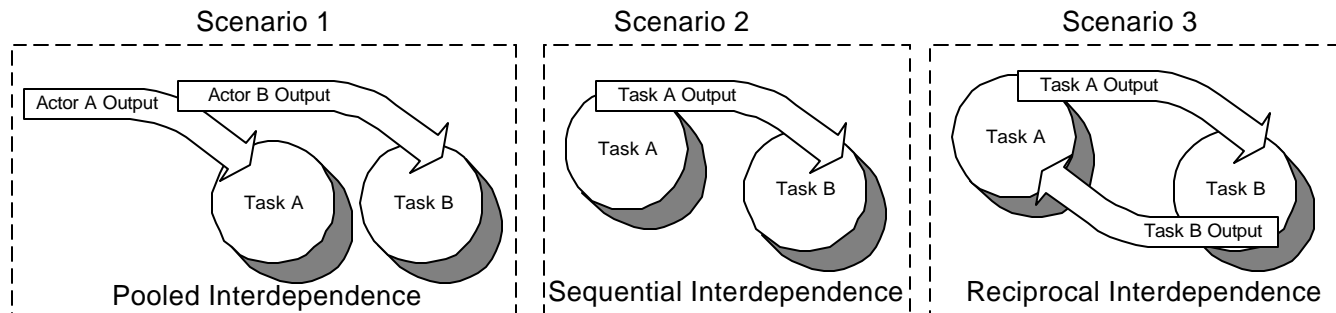
Quality of information is defined by its availability, relevance and accuracy.

Critical points, at which the trust decision and assessments of performance and trustworthiness are made, require trust information. For example, if we look at Figure 1, to make the trust decision the trustor needs information about the trustworthiness of the trustee, and the risks and rewards of the situation. Then, if a positive trust decision was made, the trustor needs information about the performance of the trustee in order to evaluate the trustee's performance. Alternatively, if a negative decision was made the trustor could use additional information about the trustee that might either confirm or deny that negative trust decision to help evaluate the accuracy of that decision.

#### 4.3.2 The Effect of Task Interdependence on the Value at Risk and Iteration

In a work situation the need to trust grows out of the interdependent nature of the tasks that are involved in the work. There are three types of interdependence, pooled, sequential and reciprocal (Thompson, 1967). (See Figure 2)

Figure 2 - Task Interdependence



Traditionally architectural design, structural engineering design and construction planning were performed sequentially. The architect completes the architectural design and “throws it over the wall” to the structural engineer who completes the structural design and “throws it over the wall” for the construction manager to plan the construction sequencing, budget and time schedule. In a design/build project the architect, engineer and construction manager work together and the design and planning activities are performed more or less concurrently. Besides potentially shortening the length of time spent in planning this creates opportunities for joint problem solving and theoretically results in a building that is more attractive, safer, cheaper and completed sooner.

All projects have pooled interdependence for all necessary tasks. When interdependence is pooled the total operation is at risk unless each contributor performs adequately. The risk involved is that one of the actors will not contribute sufficiently. To address this problem organizations adopt a standardization approach using structures such as rules and standards. (See Table 2) Standardization creates expectations between actors responsible for the interdependent

tasks about the way the actors will perform. The assumption is made that if all the actors perform according to the rules the overall project will be successful.

Table 2 Organizational techniques for different types of interdependence

<b>Interdependence</b>	<b>Organization</b>
Pooled	Standardization
Sequential	Coordination by plan
Reciprocal	Mutual adjustment

Sequential interdependence is created when the output of one task is needed as an input to another task. To address this problem organizations analyze the task inputs and outputs and develop co-ordination by planning and scheduling which may be enforced through hierarchy structures. (See Table 2)

Reciprocal interdependence occurs when the outputs of Task A are the inputs of the Task B and vice versa. Because the two tasks are completely interdependent they cannot be decoupled by either rules or schedules. Reciprocal interdependence is addressed through mutual adjustment, in other words a joint problem solving approach (See Table 2). In order to do this the actors responsible for the two interdependent tasks must create a shared understanding of the requirements of both tasks and search for solutions that address the problems of both tasks.

Each type of interdependence requires the actors to trust the other actors for different things. (See Table 3) Each type of interdependence adds to the trust requirements of the previous form of interdependence, from pooled to sequential to reciprocal. Thus reciprocal interdependence requires all the trust requirements of pooled and interdependence plus its own trust requirements.

Table 3 Trust requirements for different types of interdependence

<b>Interdependence</b>	<b>Trust Requirements</b>
Pooled	All actors must trust the other actors to contribute a sufficient amount and quality of output by the project deadline.
Sequential	Task A actors must trust Task B actors to provide accurate information about urgency. Task B actors must trust Task A actors to report inability to meet the specifications or deadline. Task A actors must trust Task B actors to provide accurate feedback about the quality of Task A output.
Reciprocal	Sequential trust requirements become reciprocal. Task A actors must trust Task B actors to provide accurate information about the potential impact of suggested solutions on Task B's time, cost and quality outcomes. This is reciprocal. Task A actors must trust the Task B actors seek and consider solutions that resolve issues for both tasks. This is reciprocal.

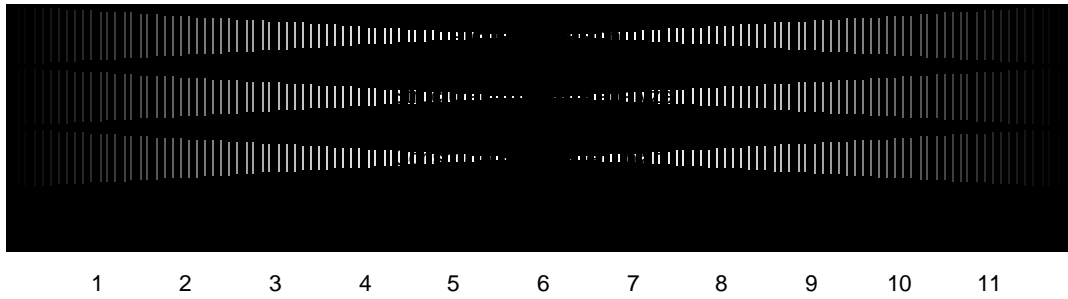
#### **4.3.3 Time granularity and iterations through the trust process**

As interdependence moves from pooled to sequential and finally to reciprocal interdependence the time granularity and the task granularity are both reduced.

For example, if the Architect, Engineer and Construction Manager could each independently produce their work and then compile the project when it is due that would be an example of pooled interdependence (See Figure 3). This is, of course impossible because their work is interdependent. If they could use a pooled approach the task size for each discipline would be the full project, i.e. the full design, analysis or planning of the building. The time frame would be the full time allowed for the project. In this case the team would complete an iteration of the trust process at the end of the project when information is available about the performance of the other team members. This never happens because the disciplines need information from each other to complete their work.

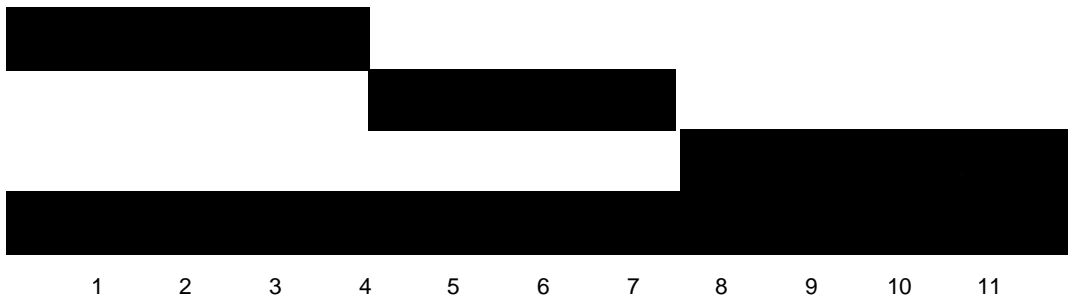


Figure 3 Pooled Interdependence



With sequential interdependence each team member is responsible for a section of the report but the Architect must provide the completed design to the Structural Engineer before the structural analysis and design can be done (See Figure 4). Thus although the work of the task is the same, the time frame is less than the full time allowed for the project. In this situation the team completes an iteration of the trust cycle for Architect when Architect’s work is due. Another iteration of the trust process is completed when Engineer’s performance information is available. The full iteration is complete when the Construction Manager’s plan is done at the project deadline.

Figure 4 Sequential Interdependence



With reciprocal interdependence the team members are each still be responsible for the same tasks but they must work together constantly sharing information about what they are writing, identifying problems caused to their work by decisions made by the other writer and jointly solving the problems raised by the interdependence of their work (See Figure 5). The tasks are the production of units of information required by the other worker and the resolution of conflicts between the two workers. Thus the tasks can be very small compared to the overall project and the time frame can be reduced to days or hours. The time frame is the amount of time needed to produce that unit of information or resolve the conflicts. In this situation the team completes an iteration of the trust process for every

unit of production and trust information is available, usually about both team members, at the end of every time frame.

Figure 5 Reciprocal Interdependence

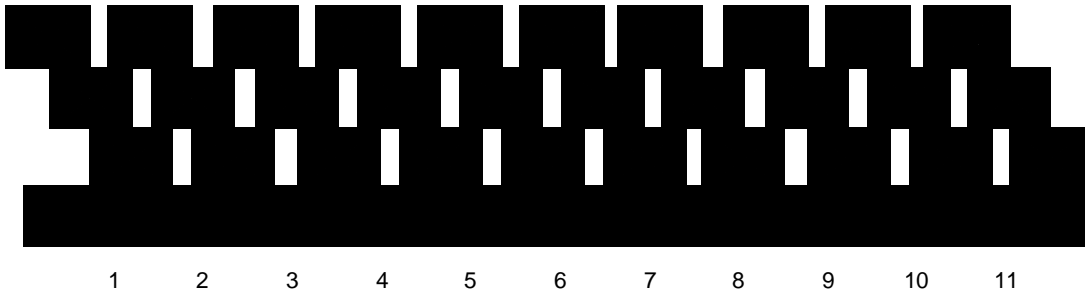


Table 4 shows a summary of the effects of interdependence upon task size, time frame and the value at risk. In it we see that pooled interdependence has a large task with a large time frame and consequently entails a large value at risk. In contrast reciprocal interdependence results in a small task size and a small time frame with a correspondingly smaller value at risk.

Table 4 Effect of interdependence upon task size, time frame and value at risk

Interdependence	Task size	Time frame	Risk
Pooled	Large	Large	Large
Sequential	Medium	Medium	Medium
Reciprocal	Small	Small	Small

If the task is such that no one gets rewarded unless the whole project is completed correctly then the risk is highest with pooled interdependence because the team members do not know if other members will complete their tasks until the project deadline is reached. Sequential interdependence has less risk because the task completion information is made available half way through the project, when A is scheduled to hand over to B. Reciprocal interdependence has the least risk because the team members are in contact all the time and performance information is constantly exchanged.

#### 4.3.4 Evolution and sensitivity

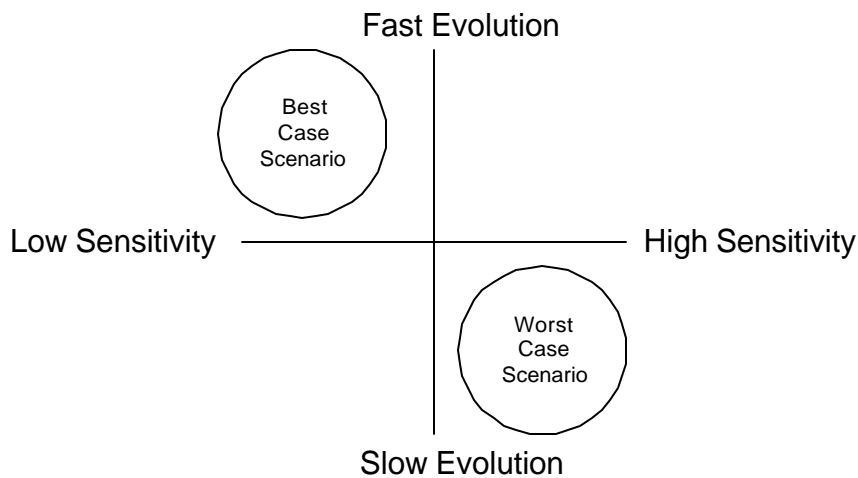
Evolution is that rate at which information becomes reliable. Fast evolution means that preliminary information can be counted on early in a project. The evolution rate of trust is how quickly a person decides that someone is trustworthy. If trust is essential or even helpful in the performance of the task, then fast evolution of trust is better.

Sensitivity is the degree to which changes in information affect the project. High sensitivity means that a small difference can cause huge effects. Trust sensitivity is the degree to which the project can be adversely affected by a poor trust decision. A poor trust decision is deciding to trust when it is not warranted or withholding trust when trust is warranted. If trust sensitivity is high you want to be very sure before deciding whether to trust or not to trust.

Thus the best-case scenario is when the situation allows for fast trust evolution (trust develops quickly) and low trust sensitivity (an incorrect trust decision does not have great adverse consequences). This is the situation with reciprocal interdependence. (See Figure 3)

The worst-case scenario is when the situation allows for slow trust evolution (it takes a long time to establish trust) and high trust sensitivity (trust is a very important decision). This is the situation with pooled interdependence. (See Figure 6)

Figure 6 Best and Worst Case Scenarios



Moving from pooled to reciprocal interdependence changes the evolution of trust information and the sensitivity of the trust decision. For example, with pooled interdependence in a three-month project the actor may not recognize that the other actors did not perform until the project deadline. In a similar project with sequential interdependence Task B will find out if the Task A actors have performed when their work is due at, say, the beginning of month two. Finally, with reciprocal interdependence the actors of Task B will have trustworthiness information about the actors of Task A as soon as they start to work on the project.

Thus as organizational techniques are used to change the type of interdependence from pooled to sequential and finally to reciprocal interdependence the speed and richness of trust information received increases.

#### *4.4 Third-Party Conduits Of Trust – Rumor and Gossip*

Information from third parties contributes to perceived trustworthiness. That information may be positive or negative but the more consistent information the trustor receives the more confidence will be placed in the perception of trustworthiness.

#### *4.5 Category Based Trust – Group Membership*

The more similarities the trustor perceives s/he shares with the trustee the easier it will be to trust.

#### *4.6 Role-Based Trust – Cultural and Organizational Factors*

The role of the trustee affects the trustor's perceived trustworthiness. If the trustee's role definition is clearly defined the trustee is more likely to make a positive trust decision.

#### *4.7 Rule-Based Trust – Situational Factors*

The trust process operates within the context of situational. (See Figure 1) Using the tenets of Social Exchange Theory, we can categorize the situational factors into two main variables: the *Risk* and the *Reward* of trusting.

Social Exchange Theory uses the concept of a social exchange to organize and analyze sociological phenomena to create social theories (Turner, 1986). The assumptions of Social Exchange Theory are much broader than economic theory, for example. Some assumptions are; Humans seek to achieve some profit, not maximized profit, through social transactions; Humans are not perfectly rational but they do calculate costs and benefits in social transactions; Humans do not have perfect information but they are usually aware of some alternatives; Humans act under constraint and they sometimes compete for profits; Humans are limited in their profit seeking by their resources. Therefore economic exchange is one type of social exchange and it happens in the context of a social exchange. Social exchange is not limited to the exchange of goods and services but includes nonmaterial, non-economic resources such as sentiments and symbols. Social exchange is relevant to trust since most exchanges require some level of trust in the other party.

Homans, one of the early proponents of Social Exchange Theory, began with the behaviorist's observations of humans that he called Elementary Principles of Social Behavior. From these principles Homans induced axioms of

human exchange behavior. Homans recognized that all exchanges do not involve direct mutual reward between two parties but sometimes reciprocity is “univocal” in which one party reciprocates through a third party. Thus univocal exchange can be conceptualized as an exchange between the individual and society. The primary form of exchange in a distributed workgroup is a form of univocal exchange called productive exchange (Molm, 1997) or “group-generalized” exchange (Ekeh 1974) in which group members must pool their resources and then receive benefits generated by the pooling. Ekeh (1974) further divides group-generalized exchange into individual-focused exchange, where the group works for the benefit of one member at a time, and group-focused exchange, where benefits are pooled and shared by all. Both types of group-generalized exchange occur in multi-disciplinary workgroups. For example, if the Structural Engineer has a problem with the design of the structural system both the Architect and Construction Manager can help in problem solving by offering to change their plans to provide fewer constraints and help accommodate the needs of the structural system. The overall project is an example of group-generalized exchange as each team member receives reputation benefits from a successful building. These forms of exchange require even greater levels of trust than exchanges involving direct mutual rewards.

Network generalized exchange (Yamagishi and Cook, 1993) is another form of exchange in which each member of the group provides benefits to another member of the group without receiving a direct exchange (Ekeh, 1974). This occurs frequently between the Structural Engineer and the Construction Manager as they try to choose materials that achieve both structural and budget requirements. Yamagishi and Cook (1993) found that participants cooperate more in a network-generalized exchange structure than in a group-generalized exchange structure. They also found that information about the other participant’s actions had a positive effect on the cooperation of high general trust participants in a network-generalized exchange structure. This suggests that higher trust participants who are provided with information about other team member contributions will cooperate more in interdisciplinary problem solving.

Blau introduces the assessment of risk into the exchange equation when he proposes his rationality principle “In choosing between alternative actions, a person will choose that one for which, as perceived by him at the time, the value of the result, multiplied by the probability of getting the result is greater.” (p265) The freedom of the human actor introduces the element of risk into social exchange. The existence of risk in exchange creates the need to employ trust as a deciding factor in the exchange. Kollock (1994) demonstrates that different levels of uncertainty create significant differences in levels of commitment, concern for reputation and levels of trust that emerge.

Blau proposes four categories of rewards, money, social approval, esteem or respect, and compliance (p 267) upon which individuals place different value. It is these differences in value that Blau uses to explain differences in patterns of social organization (p271). The recognition of differing values between actors is central to the assessment of trust in a relationship. If two actors' values and goals are perfectly aligned there would be no need for trust because the trustor could be sure the trustee would make the same decisions as s/he would make in the situation.

Social Exchange Theory is limited in that it excludes other methods of need satisfaction that are not based upon exchange, such as free gifts and coercion (Turner, 1986). Most occurrences of gift giving in a workgroup, such as sharing candy, can be explained as reciprocal exchange. In a distributed workgroup coercion is not expected to represent a significant percentage of exchanges.

#### **4.7.1 Risk and Reward**

The nature of the task determines the level of risk that the trustor faces. For example, if it is a small easy task the risk is likely to be smaller than if it is a large task.

The level of social protection afforded by the situation affects the level of risk. Roles, norms, schemas, etc. create expectations that the trustee will act in a certain way. They also provide some expectation of social protection in the event that the trustee does not perform as expected. These patterns may operate at all levels of social interaction, such as the national culture, the industry culture, the organizational culture or the team climate.

The task performance expectations are based upon shared understandings of cultural roles, norms or schemas and explicit agreements such as contracts. In some cultures it would be unthinkable to ask someone to haggle strongly to get you a good price, in other cultures it is such a basic assumption that it would be taken for granted.

The extent to which the culture is strong, shared and explicit determines the strength of task performance expectations. For example, when roles are well defined and shared the trustor will have strong expectations that the trusted person will perform the task requirements relating to trustee's role.

The reward value of the trust interaction is the opportunity cost of the next best alternative way to achieve the task goals. The task dependence and interdependence determines the reward value of the trust interaction. If the trustor is highly dependent upon the trustee there is a high reward available. If the task is highly specialized and no one else can perform the task the reward from the interaction is high. If the task is not specialized and there are many alternatives for achieving task performance the reward is small.

## 4.8 Failure of Trust

A failure of trust is a situation in which one or more team members cannot contribute to the project goals because one or more of them have made a trust error.

There are two errors that can be made in a trust decision, unwarranted trust or unwarranted distrust.

Trust decision errors are caused by a mismatch between the perceived and actual trustworthiness of the target. If perceived trustworthiness is greater than actual trustworthiness then unwarranted trust occurs (Type 1 Error). If perceived trustworthiness is less than actual trustworthiness then unwarranted distrust occurs (Type 2 Error).

### 4.8.1 Type 1 Error: Unwarranted Trust

The **Type 1 Error**, unwarranted trust, is deciding to trust an untrustworthy person. Type 1 Errors can result in assessment by the actor that the target person failed to meet minimum performance requirements. If this happens and the actor assesses why the other person's performance did not meet expectations. The reason could be something outside the person's potential to predict and control. In this case the trustor would not be likely to change the perception of trustworthiness. Alternatively the failure could be something that could have been avoided had the person exercised reasonable care, .N this case the trustor is likely to reduce perceived trustworthiness and the likelihood of all future positive trust decisions.

### 4.8.1 Type 2 Error: Unwarranted Distrust

The **Type 2 Error**, unwarranted distrust is deciding not to trust a trustworthy person. Type 2 Errors result in the **Type 2 Failure** of trust causing lost opportunities; wasted time spent in surveillance, and lost opportunities of future cooperation unless the decision is reversed.

Hence in order to build trust one needs to focus on trust building by increasing the percentage of correct trust decisions, not merely increasing the number of positive trust decisions.

## Chapter 5 Operationalizing Variables And Collecting Data

### *5.1 The Level of Analysis*

Trust can be conceptualized as a property of the relationship between two actors that has a directional quality (Cook and Whitmeyer, 1992). Actor A's trust of Actor B is different, although possibly related to, Actor B's trust of Actor A. Thus the unit of analysis is the relationship from the point of view of one actor to another actor.

The focus of this research is on trust at the level of the individual contributor. The unit of analysis is a directional dyadic relationship, e.g., the relationship from Person A (trustor) to Person B (trustee). Thus in each dyadic relationship there are two directional relationships, the relationship from Person A to Person B and the relationship from Person B to Person A.

The individual contributor level was chosen, because it is in a person-to-person relationship that trust exists and is exercised. The two-party interpersonal relationship is also the building block of a team and determines the effectiveness of the interface between disciplines. When we have the concepts, models and metrics to study and predict trust at the interpersonal level, those tools can be applied to understand trust in more complicated relationships, such as across business borders (customer, subcontractor, supplier or investor relationships) or between different levels of the organization (manager to team, for example).

### *5.1 Sample Selection*

Stanford's Project Based Learning Lab (PBL) provided an ideal test bed for such research. The subjects under investigation were involved in a five-month project multidisciplinary project as part of a subject in the Project Based Learning lab (PBL) in the Department of Civil and Environmental Engineering at Stanford University. (See Figure 7)



Figure 7 CEE 222: Computer Integrated Architecture, Engineering and Construction  
Observed Failures of Trust

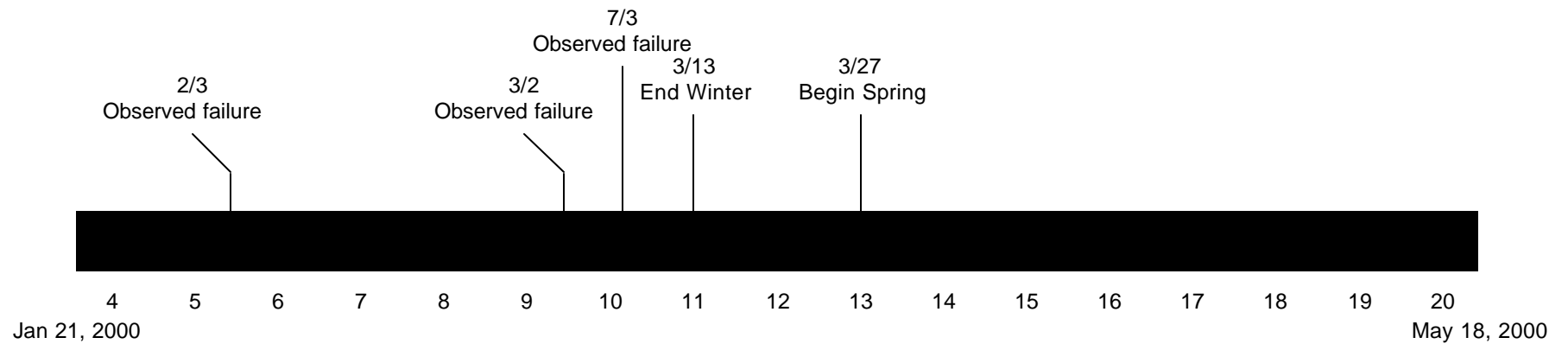
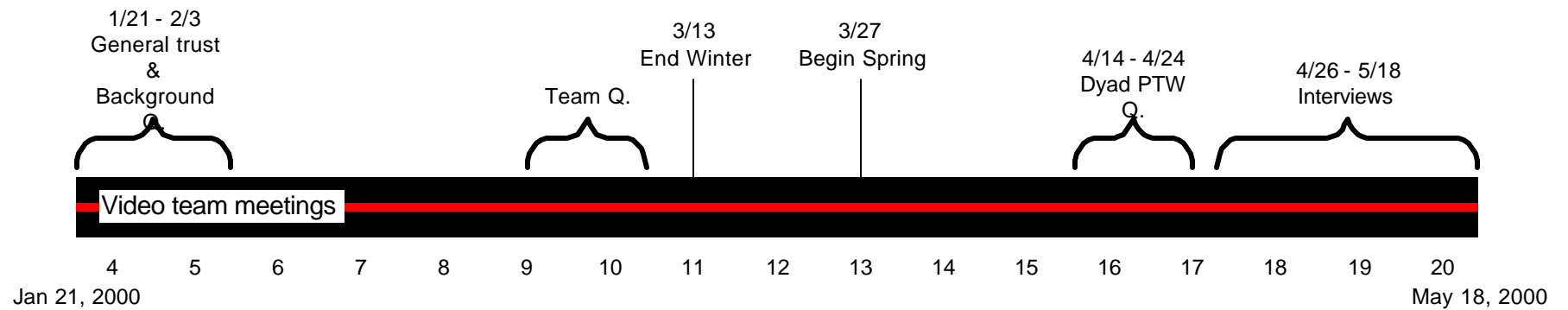


Figure 8 Stage 1 Data Collection



Seven groups of four geographically distributed students engaged in a realistic role-play simulation of the activities of a multidisciplinary design/build construction team. The goal of the student's project was to design, analyze and plan the building of a facility containing an auditorium, offices, classrooms and computer lab. Each team comprised at least one architect, one structural engineer and one construction manager. Teams with four members had an additional structural engineer, construction manager or an apprentice helper. Within this constraint team members were randomly assigned to teams. The goal of the subject is to provide superior learning experience through the accurate simulation of real work situation under supported conditions of exceptional support, such as the provision of highly qualified faculty and industry mentors for each discipline.

### *5.2 Use of student teams and scope of research*

Project based learning is a growing trend in teaching collaborative skills using team-based projects. The objective of project-based learning is to simulate as closely as possible a real life work situation while providing additional resources and reduce the risks involved with learning on the job (embarrassment, loss of position, waste of costly resources).

Project based courses are often the subject of research because they closely replicate reality but are more accessible for measurement. Few companies would agree to the high level of data gathering that was necessary in Stage 1 of this research. Some recent studies of trust involved student teams (Iacono and Weisband, 1997), (Jarvenpaa and Leidner, 1999). These studies typically select a student population and collect data from all individuals in that population, as we have done in our study.

There are some drawbacks in projecting the results of student teams studies into a real work situation. As mentioned, student teams differ from a real work situation because the level of risk is reduced to encourage students to experiment and learn. In in-depth individual interviews, a question was asked to determine to what extent the participants perceived their experience to be different from a real work situation. Virtually every participant mentioned some way the experience would be different, from less contact with the other disciplines to more risk.

From the analysis, risk is a major factor influencing trust decisions. Consequently, a model of trust developed with student teams would be unlikely to predict trust or trust failure accurately in a real work environment. Such a model must be initially tested in a student team environment to validate the model's predictive capacity. Should the model validate in the environment, for which it was designed, then the model can be applied in a real work environment

and the differences noted. Those differences will provide valuable insights into how the development of trust differs between a student environment and a work environment, and form the basis for a revised and recalibrated model of trust in a real working environment.

The goal of this research is to determine the level of accuracy that can be achieved in a predictive model of trust and to achieve that goal the use of student teams was chosen. Expanding the model to predict trust in a real work environment is beyond the scope of this research.

### *5.3 Data Collection Issues In Virtual Teams*

Virtual Teams provide a number of simplifications to the experimental conditions, which are now described. The use of computer-mediated communications in virtual teams requires a greater level of documentation of communications and offers more opportunities to collect data unobtrusively. Gossip and reputation are important information sources for the development of trust (Meyerson, Weick & Kramer, 1996). Virtual teams provide a situation in which team members are less likely to gossip because situations that promote gossip, like meeting at the office water cooler, are reduced or non-existent. In addition, in a distributed team, where many of the communication mediums recorded, the possibility of recording gossip is higher.

### *5.4 Project Stages*

Data collection is planned in a series of stages. (See Table 5) The purpose of the staged approach is to provide a continuum of data collection methods from the highly qualitative through to the more quantitative measures. The qualitative techniques provide a richer context of understanding for the quantitative methods. Thus the understanding obtained through quantitative information is checked through triangulation with the qualitative information. The Preparation stage was qualitative and consisted of observing the distributed teams and conducting group discussions with each of the disciplines. Stage 2 data collection techniques were partly qualitative and partly quantitative. Teams were observed and in-depth individual interviews were conducted but questionnaires were also conducted to provide quantitative measurements. The results obtained through the quantitative measurements can then be checked against the knowledge gained through the qualitative assessments. For example, a statistical analysis the answers to the dyadic questionnaire was conducted but the questionnaire answers were screened to determine if they fit with the knowledge already gained of the specific relationships. Inconsistent data could then be further investigated. This procedure generally confirmed the reliability of the quantitative measures and occasionally

highlighted errors in the statistical analysis techniques applied. As a simple example, knowing that a certain team had trust problems helped identify a coding error in the statistical analysis.

Table 5 Data Collection By Project Stages

Stage	Objective	Data Collected
Preparation Stage*	Inductive stage: Understand trust interactions in the context of the multidisciplinary distributed workgroups.	Observations Group Discussions (by Discipline)
Stage 1*	Model building stage: Gather a wide range of qualitative and quantitative data for model building.	Questionnaires: Dyad, Individual and Team Video group meetings, Group discussions, Individual interviews Internet interaction pages Assessments and grades Faculty interviews
Stage 2**	Model testing stage: Gather data used in the model and test model predictions.	Individual Interviews Questionnaire: Dyad Faculty interviews

\* Completed    \*\* Proposed

#### 5.4.1 Preparation Stage: Understanding the Context

Initial preparatory work involved observation of the AEC group interactions and Group Discussions with each of the three disciplines. As would be expected, each profession said that they would trust a member of their own profession more than one of the other professions. The importance of trust was different in each profession. The architects said that trust was crucial. Structural engineers said that lack of trust caused worry, as one German engineer reported, “you go pregnant with the situation”. Construction Managers said that you have to do the job regardless, if you don’t trust your teammates you become defensive and manipulative. Things that build trust were “personal sacrifices for the good of the team”. Selfishness erodes trust. Interruptions to work caused by lack of discussion severely damaged trust. No significant differences in resulting from different organizational cultures were reported. Being physically and temporally distributed (different time zones) and relying on technology made trust more difficult. This provides evidence that the more distributed the team becomes the more likely a trust failure could be.

#### 5.4.2 Stage 1: Model Building

Data was collected in Stage 1 to investigate trust interactions and build a preliminary model of trust development. (See Figure 8 previous)

Data sources included questionnaires, video recordings of group Internet meetings, group discussions, individual interviews and Internet interaction pages. Internet Interaction Pages are specially designed web pages that facilitate interactions and record messages between team members and with outside parties.

The data was analyzed to produce an interpersonal history of the relationship between each of the three or four team members. Significant events in that history were identified from the video analysis. The interpretation of those events was confirmed through triangulation with individual interviews and other data sources. For example, by week three it was obvious from observation that one of the teams had a problem with trust. As additional information was collected in questionnaires and interviews that observation was checked against the new information to see if the interpretation was consistent with the original observation. This produced an ongoing cycle of observation, comparison with previous data, and revision of theories about the situation.

In order to track the trust development process the following constructs were measured (See Table 6).

Table 6 Operationalization of Model Variables

**Dependent Variable:**

Variable	Measurement instrument	Operationalization
<b>Trust - level of checking</b>	Dyad questionnaire (See Appendix 2)	Calculated variable derived from measures of reported checking behavior (See Appendix 2)
<b>Observed Failure of Trust</b>	Observations and interviews with the faculty.	A team problem described as being caused by a lack of trust between team members, and interferes with team performance to the extent that the Professor notices it and that intervention is required.

**Confidence:**

Variable	Measurement instrument	Operationalization
<b>Competence</b>	Dyad questionnaire (See Appendix 2)	Calculated variable derived from measures of perceived <i>Competence</i> (See Appendix 2)

**Assurance Test:**

Variable	Measurement instrument	Operationalization
<b>Value of Reward</b>	Individual Interviews (See Appendix 2)	Interview questions about importance of team member cooperation, value of cooperation and availability of alternatives. Group discussions explore the impact of discipline on dependence
<b>Value at Risk</b>	Individual Interviews (See Appendix 2)	Interview questions are asked about what is at risk if the other team members do not perform. Group discussions explore the impact of discipline on potential loss.

**Commitment:**

Variable	Measurement instrument	Operationalization
<b>Care</b>	Dyad questionnaire (See Appendix 2)	Calculated variable derived from measures of perceived <i>Care</i> (See Appendix 2)

**History:**

Variable	Measurement instrument	Operationalization
<b>Follow-through behavior</b>	Dyad questionnaire (See Appendix 2)	Calculated variable derived from measures of follow-through (See Appendix 2)
<b>Perceived trustworthiness</b>	Dyad questionnaire (See Appendix 2)	Calculated variable derived from measures of dimensions of perceived trustworthiness (See Appendix 2)

**5.4.3 Stage 2: Model Testing**

The procedures used in Stage 3 to test the models are described in more detail in Chapter 7 “Testing The Model In Predictive Case Studies”. The data collection methods are reduced to those necessary to gather information for model inputs and to verify the model: participant interviews, the dyad questionnaire and faculty interviews.

**5.6 Questionnaire Survey method**

Although a full spectrum of qualitative and quantitative data was collected during the pilot, the analysis in this paper reports upon data collected through on-line Intranet questionnaires completed approximately during week 12 of the 18-week program. This time period was chosen to allow the development of close working relationships between the team members prior to collecting the data.

For each variable a number of questions were asked and the results were recorded using a five point Likert scale (See Appendix 3 – Survey Questions.) The questions followed the theoretical understandings of trust as part of a three-part process in which **A** trusts **B** about **X**. Consequently the questions elicited information held by the trustor about the trustee with reference to a specific performances, rather than the more usual general questions such as “Do you trust B?”

### **Unit of Analysis**

The model of the Trust Development Process predicts a trust decision by the trustor about the trustee. This is described as a directional dyadic relationship. In every team there are **n(n-1)** directional dyadic relationships.

From our sample of 28 participants we obtained 64 observations (See Table 4). Nearly all participants completed the questionnaire. The on-line survey method ensured that a high percentage of completed questionnaires contained no missing data.

## *5.7 Selection of the Statistical Model*

Because the dependent variable, checking behavior, is ordinal we choose the more Ordinal Logit model. The linear regression model (LRM) assumes that the observed values are interval, which means that there is equal distance between each category. If the category thresholds are not the same distance apart the LRM can give misleading results. (Long, 1997, p119) Answers gathered using the Likert scale are not guaranteed to have equal distance between categories. For example we cannot say that there is the same distance between the answers *Agree* and *Strongly Agree* as there is between *Agree* and *Strongly Disagree*. This suggests the use of the ordinal Logit model.

An added advantage of the ordinal Logit model is that the results can be interpreted in terms of probabilities relating the independent variables to the dependent variable. The ordinal Logit model tests relationships between ordered categories of ordinal. Each of the three variables, follow-through, perceived trustworthiness and checking, were coded to represent three categories: Low, Medium and High. To create these categories, the range of each variable was divided into three segments and labeled.

## Chapter 6 Building A Computational Model Of The Trust Decision Making Process

The Trust Development Process Model revolves around the trust decision-making process. At that point the trust theories intersect. In some way the individual takes action that demonstrates a more or less positive or negative trust decision. This is called the trust decision-making process. As mentioned previously, the trust decision is not completely conscious or rational. It is partly unconscious and affective and partly conscious and calculated.

In discussing the trust decision-making process, Yamagishi and Yamagishi (1994) distinguish between *confidence*, *assurance* and *trust*.

*Confidence* relates to the task specific aspects of perceived trustworthiness that Barber (1983) described as the “expectation of technically competent role performance”.

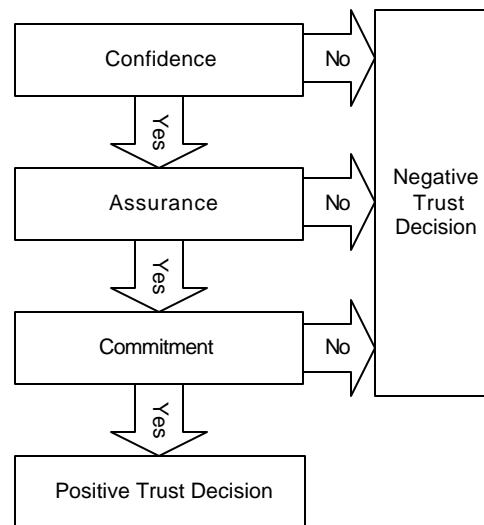
*Assurance* is defined as “an expectation of benign behavior for reasons other than the goodwill of the partner.” (Yamagishi and Yamagishi, 1994, p132) In other words, the situation provides the trustee with certain rewards and punishments that guarantee or at least promote performance without any expectation of goodwill.

*Trust* is the “expectation of goodwill and benign intent.” (Yamagishi and Yamagishi, 1994, p131) With this distinction, trust is concerned with the commitment or encapsulated interest that Barber described as “expectation that parties in interaction will carry out their fiduciary obligations and responsibilities—that is their duties—in certain situations to place others’ interests before their own. Thus trust relates to the aspect of perceived trustworthiness that evaluates the trustee’s motivations.

If the assessments of *Confidence*, *Assurance* and *Commitment* are made in a linear fashion then the Trust Decision Making Process can be described as a three-stage decision making process. (See Figure 9)

Figure 9 Trust Decision Making Process





## 6.1 Confidence – A Necessary Pre Condition To Trust In Fast Start Teams

*Confidence* means that we believe that the person has the resources and ability to do the job. For example, we don't trust the Construction Manager to do the structural analysis, but we do trust the Structural Engineer.

*Competence* determines the level of confidence the trustor has that the trusted person can do the job. *Confidence* reflects the trustor's evaluation of whether the trusted person can do the job or not. It is determined by comparing the task requirements to the perceived ability of the trusted person. *Confidence* is usually conceptualized as a binary variable. If the trusted person appears to be able to perform the task requirements the *Confidence* of success is True, if not, it is False. It is usually not so simple. The result is more likely to be a fuzzy variable rather than a binary "True" or "False" answer. The person can probably do the job to a certain extent. Hence use of the ordinal variable of checking behavior can give a more accurate measure of the outcome of confidence by reflecting those times when there is some doubt about the trustee's capacity to do the job. Despite the fuzzy nature of the assessment of *Confidence*, it is a necessary pre-condition to trust.

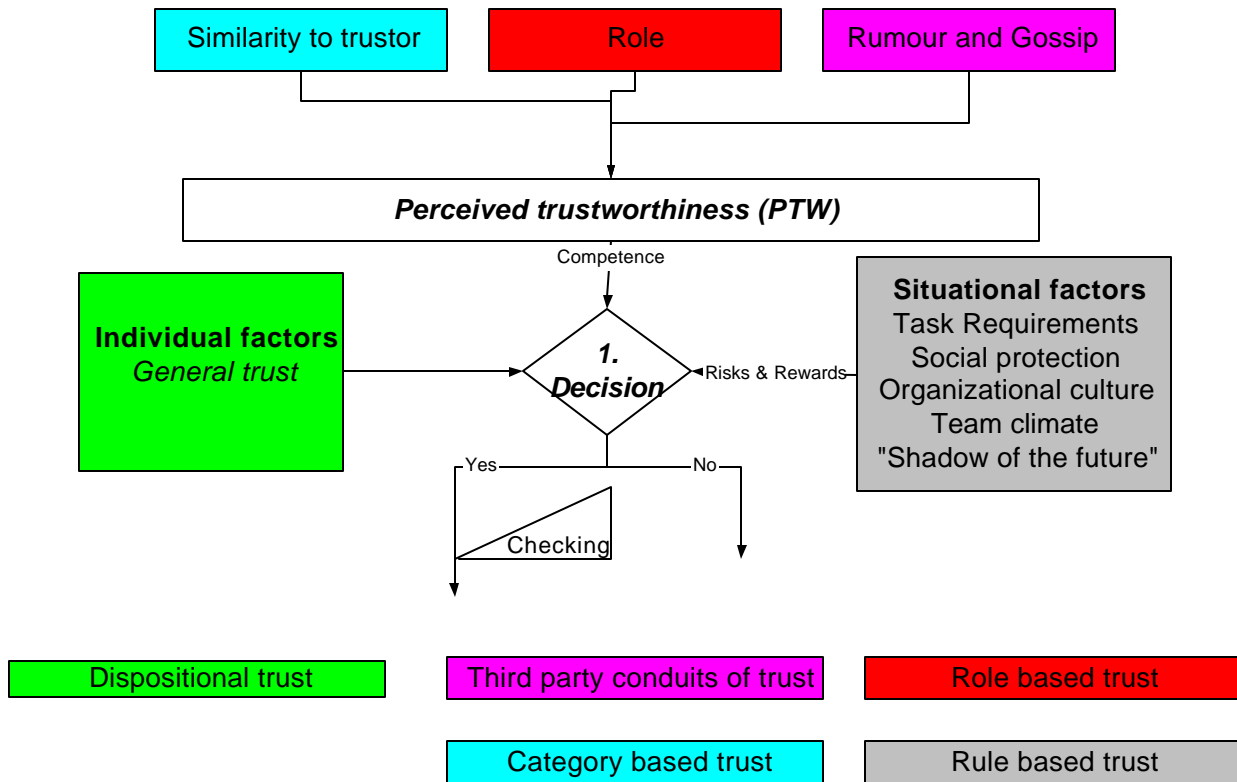
### 6.1. 2 Model building: CONFIDENCE

If the level of confidence is too low, the trustor does not believe that the trusted person has the ability to perform the task requirements and a negative trust decision is made. Confidence has added significance in multidisciplinary projects where team members depend upon each other's technical competence.

Fast Start project team members, who, by definition, do not have any history of interaction to guide their trust decisions, use *Swift* trust based on category similarities to form stereotypical impressions of others (Meyerson, Weick and Kramer, 1996), (Jarvenpaa and Leidner, 1999). In that situation *Confidence* is replaced by *Swift* trust in the trust

decision process. (See Figure 10) In a multidisciplinary project workgroup we would expect team members to assess the combined competence of other team members and that assessment would influence their initial level of trust. Possibly in “swift” trust situations this stage is foregone. Project-based education courses most likely replicate this feature of swift trust because part of simulating a “real life” workgroup is the assumption that the team members have the competence their title implies.

Figure 10 The Fast Start Model of Trust Development



In project-based educational courses, as part of simulating a “real, live project”, participants are implicitly asked to assume that the other team members have the skills, attitudes and expertise required to do the job. This may reduce the participant’s tendency to attempt to assess team member’s competence before trusting.

*Hypotheses 1: In a mature working relationship, as the trustor’s perceived competence of the trustee increases, trust increases and checking decreases.*

**Dependent Variable**

Trust is measured by the level of checking the trustor feels is necessary in the relationship. High checking is associated with a lack of trust. The closer the trustor gets to making a negative trust decision the more checking is employed as a self-protective device. Checking was measured in the Dyad Questionnaire using questions about the level of checking the team member felt was necessary for another team member. (See Appendix 2)

**Independent Variable**

Competence is the trustee's perceived ability to perform the task. It was measured in the Dyad Questionnaire using questions about the trustee's technical, project and professional ability (See Appendix 2). Table 7 shows a description of the two variables, *Competence* and checking.

Table 7 Means and Standard Deviations for Variables

Variable *	Observations	Mean	Std. Dev	Min	Max
Competence	64	3.48	2.41	-2	8
Checking	64	7.31	3.31	3	17

Source: PBL Online Dyad Survey, 4/14/00 N=64 \* See Appendix 3 for survey questions.

### 5.2.2 Findings

Grouping of the observations into categories allows a more general observation of the relationships between variables. Table 8 shows the spread of observations among the categories related to the hypotheses. Out of 36 individuals who reported low checking on another team member, 4 low perceived *Competence* and low checking, 17 reported medium *Competence* and low checking and 15 reported high *Competence* and low checking.

Table 8 Tabulation of Checking by Competence (H1)

Checking*	Competence			
	Low	Medium	High	Total
Low	4	17	15	36
Medium	8	7	9	24
High	3	0	1	4
Total				

Source: PBL Online Dyad Survey, 4/14/00 N=64 \* See Appendix 3 for survey questions.

To test hypotheses 1, an ordinal Logit analysis was performed using competence as the independent variable and checking as the dependent variable (See Table 9). The results indicate that there is a negative relationship between the two variables that is significant at the 95% confidence interval ( $P > |z|$  is less than .05). As shown in Table 9, as Competence decreases checking increases. Thus we can describe the relationship with the following equation:

$$Ck = -.66 CP$$

(Ck = Checking, Cp = Competence)

Table 9 Unstandardized Coefficients From An Ordinal Logit Model Predicting The Probability Of Greater Checking Using Perceived Competence (H1)

Independent Variable	Coefficient	Std. Err.	P> z
Competence	-.66	.33	.049

Cut-point 1	-.51	.46
Cut-point 2	2.06	.60
Model Chi-square	4.02	

Source: PBL Online Dyad Survey, 4/14/00      N=64      \* See Appendix 3 for survey questions.

## 6.2 Assurance - - How The Situational Factors Predict Trust Failure in New Teams

*Assurance* is the expectation that the trustee will perform based upon other factors than the individual's own motivation. It is an assessment of the situation rather than the perceived trustworthiness of the trustee. This analysis of the situational factors employs the perspectives of Social Exchange Theory.

### 6.2.1 Value At Risk

The value at *Risk* is what the trustor or trustee could lose if a positive trust decision to trust is made. The *Risk* is a major consideration to the trustor in making a positive trust decision. It represents the "leap of faith" that the trustor must make. The value at *Risk* for the trustor equates to the cost of a **Type 1 Failure**, unwarranted trust. That is the value of what will be lost if the trusted person does not perform. Failure to perform by the trusted person always results in loss of some portion of the task performance requirements; usually results in lost time and could also result in loss of personal and/or corporate reputation if the trustor fails to meet obligations to others. In addition, if the trustor determines that the trusted person was at fault, the trustor will downgrade the perceived trustworthiness of the trusted person, which could result in the loss of the relationship itself. Although a **Type 1 Failure** involves the same factors for the trustor as it does for the trusted person, those factors may have widely different values due to different levels of interest in having the task done, different investment of resources, different risk to reputation and different value placed on the relationship.

### 6.2.2 Reward Of Trust

The value of *Reward* is what the trustor or trustee could gain if a positive decision to trust is made. (See Figure 8) It represents both the costs and the benefits of the interaction.

The *Reward* that derives from trusting equals the cost no interaction, the **Type 2 Failure**. . The benefit of the trust interaction for the trustor is the difference between this option and the next best alternative. Consider the cost of no interaction to an information seeker (trustor) compared to the cost to an information provider (trusted). Because the information seeker is asking, the information source must have some value. In contrast, the information provider may get no reward for providing information and may incur costs due to time taken away from doing the job. Hence their levels of dependence are different and the cost of a **Type 2 Failure** is negative for the information seeker and

positive for the information provider. The rewards of trust involve the same factors for the trustor as it does for the trusted person, but those factors may have widely different values due to different values, goals and opportunities to satisfy those goals

### 6.2.1 Model Building: ASSURANCE

This research proposes that a level of assurance is a necessary pre-condition to the trust decision-making process. To determine the level of assurance the trustor “weighs” the relative *Risks* and *Rewards* to both parties.

An alternative theory might be that people always trust initially, until experience proves that trust to be unwarranted.

The situation facing the trustor and the trusted person in terms of the value at *Risk* and the *Rewards* of trusting are shown in Table 10. For example, if the trustor perceives the trust opportunity to entail low value at risk and high benefits of trust the Situation is called a “Good Deal” because it is clearly advantageous to make a positive trust decision. Similarly, if the trusted person faces a situation of high value at *Risk* and low *Rewards* of trust the Situation is called “No Way” because it is clearly not in the person’s interests to comply.

Table 10 Potential Risks and Benefit Situation

<i>Rewards of trust</i>	<i>Value at Risk</i>	
	<b>High</b>	<b>Low</b>
<b>High</b>	High Stakes	Good Deal
<b>Low</b>	Bad Deal	Low Stakes

The results of these two tables are combined and all potential combinations involving *Risks* and *Rewards* for the trustor and the trusted person are contained in the following table. (See Table 11)

Table 11 *Risk* and *Reward* Scenarios

	<b>Trustor</b>			
	<b>Good Deal</b>	<b>High Stakes</b>	<b>Low Stakes</b>	<b>Bad Deal</b>
<b>Trusted</b>				
<b>Good Deal</b>	Positive	Positive	Positive	Negative
<b>High Stakes</b>	Trust required	Trust required	Trust required	Negative
<b>Low Stakes</b>	Trust required	Trust required	Trust required	Negative
<b>Bad Deal</b>	Negative	Negative	Negative	Negative

Cells that contain a “Positive” or “Negative” decision represent scenarios in which trust is either not necessary (“Positive” cells) or not enough to change the decision (“Negative” cells). Cells that contain a “Positive” represent situations in which both the trustor and the trusted receive sufficient benefit to make it reasonable for the trustor to take the risk. Cells that contain a “Negative” represent situations in which either there is not enough *Reward* to make the *Risk* attractive to the trustor or there is not enough benefit to the trusted person to rely upon compliance.

Scenarios represented by all the other cells require trust to achieve a positive trust decision. In these other cells the model assesses the level of trust that the trustor has for the trusted person, and the level of obligation that has developed to determine whether a positive or negative trust decision will be made. For example, the trustor might face a “Good Deal” situation while the trusted person faces a “Bad Deal” situation. In that scenario the trustor should make a negative trust decision because the trusted person has no benefit from the trust interaction. In a negotiated exchange the trustor could increase the proportion of benefits to the trusted person to gain additional security. If the trusted person’s situation was “Low Stakes” then trust is required for the trustor to make a positive trust decision because it is not clear that it is to the trusted person’s advantage to cooperate. Finally if both the trusted person and the trustor face a “Good Deal” situation the trustor should make a positive trust decision because both will benefit.

***Hypotheses 2:*** *In a new team, the more Risk and Reward scenarios that predict negative trust decisions, the greater the likelihood of observable failure of trust.*

From the interviews-interviews, conducted in weeks 15 to 18 of the projects, a “High” or “Low” value was assigned to each team member to represent the level of risk and level of reward they expressed in the project. (See Appendix 2 for a list of interview questions.)

A scenario emulator was built to calculate the *Risk* and *Reward* scenarios based upon the proceeding analysis. The emulation successfully predicted the one team out of the seven teams that experienced an observable failure of trust in the first three weeks of the project. (See Table 12 for results of the analysis. See Appendix 3 for examples of the emulation output). Table 12 shows that the Scenario Analysis predicts 6 negative trust decisions for Island Team, the only team to experience a failure of trust in the first month of the project. The emulator predicted 6 positive trust decisions for Ridge Team, one of the highest performing teams.

Table 12 Trust Decisions Predicted By *Risk* And *Reward* Scenario Analysis

Team	Members	Dyads	Positive	Trust Required	Negative
Pacific	3	6		6	
Atlantic	3	6		6	
Ridge	3	6	6		
Island*	4	12	2	4	6
River	4	12	6	6	
Central	4	12	12		
Express	3	6	2	4	

\* Island team experienced an observed failure of trust in week three of the project.

Due to the small number of teams observed it is not possible to calculate the statistical probability of this relationship but the evidence supports the proposition that *Risk* and *Reward* scenarios predict initial trust failures, but not trust failures that occur later.

### 6.3 Commitment – The Deciding Factor

Hardin describes trust in terms of the encapsulation of the interests of the actor by the interests of the target (Hardin, 2000). In other words “I trust you if I think that you have my interests at heart”. He points out “A fully rational analysis of trust would not depend solely on the rational expectations of the trustor, but also on the commitments, not merely the regularity of the trusted.” In terms of the dimensions of trustworthiness, commitment is expressed in the aspect of *Care*. The dimension *Care* might be best understood in terms of the question “Is the person *Committed* to the task and/or me?”

*Commitment* is the assessment that the trustee has a personal stake in achieving the performance requirements.

Information that builds the perceived trustworthiness dimension of *Care* is largely gained through the history of the relationship. During the observation stage and in the Group Discussions, team members said that when they saw their team members making a sacrifice for the sake of the team it increased their trust in the team member.

*Commitment* is evaluated based upon information the trustor has about the goals of the trusted person. If the goals of the trusted person are aligned with those required by the task (and consequently with the goals of the trustor) the trust is stronger. *Commitment* means that the trusted person is interested and motivated to do the job. For example, we may not trust the Architect to do the costing for the project, even though s/he might be able to do it. While ability is necessary, it is not sufficient to create a positive trust decision without commitment. Therefore *Commitment* is the deciding factor in Perceived Trustworthiness that informs the decision to trust.

#### 6.3.1 Model Building: COMMITMENT

The final step in the proposed trust decision-making process is the assessment of Commitment based upon the dimension of perceived trustworthiness, *Care*.

***Hypotheses 3: As Care increases, trust increases and checking behavior decreases.***

**Independent variable: *Care***



In the Dyad Questionnaire, *Care* was measured using ten specific questions about the team member's "carefulness" (See Appendix 2). The questions addressed behavior such as making extra efforts, causing extra work, listening, and notifying about changes. Table 13 shows a description of the two variables, *Care* and checking.

Table 13 Means and Standard Deviations for Variables

Variable *	Observations	Mean	Std. Dev	Min	Max
Care	64	8.78	5.83	-5	21
Checking	64	7.31	3.31	3	17

Source: PBL Online Dyad Survey, 4/14/00 N=64 \* See Appendix 3 for survey questions.

### 6.3.2 Findings

Grouping of the observations into categories allows a more general observation of the relationships between variables. Table 14 shows the spread of observations among the categories related to the hypotheses. Out of 36 individuals who reported low checking on another team member, 6 reported low checking and a low perceived *Care*, 19 reported medium checking and low *Care* and 11 reported high checking and low *Care*.

Table 14 Tabulation of Checking by Care (H3)

Checking*	Care*			
	Low	Medium	High	Total
Low	6	19	11	36
Medium	14	9	1	24
High	3	1	0	4
Total	23	29	12	64

Source: PBL Online Dyad Survey, 4/14/00 N=64 \* See Appendix 3 for survey questions.

To test hypotheses 4, an ordinal Logit analysis was performed using *Care* as the independent variable and checking as the dependent variable (See Table 15). The results indicate that there is a positive relationship between the two variables that is significant at the 99% confidence interval ( $P > |z|$  is less than .01). As shown in Table 15, as Follow-through decreases checking increases. Thus we can describe the relationship with the following equation:

$$Ck = -1.69 Ft$$

(Ck = Checking, Ft = Follow-through)

Table 15 Unstandardized Coefficients From An Ordinal Logit Model Predicting The Probability Of Greater Checking Using Care (H2)

Independent Variable	Coefficient	Std. Err.	P> z
Follow-through	-1.69	0.46	0.000

Cut-point 1	-1.04	.43
Cut-point 2	1.85	.55
Model Chi-square	17.52	

Source: PBL Online Dyad Survey, 4/14/00 N=64 \* See Appendix 3 for survey questions.

## 6.4 The History-Based Process

The History-based process proposes a relationship based upon experiential learning.

An alternative theory might be that we trust those whom we know, otherwise called familiarity.

The difference between these two theories is that, the History-based trust proposes that if a person is untrustworthy, the more we familiar we become with that person, the less we trust that person. This means that there is an intervening factor, the person's follow-through behavior.

The model proposes that as the trustee's follow-through behavior decreases perceived trustworthiness decreases and as perceived trustworthiness decreases checking increases.

### 6.4.1 Model Building: THE HISTORY-BASED PROCESS

Data from the pilot study was analyzed using statistical procedures to test hypotheses based upon the proposed model of the Trust Development Process (See Figure 1). As mentioned previously, the unit of analysis is the directional dyad (Person A to Person B). The population studied was members of distributed A/E/C educational teams in the Project Based Learning Lab. The dependent variable was a self-reported measure of trust based upon the extent the team member A felt the need to check up on team member B. The explanatory variables were a) Perceived trustworthiness and b) A measure of Person A's perceived level of follow-through by Person B. As predicted by the model (See Figure1, The Trust Development Process Model):

**H4a:** *As follow-through behavior decreases, perceived trustworthiness decreases.*

**H4b:** *As perceived trustworthiness decreases trust decreases and the level of checking increases.*

### Independent Variables

There are two independent variables tested in this study; perceived trustworthiness and follow-through behavior. Follow-through predicts perceived trustworthiness. Perceived trustworthiness, in turn, predicts trust, as measured by the checking variable (See Figure1, The Trust Development Process Model).

Follow-through is defined as completing work commitments (See Appendix 2 for a list of the survey questions). Perceived Trustworthiness contains the constructs of *Care*, *Understanding*, *Competence*, *Self-Control* and *Own-Control* (See Appendix 2). Table 16 shows a description of the three variables, perceived trustworthiness, follow-through and checking.

Table 16 Means and Standard Deviations for Variables

<b>Variable *</b>	<b>Observations</b>	<b>Mean</b>	<b>Std. Dev</b>	<b>Min</b>	<b>Max</b>
Perceived trustworthiness	64	24.28	9.50	4	46
Follow-through	64	4.30	2.61	-4	8
Checking	64	7.31	3.31	3	17

Source: PBL Online Dyad Survey, 4/14/00 N=64 \* See Appendix 3 for survey questions.

#### 6.4.2 Findings

Grouping of the observations into categories allows a more general observation of the relationships between variables. Table 17 shows the spread of observations among the categories related to the hypotheses. Out of 16 individuals who reported low perceived trustworthiness of another team member, 5 reported low perceived trustworthiness and a low follow-through, 5 reported low perceived trustworthiness and medium follow-through and 6 reported low perceived trustworthiness and high follow-through.

Table 17 Tabulation of Perceived trustworthiness by Follow-through (H4a)

<b>Perceived trustworthiness*</b>	<b>Follow-through*</b>			
	<b>Low</b>	<b>Medium</b>	<b>High</b>	<b>Total</b>
<b>Low</b>	5	5	6	16
<b>Medium</b>	1	16	20	37
<b>High</b>	0	1	10	11
<b>Total</b>	6	22	36	64

Source: PBL Online Dyad Survey, 4/14/00 N=64 \* See Appendix 3 for survey questions.

In Table 18, out of 36 individuals who reported low checking for another team member, 6 reported low checking and a low perceived trustworthiness, 19 reported low checking and medium low perceived trustworthiness and 11 reported low checking and high low perceived trustworthiness.

Table 18 Tabulation of Checking by Perceived Trustworthiness (H4b)

<b>Checking*</b>	<b>Perceived trustworthiness*</b>			
	<b>Low</b>	<b>Medium</b>	<b>High</b>	<b>Total</b>
<b>Low</b>	6	19	11	36
<b>Medium</b>	7	17	0	24
<b>High</b>	3	1	0	4

<b>Total</b>	16	37	11	64
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Source: PBL Online Dyad Survey, 4/14/00 N=64 \* See Appendix 3 for survey questions.

To test hypotheses 4a, an ordinal Logit analysis was performed using follow-through as the independent variable and perceived trustworthiness as the dependent variable (See Table 19). The results indicate that there is a positive relationship between the two variables that is significant at the 99% confidence interval ( $P > |z|$  is less than .01). As shown in Table 19, as follow-through decreases perceived trustworthiness also decreases. Thus we can describe the relationship with the following equation:

$$PTW = 1.41 Ft$$

(PTW = Perceived Trustworthiness, Ft = Follow-through)

Table 19 Unstandardized Coefficients From An Ordinal Logit Model Predicting The Probability Of Greater Perceived Trustworthiness Using Follow-Through (H4a)

Independent Variable	Coefficient	Std. Err.	P> z
Follow-through	1.41	.43	0.001
Cut-point 1	0.76	.62	
Cut-point 2	3.86	.81	
Model Chi-square	12.30		0.0005

Source: PBL Online Dyad Survey, 4/14/00 N=64 \* See Appendix 3 for survey questions.

To test hypotheses 4b, an ordinal Logit analysis was performed using perceived trustworthiness as the independent variable and checking as the dependent variable (See Table 20). The results indicate that there is a negative relationship between the two variables that is significant at the 99% confidence interval ( $P > |z|$  is less than .01). As shown in Table 20, as perceived trustworthiness decreases, checking also decreases. Thus we can describe the relationship with the following equation:

$$Ck = -1.5 PTW$$

(PTW = Perceived Trustworthiness, Ck = Checking)

Table 20 Unstandardized Coefficients From An Ordinal Logit Model Predicting The Probability Of Greater Checking Using Perceived Trustworthiness (H4b)

Independent Variable	Coefficient	Std. Err.	P> z
Perceived-trustworthiness	-1.51	.48	0.002
Cut-point 1	-1.11	.50	
Cut-point 2	1.64	.60	
Model Chi-square	12.02		0.0005

Source: *PBL Online Dyad Survey, 4/14/00*      *N=64*      \* See Appendix 3 for survey questions.

## Chapter 7 Testing the model in predictive case studies

From the preceding analysis there are two models to be tested: the Fast Start Model and the Mature Team Model.

### *7.1 Testing the Fast Start Model*

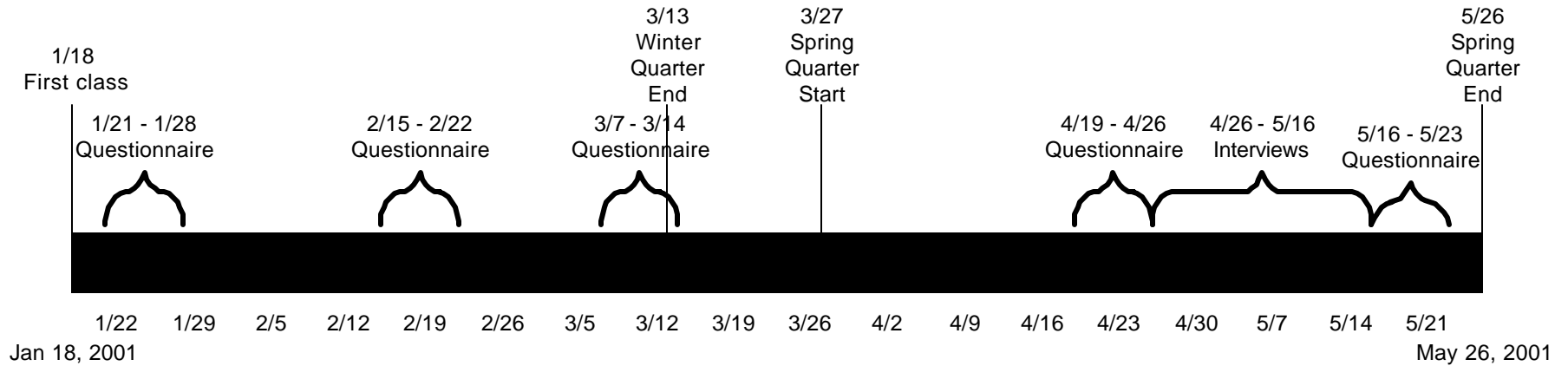
The Fast-Start Model of Swift Trust contains the prediction of trust, measured by checking, and based upon *Assurance* as predicted by the *Risk* and *Reward* scenarios.

During the first week of the project team members will be surveyed to determine their perceptions of *Risk* and *Reward* relating to the project. (See Figure 11) In Stage 1 *Risk* and *Reward* was measured by the interview in the middle of the Spring Quarter. It is necessary to change the timing of the measurement to use them for predictive purposes. This introduces a measurement risk because in the early stages of the project participants may perceive the questions as a screening device and exaggerate their reported level of reward. Every attempt will be made to avoid this effect with reassurances and by embedding the questions in other material in the survey. The values for *Risk* and *Reward* will be compared to those from Stage 1 using a statistical analysis such as ANOVA (Analysis Of Variance) to determine if the change in timing has significantly changed the quality of the answers. The measurement problem of inter-rater reliability will be removed by using the survey to measure *Risk* and *Reward* because respondents will be answering specific questions and no qualitative assessment will be necessary.

The *Risk* and *Reward* values for each team member will be used in the Assurance emulation.

Teams in which one or more team members have *Risk Reward* Scenarios suggesting negative trust decisions will be predicted to experience a trust failure.

Figure 11 Timeline and Gantt Chart



ID	Task Name	Start	End	Duration	Q4 00		Q1 01			Q2 01			Q3 01		
					Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1	Revise Intranet Interaction Pages	11/14/00	12/15/00	24d	█										
2	Update Dyad Questionnaire	12/15/00	12/29/00	11d		█									
3	Conduct Dyad Questionnaire 1	1/19/01	1/26/01	6d			█								
4	Use Questionnaire results in simulation	1/26/01	1/31/01	4d			█								
5	Conduct Dyad Questionnaire 2	2/15/01	2/22/01	6d				█							
6	Conduct Dyad Questionnaire 3	3/7/01	3/14/01	6d					█						
7	Conduct Dyad Questionnaire 4	4/19/01	4/26/01	6d						█					
8	Conduct Dyad Questionnaire 5	5/16/01	5/23/01	6d							█				
9	Conduct interviews	4/26/01	5/16/01	15d							█				
10	Interview faculty for observable failures	4/2/01	5/25/01	40d							█				
11	Compare predictions to results	1/30/01	6/29/01	109d								█			
12	Write Dissertation	1/1/01	11/29/01	239d									█		

These predictions will be checked against observations of trust failure made by researchers and faculty members to test the following hypothesis:

- **H2:** In a new team, the more *Risk* and *Reward* scenarios that predict negative trust decisions, the greater the likelihood of observable failure of trust.

The model is validated if it predicts trust failure in a team that later has a trust failure, or if the model predicts no failures and none occur.

### *7.3 Testing the Mature Team Model*

As discussed in Chapter 5, the Mature Team Model is based upon the relationship between *Care* and trust which is measured by checking.

*Car*, *Competence*, *Risk*, *Reward*, *Checking* and *Follow-through* will be surveyed in the Dyadic Questionnaire which will be administered a number of times during the life of the project. This measurement is being taken at the same time as it was during Stage 1. In addition, measurements will be taken at the very beginning of the project and at the end of the first quarter, when most observable trust failures occurred.

The measurements will be used in the model and to test the following hypotheses:

- **H1:** As perceived *Competence* increases, checking decreases (trust increases).
- **H2:** The more *Risk* and *Reward* scenarios that predict negative trust decisions, the greater the likelihood of observable failure of trust.
- **H3:** As *Care* increases, checking decreases (trust increases).
- **H4a:** As follow-through decreases, perceived trustworthiness decreases. **H4b:** As perceived trustworthiness decreases, checking increases (trust decreases).

The predicted level of trust will then be compared to the actual measured level of trust to test the model. ANOVA (Analysis of variance) tests will be conducted to determine if the measured values of *Care* and trust differ significantly from those found in Stage 1.



## Chapter 8 Contributions and Future Research

This research offers potential contributions in the areas of the theory of trust development, organization theory and computational organizational and social science.

### *8.1 Contributions To Theory of Trust Development*

Trust is a difficult subject to research and research findings about trust have been difficult to apply because there has been no generally accepted definition of trust. The definition of trust proposed by this research unites the many diverse aspects of trust into a conceptually valid whole.

Many of the proposed definitions of trust can also be criticized for excluding important elements of trust or for being just as difficult to operationalize as trust. This work aims to provide measurable variables for the operationalization of trust and the associated concept of perceived trustworthiness.

The trust decision-making process is articulated, described modeled and tested. Many theoretical papers describing models of the factors influencing trust do not test or validate their models empirically (Jones and George, 1998), (Whitener et al, 1998), (Das and Teng, 1998), McKnight et al, 1998), (Bhattacharya, Devinney and Pillutla, 1998).

This research project aims to test the proposed model.

Finally, the articulation of the pre-conditions for trust and the development of the model make application of the concepts easily applicable to future research, extension of the model and application in practical situations.

### *8.2 Contributions to Organization Theory*

The development of a language of trust provides more accurate means of communication about this highly subjective subject. These new concepts and terms can provide conceptual building blocks for future development of organization theory.

The model of trust development can be shared within an organization to provide a common framework for discussions about the impact of trust in organizations and the effect on organizations of different levels of trust.

The trust measurement methodology can be used in other organizational settings to unobtrusively gather information relevant to trust.

### *8.3 Contributions to Computational Social and Organizational Science*

The modeling methodology developed for the research of trust could be applied to the study of other social phenomena. This research brings together the use of certain sociological tools that may prove to be extremely powerful.

The steps in the methodology are articulated and demonstrated. For example, this research demonstrates the progression from a graphical model to a computational model.

The model thus developed can then become the basis for future research in associated areas, for example the impact of organizational boundary spanning on trust development. By applying the model to new situations the impact of those situational variables can be measured and the model expended.

### *8.4 Development of language*

One of the current difficulties in researching and applying the findings of research is that we lack an accurate language to describe the trust process. This research identifies the need for language and proposes terms to suit those needs.

## 8.2 Future Research

When validated, the trust development model could be useful for practical application, intellectual experiments and further research.

### 8.2.1 Model Expansion

From this kernel, which describes trust in an interpersonal relationship, the model can be expanded in three directions: greater range of inputs greater range of outputs and more internal relationships between variables.

Expanding the range of inputs allows the use of “what if?” analysis for more variables and the testing of interactions between different combinations of variables. For example, the model of inputs could be expanded to predict such things as how cultural differences will effect the trust decision. Using the same methodology of modeling and validation it might be possible to expand the simulation that predict the impact of mergers between two companies with different cultures.

Expanding the range of outputs means predicting other dependent variables than the trust decision. For example hypotheses can be added to the model predicting the effect on work performance or quality.

Expanding the range of internal relationships can make the model more complex and thus demonstrate more interesting and accurate emergent behavior. For example, to represent the reciprocal nature of trust the giving and receiving of obligations can be added to the model with the appropriate feedback loops. This would make the model’s predictions richer and more representative of complex human interactions.

### 8.2.2 Model Adaptation

The methodology developed could be used to adapt the model to different situations. For example, first the model can be applied to predict trust in an industry work environment. As would be expected the model would fit, to some extent, but also would not fit in some areas. Those areas where the model does not fit provide us with interesting information about how the new situation differs from the one already studied. The model building methodology can be applied and a new model of trust development created to fit the new situation.

In this way the model of trust development can be expanded to explain more complicated situations such as the development of trust in e-commerce exchanges.

### **8.2.2 Model Incorporation**

The kernel of the trust development model can be incorporated into existing simulations of organizational behavior, such as the VDT (Virtual Design Team) simulation of project performance (Levitt et al, 1994). This would provide an additional dimension of trust to an already rich and well-tested predictor of workgroup performance that contains relevant features such as goal incongruency (Thompson, Levitt and Nass, 1998).

## Glossary of Defined Terms

The following definitions are used in this paper. Some terms are italicized when used in the text to highlight that these specific definitions apply.

**Trust** is the deciding factor in a social process that leads to a decision to accept a risk that another party will meet certain behavioral expectations.

**Virtual Teams** are teams with virtual context, virtual composition and virtual structure (Wong and Burton, 1999).

**Type 1 Error**, unwarranted trust, is deciding to trust an untrustworthy person.

**Type 2 Error**, unwarranted distrust, is deciding not to trust a trustworthy person.

**Perceived trustworthiness** is the individual's assessment of how much and for what type of performance another person can be trusted (Hardin, 2000).

*Care* means that your goals include positive outcomes for the other party.

*Competence* means that you have the skills, and resources that you need to perform the task.

*Understanding* means that you know what my priorities and requirements are.

*Self-control* means that you are disciplined enough to control your behavior.

*Own-control* means, "I can trust you because you are free to make your own decisions and take action".

*Confidence* means that we believe that the person has the resources and ability to do the job.

*Assurance* is the expectation that the trustee will perform based upon other factors than the individual's own motivation.

*Commitment* is the assessment that the trustee has a personal stake in achieving the performance requirements.

**Value at Risk** is what the trustor or trustee could lose if a positive decision to trust is made.

**Value of Reward** is what the trustor or trustee could gain if a positive decision to trust is made.

## Appendix 1 –Research Comparison

Authors	Independent variables	Dependent variables	Operationalization of dependent variable	Results
Rotter (1970)	Interpersonal Trust, Gullibility, dependability and trustworthiness	Interpersonal Trust scale	College students were asked to rate group members for interpersonal trust, gullibility, dependability and trustworthiness. Results were compared with scale of interpersonal trust.	The interpersonal trust scale significantly predicted sociometric ratings of trust. Gullibility and dependency were negatively related to the sociometric trust and the interpersonal trust scale. There was a high correlation between trustworthiness, sociometric trust and the trust scale.
Rempel, Holmes and Zanna (1985)	Love, perceptions of partner's motives (intrinsic vs. extrinsic) and personal motives.	Trust measured by faith, dependability and predictability.	Questionnaire questions combined into scales for trust (faith, dependability and predictability), love and motivation.	Strong correlation between love and faith, weaker correlation with dependability and no correlation with predictability. Strong positive correlation between intrinsic motivation and faith, weaker correlation with dependability and no correlation with predictability. Non-statistical negative correlations between perception of extrinsic motivation and the trust measures.
Peter Kollock (1994)	Uncertainty level caused by the level of information available about the quality of goods for sale.	Commitment as the primary dependent variable, trust as a secondary variable.	Commitment was measured at the behavioral level by recording that traded with whom. A variation of the Cook Emerson network-based measure was used. At the end of the trading exercise each of the participants was asked to rate how untrustworthy/trustworthy each of their partners were.	Significant differences in the level of commitment, concern for one's own and others' reputation, and the level of trust that emerge when uncertainty (in the form of asymmetries) is varied.
Yamagishi and Yamagishi (1994)	National cultures USA and Japan	General Trust, Caution, Knowledge-based trust and Utility of Relations	Survey questions correlated into scales	Americans scored higher on General Trust scale, inconclusive results on Caution scale, US scored higher in Knowledge-based Trust Scale. Japan scored higher on Utility of Relations Scale.
Yamagishi, Toshio (1995)	General trust defined as a belief in human benevolence. Caution or Prudence in dealing with others.		Survey questions: "Generally speaking would you say that most people can be trusted or that you can't be too careful in dealing with people?" (Prudence) "Would you say that most of the time people try to be helpful, or that they are mostly just looking out for themselves?" (General trust)	The proportion of trustful and prudent respondents increased over time. The proportion of distrustful and prudent respondents did not change.
Iacono and Weisband (1997)	Trust measured by categories of interaction initiations	Team performance	Project Grade	Initiations and responses were positively related to team performance. High performing teams formed more quickly,

	and responses, GPA, computer access, computer experience, electronic communication experience, team performance and team diversity			did not respond to every initiation and handled several activities at once. Computer access and age, contributed to team performance. Team diversity, GPA, computer experience and electronic communications experience were not related to team performance.
Yamagishi, Cook and Watabe (1998)	Country – USA or Japan Individual propensity to trust – High or low Social uncertainty	The degree of commitment formed in a trading relationship.	The probability that an existing pair of traders on one trial is maintained on the next trial.	The main effect of nationality X uncertainty X trust was highly significant. Correlations between high uncertainty and concern for being duped and low trust and concern.
Zaheer, McEvily and Perrone (1998)	Cost of negotiation, level of conflict and supplier performance	Interorganizational trust and interpersonal trust	Interorganizational trust was measured in the survey by general questions about the business relationship with the supplier. Interpersonal trust was measured by questions about the respondent's relationship with and attitudes toward the contact person.	Interpersonal and inter-organizational trust was highly correlated. A negative relationship was found between inter-organizational trust and costs of negotiation. A positive relationship was found between interpersonal trust and cost of negotiation. A negative relationship was found between inter-organizational trust and conflict. No clear relationship between inter-personal trust and conflict, or supplier performance and conflict or supplier performance and cost of negotiation.
Michael W. Macy and John Skvoretz (1998)	The relative cost of exit, the neighborhood size and the embeddedness of the interaction.	Trust	The behavioral indicator to trust is the decision to exchange.	Simulation showed how trust and cooperation can evolve with formal or informal controls but depends upon the payoff for refusing to pay and embeddedness of the interaction. Norms emerge and diffuse.
Jarvenpaa, Sirkkka L. and Dorothy E. Leidner (1999)	Culture of country of birth, and International experience,	Team trust (adapted from Mayer et. Al. 1995) Group trust (adapted from Pierce et al. 1992)	Mayer: "If I had my way, I wouldn't let the other team members have any influence over issues that are important in the project." Pierce: "Members of my work group show a great deal of integrity." Measured using a 5-point Likert scale at time 1 and time 2.	There was no difference for individualistic cultures vs collectivist cultures or for international experience. Their qualitative results suggest that global virtual teams may experience a form of "swift" trust, but such trust appears to be fragile and temporal.
Molm, Takahashi and Peterson (2000)	Power imbalance, negotiated vs. reciprocal exchange relations	Behavioral and affective Commitment, Trust	Trust measured by asking "How much did you trust person X during the experiment?" Behavioral commitment measured by percentage of A's exchanges with B rather than others Affective commitment measured by asking how	Significant main effects on commitment of both power and actor. Behavioral commitment more frequent in low rather than high power network. Commitment of the less powerful actor is higher. Form of

			committed subjects felt and their affective evaluation of the partner.	exchange had not effect on behavioral commitment. Power and form of exchange influence inequality of exchange. Inequality is greater when power is higher and exchange is negotiated rather than reciprocal.
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## Appendix 2 Preliminary and Stage 1 Data Gathering Instruments

### *Preliminary Stage: Group Discussion Questions*

#### *Introduction:*

How much work experience did you have before joining the group?

What were your personal goals for the project?

To what extent do you feel your personal goals were achieved?

Why?

Do you think yours was a successful project?

Thinking of your team, what do you think had most important influence on the success of the project?

#### *Definition of trust*

We're going to be talking about trust so let's start by defining what we mean by trust/

How would you define trust?

For the purpose of this talk can we agree that trust is:

*Trust is the commitment of resources (including time, effort, attention or reputation) based on the expected action of another person.*

What is a trustworthy (Architect/Structural Engineer/Construction Manager)?

What does a trustworthy (Architect/Structural Engineer/Construction Manager) do?

Who would you trust more – an Architect, Structural Engineer or Construction Manager?

Has this project changed your view of the other disciplines?

Do you think that will change the way you work with them in the future?

What is a trustworthy team member?

What does a trustworthy team member do?

How important was having trust in your team members?

How important was it for them to trust you?

What builds trust?

How important are timeliness, reliability, commitment, expertise, and initiative to building trust

What erodes trust?

Did you consciously do anything to build your team mate's trust in you? What?

What other things may have been more important for team performance than trust?

#### *Structural*

Did you find any differences in trust due to different national cultures?

Did you find any differences in trust due to different university cultures?

Did you find any differences in trust due to different discipline cultures?

Did you find any differences in trust due to different genders?

Did you feel that the organization provided protection for you as a member?

Did you feel that if something went wrong the organization would enforce a fair settlement?

*Your project was part of a Stanford subject offered by the PBL. Being part of an organization provides some protection against unfair practices.*

Did you feel that the level of organizational support for this project was sufficient? Or too much?

Who were your mentors in (Architecture/Structural Engineering/Construction)?

How many times did you consult your mentor(s)?

Were they helpful? Why / Why not?

Did you trust them, like trust their expertise?

#### *Situational*

What differences do you think being a distributed workgroup might have made to the levels of trust in the team? Did that increase trust or decrease it?

When did you have to exercise trust?

Did you have any challenges to trust that were caused by not knowing each other?

Did you have any challenges to trust that were caused by geographic distance?

Did you have any challenges to trust that were caused by time zone differences?

Did you have any challenges to trust that were caused by the communications technology?

## Stage 1: Interview Questions

How are things going? ... in your group? ... with your project?  
 What was your reason for taking on the project?  
 Was that an important reason? How important?  
 Do you feel like you are achieving your goal in the project? Why or why not?  
 How much experience did you have working in your profession before this project?  
 Now that you have worked as a \_\_\_\_, how specialized do you think your discipline is compared to the other two disciplines?  
 More/Same/Less Why?  
 How closely do you think you need to work with the other disciplines? For example, can you do your job and then pass it over to the others or do you need to work together?  
 How did being distributed affect your team or project? Any disadvantages? Any advantages?  
 Did your team mates perform as you expected them to on project work? Better/Same/Worse?  
 As you know we are interested in how trust develops in teams like yours.  
 Do you think trust is important? Why?  
 Do you recall actually having to think about whether you trusted your team mates? Who? What? Where? How? When? Why?  
 Did you feel that you were at risk if your team mates did not perform? In what way?  
 What was at stake for you if the other person did not do their job?  
 What do you think would happen if a team mate just refused to perform? For example, didn't show up for meetings but always had an excuse and promised better next time?  
 Did you do anything to protect yourself in case the other person failed? What? When?  
 What might have been different in your team if there was more trust? ... less trust?  
 Could you show me on this timeline how trust for year team members or team changed over the project?  
 Did you know your team members at the beginning?  
 How quickly did your team start to interact? Fast or slow start?  
 Do you think things might have been different if you were working in a real live project? How?  
 Plus Delta on the Program  
 Advice for future students?

\*\*\*\*\*

The following questions were used from the interviews to assess the value at *Risk* and value of *Reward*:

### *Perceived Risk*

Did you feel that you were at risk if your team mates did not perform? In what way?  
 What was at stake for you if the other person did not do their job?  
 What do you think would happen if a team mate just refused to perform? For example, didn't show up for meetings but always had an excuse and promised better next time?

### *Perceived Reward*

What was your reason for taking on the project?  
 Was that an important reason? How important?

## Stage 1: General Trust Questionnaire

Most people are basically good and kind  
 Most people are trustworthy  
 Most people are basically honest.  
 I am trustful.  
 Most people are trustful of others.  
 Most people will respond in kind when they are trusted by others.  
 People are always interested only in their own welfare.  
 No matter what they say, most people inwardly dislike putting themselves out to help others.  
 One can avoid falling into trouble by assuming that all people have a vicious streak.  
 In this society, one does not need to be constantly afraid of being cheated.  
 People usually do not trust others as much as they say they do.  
 In this society, one has to be alert or someone is likely to take advantage of you.

## Stage 1: Team Trust Questionnaire

1. To what extent does your team understand why you need to achieve certain goals required by your discipline?
2. To what extent does your team understand what you mean when you talk about the requirements of your discipline?

3. 3. To what extent does your team care about your ability to achieve your personal and professional goals in the project?
4. To what extent is your team indifferent to your success in the project?
5. To what extent is your team controlled by outside people or influences?
6. To what extent could your team be interfered with by events in the environment?
7. To what extent has your team developed control over their behavior and impulses?
8. To what extent has your team exhibited competence?
9. To what extent is your team skilled in their disciplines?
10. To what extent is your team experienced in their discipline?
11. To what extent is your team professional in its behavior?
12. Please use this space if you would like to make any additional comments or explain your answers.

## Stage 1: Dyad Questionnaire Questions

### Checking

1. How often have you needed to check/ask to see if this team member had completed her/his commitments?
2. How often have you counted or compared to see if this team member was contributing to the group?
3. How often have you worried about this team member's performance?
4. How often did you wish the team were co-located so you could check up on what this team member is doing?

### Follow-through

1. How often did this team member follow-through on work commitments?
2. How often did this team member fail to follow-through on work commitments?
3. How often did this team member complete work commitments on time?
4. How often did this team member fail to complete work commitments on time without good reason?

### Perceived Trustworthiness

#### Care:

1. How often has this team member made an extra effort to make your job easier?
2. How often has this team member caused extra work or stress through carelessness?
3. How often has this team member listened carefully to hear your problems or concerns?
4. How often has this team member failed to listen to your problems or concerns?
5. How often has this team member notified you when she could not meet a commitment?
6. How often has this team member failed to notify you when s/he could not meet one of her commitments?
8. How often has this team member passed on new information that may be helpful to you or the group?
9. How often does this team member check to make sure that communication was received or understood?
10. How often has this team member failed to notify you about a relevant change in her communication circumstances? For example, a change in e-mail address.

#### Understanding:

1. How often have you thought or speculated that this team member understood what you are trying to achieve?
2. How often have you thought or speculated that this team member failed to understand what you are trying to achieve?
3. How often has this team member understood your time zone requirements for convenient meeting times?
4. How often has this team member failed to understand your time zone requirements for convenient meeting times?
5. How often has this team member understood your communications preferences or limitations?
6. How often has this team member failed to understand your communications preferences or limitations?

#### Competence:

1. How often has this team member exhibited technical or project competence?
2. How often has this team member failed to exhibit technical or project competence?
3. How often have you noticed that team member exhibit professional behavior?
4. How often have you noticed that team member exhibit unprofessional behavior?

#### Self-Control:

1. How often has this team member lost self-control?
2. How often has this team member maintained self control?

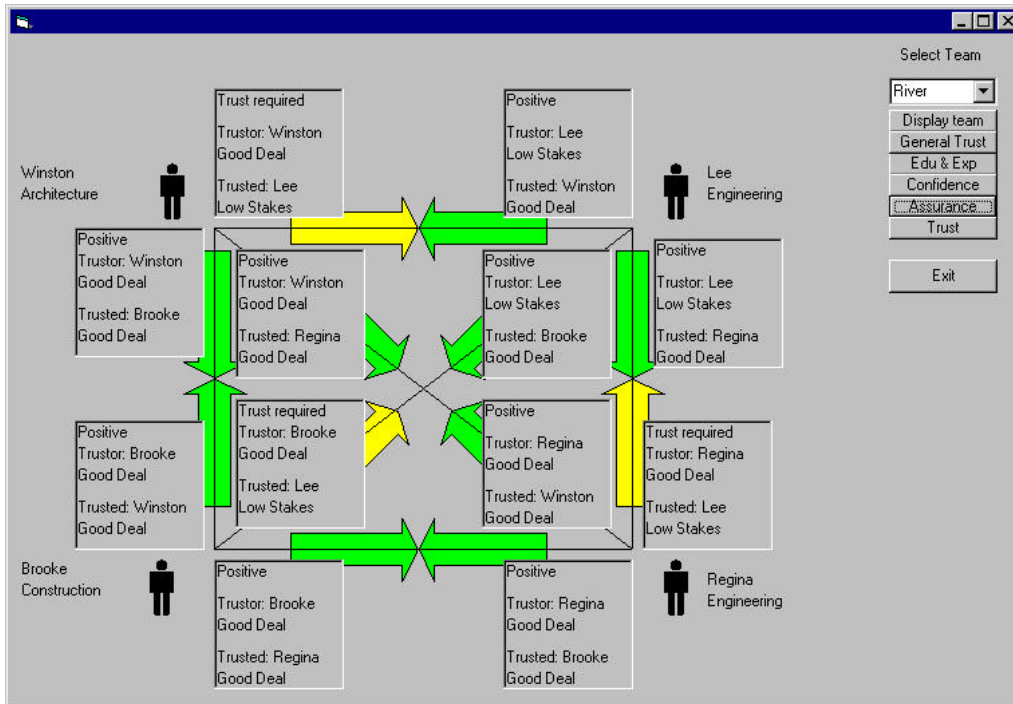
#### Own-Control:




1. How often have you noticed that this team member is under the control of another person or situation?
2. How often have you noticed that this team member is in control of his/her own behavior?

3. How many times has this team member's performance been interfered with by a failure in her computer hardware, software or network?

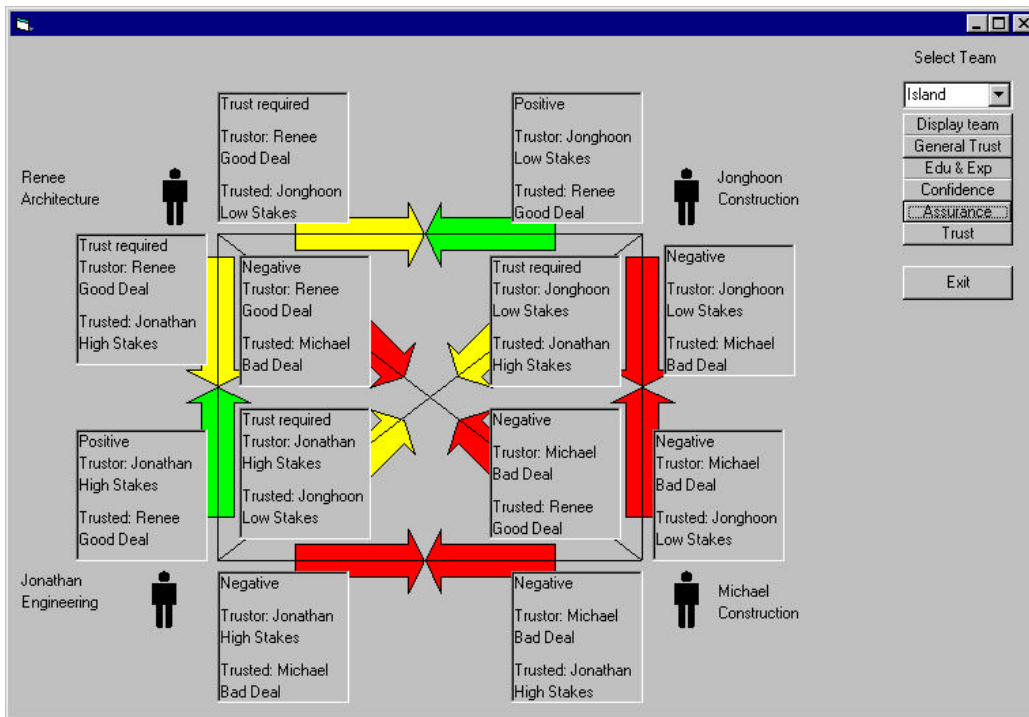
# Appendix 3 – Risk and Reward Scenario Emulation Results

A Typical Team:



-  Positive
-  Trust required
-  Negative

A Trust Challenged Team:



## Appendix 4 Stage 2 Data Gathering Instruments

### *Stage 2: Dyad Questionnaire Questions*

#### *Checking*

1. How often have you needed to check/ask to see if this team member had completed her/his commitments?
2. How often have you counted or compared to see if this team member was contributing to the group?
3. How often have you worried about this team member's performance?

#### *Follow-through*

1. How often did this team member follow-through on work commitments?
2. How often did this team member fail to follow-through on work commitments?
3. How often did this team member complete work commitments on time?
4. How often did this team member fail to complete work commitments on time without good reason?

#### *Perceived Trustworthiness*

##### *Care:*

1. How often has this team member made an extra effort to make your job easier?
2. How often has this team member listened carefully to hear your problems or concerns?
3. How often has this team member notified you when s/he could not meet a commitment?
4. How often has this team member passed on new information that may be helpful to you or the group?
5. How often does this team member check to make sure that communication was received or understood?

##### *Competence:*

1. How often has this team member exhibited technical or project competence?
2. How often have you noticed that team member exhibit professional behavior?

##### *Value at Risk*

1. To what extent did you feel that you were at risk if your team member did not perform? For example, didn't show up for meetings but always had an excuse and promised better next time?
2. How much was at stake for you if the other person did not do their job?
3. How serious would it be if a team member refused to perform through most of the project?

##### *Value of Reward*

1. How many reasons did you have for taking on the project?
2. How important were those reasons?

## Stage 2: Interview Questions

How are things going? ... in your group? ... with your project?  
What was your reason for taking on the project?  
Was that an important reason? How important?  
Do you feel like you are achieving your goal in the project? Why or why not?  
How much experience did you have working in your profession before this project?  
Now that you have worked as a \_\_\_\_, how specialized do you think your discipline is compared to the other two disciplines?  
More/Same/Less Why?  
How closely do you think you need to work with the other disciplines? For example, can you do your job and then pass it over to the others or do you need to work together?  
How did being distributed affect your team or project? Any disadvantages? Any advantages?  
Did your team mates perform as you expected them to on project work? Better/Same/Worse?  
As you know we are interested in how trust develops in teams like yours.  
Do you think trust is important? Why?  
Do you recall actually having to think about whether you trusted your team mates? Who? What? Where? How? When? Why?  
Did you feel that you were at risk if your team mates did not perform? In what way?  
What was at stake for you if the other person did not do their job?  
What do you think would happen if a team mate just refused to perform? For example, didn't show up for meetings but always had an excuse and promised better next time?  
Did you do anything to protect yourself in case the other person failed? What? When?  
What might have been different in your team if there was more trust? ... less trust?  
Could you show me on this timeline how trust for year team members or team changed over the project?  
Did you know your team members at the beginning?  
How quickly did your team start to interact? Fast or slow start?  
Do you think things might have been different if you were working in a real live project? How?  
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## Appendix 5 Scale Analysis

Reliability Analysis and Factor Analysis were conducted on the scales used in Stage 1.

The scales were adjusted resulting in the following scales for Stage 2.

<b>Scale</b>	<b>Alpha</b>	<b>Factors</b>	<b>Number of Questions</b>
Care	.86	1	5
Follow-through	.8647	1	4
Check, Count & Worry	.8215	1	3
Competence	.7706	1	2



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