

# A KNOWLEDGE MANAGEMENT FRAMEWORK FOR PROJECT DEFINITION

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**SUMMARY:** *This paper proposes a knowledge management framework for project definition of capital facility projects. The conceptual framework emphasizes project-based learning and the creation of group knowledge in early phase project planning and design activity. The use of multi-disciplinary expertise in this phase of project development acknowledges the use of multiple decision frames by which stakeholders approach project solutions. This research views project definition as a collaborative decision-making process, and highlights the need for supporting group management techniques and technologies.*

*Project definition is regarded as the phase of project development where exploration of alternatives creates innovative problem and solution definitions that allows maximum customer value generation to be developed. This paper proposes a management framework to support organizational and process interfaces within project definition. The model is based primarily on findings from recent research literature and on exploratory descriptive research. The model presents a process for project definition and supports group knowledge creation and management. The model bases its development on soft systems methodology to support group cognition, learning and creative solution generation. Collaborative group theory is incorporated into the model to support project definition. The framework builds on theoretical principles of lean design and construction.*

**KEYWORDS:** *client purpose, group knowledge creation, decision-making, learning, organizational cognition, project definition.*

## 1. INTRODUCTION

The recent interest in knowledge management by business communities: researchers and industry practitioners have identified organizational knowledge as a competitive asset. Processes and knowledge-based environments are being developed to support the knowledge worker. Company knowledge is known to exist primarily in the minds of people, business processes, policies and strategies of the organization with supporting document management systems and information technology systems. Architecture/Engineering/Construction (AEC) industry organizations need to adopt a similar knowledge-based view of the firm in order to better manage their associated knowledge assets and remain competitive.

Knowledge management systems and strategies are more recently being researched and developed by AEC organizations (Kamara et al, 2002). These knowledge systems are based on the core competencies of the organization and rarely hold the entire knowledge base required to deliver full project solutions. The onus on fragmented organizations to share knowledge to deliver client solutions is necessary. Cross-boundary knowledge transactions are of growing importance given the complexity of construction-related projects and client organizations. The reliance on project participants to share knowledge in order to succeed in project delivery has never been greater.

A central focal point for AEC knowledge creation is the project based environment. Project stakeholders practice their individual knowledge-based skills and learn to apply their knowledge in project delivery systems. The project is of great importance as it forms the collective knowledge work space for the project participants. Within the knowledge management spectrum of research<sup>1</sup>, this work is concerned with the collective group process within the project setting. In particular, this research is concerned with group knowledge; its creation, sharing and management within project definition activity.

Project definition refers to front end planning and conceptual design. Ballard and Zabelle (2000) define project definition as “the first phase in project delivery consisting of three modules: determining purposes (stakeholder needs and values), translating those purposes into criteria for both product and process design, and generating design concepts against which requirements and criteria can be tested and developed”. Ballard et al. support collaborative design processes through the specification of data collection methods and a project definition conference(s). These processes support group decision-making, and product development leading to the production and alignment of purposes, criteria and concepts.

Highlighting the importance of early phase project planning and design is critical because as much as 80% of a product can be specified in this early phase. Strategic decision making at this phase requires the necessary expertise to inform the process. While the activities in project definition arise from multiple paradigms of professional design and management disciplines, for the purposes of this research the term “project definition” will be used to encompass all project activity prior to lean design development.

Developing project purpose is a particular focus of the research. In order to understand project purpose, group action is required to actively create and develop the project requirements. Explication of the belief and value systems embedded within client organizations and stakeholder representatives is a knowledge intensive process. The essential goals of purpose development are to: elicit needs and wants, uncover latent needs, validate whether the need is necessary, and verify that the need can be fulfilled in a design solution. A process of group learning and change is perceived to occur throughout the project definition activity.

The paper identifies current barriers to effective knowledge management within the process. Current project definition practice reveals a range of boundary objects that inhibit effective knowledge creation. Based on the understanding of these barriers a set of propositions are set out in order to develop an effective environment within which, project definition can succeed. This paper proposes that project definition provides an opportunity to deliver value to the customer through the creation of accurate problem definitions and innovative project solutions. In order to achieve this goal, project definition groups need to adopt a knowledge-based view of how work is developed.

Greater understanding of the complex system that comprises diverse stakeholders, complex work processes and the environment or context that the project is situated is necessary. This paper argues that project definition is a knowledge intensive process requiring the services of many project stakeholders. Project stakeholders perceive the problem at hand based on their individual backgrounds, knowledge and experience. Forming a necessary and diverse group of specialists creates a complex system to operate within. A process to improve transparency of problem framing is required. Organizing in cross functional teams is advocated as the satisfactory organizational knowledge creation unit.

This paper proposes a conceptual framework within which the collective group process can be managed effectively. First an activity model is proposed in order to manage group action. This model considers the project definition group as a learning organization and the process characteristics are identified. A spiral development model illustrates the iterative nature of project definition. In order to model purpose-related group dialogue, a moderator role is proposed to manage developing project definition conversations. The framework proposes that productive inquiry is necessary to explicate tacit assumptions embedded within the belief and value systems of the client and stakeholder organizations. Collective knowledge is said to exist in the minds of the group. In order to understand the collective mind of the group, a cognitive mapping approach is proposed to model the group dialogue ongoing within the conversation network. Finally, a set of experimental objectives are outlined to test the performance of cognitive mapping tools in the group support of project purpose development.

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<sup>1</sup> Knowledge management frameworks are being researched and developed for construction related fields. The broad knowledge management discipline covers strategic issues, information technology supported knowledge systems, among others. This work acknowledges other research initiatives based at the individual organizational levels, but are not within the scope of this research.

## **2. REVIEW OF CURRENT MANAGEMENT PRACTICE**

### **2.1 Project Definition Process Goals**

Once a client identifies a perceived need for a construction facility project, a project definition process is implemented to develop the project need into tangible product-process requirement specifications and concepts, or alternative client solutions. Project definition is the process prior to final investment decision making. The process usually covers the preparation of project proposal, project initiation, design and appraisal. The Construction Industry Institute (CII) (1995) define pre-project planning as the process of developing sufficient strategic information for owners to address risk, and decide to commit resources to maximize the chances of a successful project. The objective of project definition is to maximize successful project realization through the production of strategic information for the owner and the development of project implementation solutions.

### **2.2 Research Initiatives**

The management of project definition has received attention from various industry and research initiatives over the past decades. Barrett et al. (1998) recites calls for improvement in the client briefing process. Such calls for improvement include Sir Michael Latham's report, and the construction industry survey of briefing practice in the UK by Kamara and Anumba (2001). Initiatives for improvement occur across various bodies of knowledge, but primarily include the areas of process re-engineering and modelling, client requirements processing, design methodology, architectural theory and programming, information technology support, decision paradigms, and finally, human and organizational dynamics.

Traditionally in building facilities design, architecture assumes the role of developing client requirements through the practice of architectural programming. Pena and Parshall (2001) describe programming as the pre-design activity that develops the considerations or design determinants that define a comprehensive architectural problem. The information gathered and processed from the five step iterative phase culminates in an information index that adequately defines the problem and solution for design and construction development. These considerations are: function, form, economy and time.

Methods of architectural programming approach pre-design activity as a collaborative process. The work of Pena and Parshall develop various programming methods to establish client and project values to allow designers to respond with alternative solutions to defined problems. Programming is defined as a process of five steps: 1) Establish goals; 2) Collect and analyze facts; 3) Uncover and test concepts; 4) Determine needs; and 5) State the problem.

Macmillan et al. (2001) approach the process of project definition through understanding design methodology. Recognizing the "rapid and dynamic information and knowledge transfer between designers during the conceptual phase of building projects", this research develops and verifies a structured framework to support interdisciplinary design. A generic model with framework terminology was proposed based on processes, tasks, and activities leading to improved integration of interdisciplinary design, improved collaboration and improved process understanding.

From a process re-engineering approach, investigations are being undertaken in the form of process improvement initiatives such as the UK Process Protocol (Kaglioglou et al, 1999). Based on governmental and institutional reports regarding industry improvements a generic process protocol for design and construction has been developed by the University of Salford, UK and industry partners (Univ. of Salford, 1995). CII (1999) developed a project management tool to support project management activity in the project definition phase. The Project Definition Rating Index (PDRI) has been developed through industry modeling of the construction delivery process. CII research has shown that the PDRI can be effectively used to improve the predictability of project performance. The PDRI tool allows the project team to quantify, rate, and assess the level of scope development on projects prior to beginning development of construction documents.

Other notable research work is in the field of requirements engineering by Kamara et al. (2000). This research approaches construction briefing as "client requirements processing" within the discipline of concurrent engineering for life cycle design and construction. As the primary source of information for construction projects, client requirements provide the link between clients and the industry and their effective processing is very important for project success and client satisfaction. Client briefing is "the process running throughout the construction project by which means the client's requirements are progressively captured" (Barrett and Stanley,

1999). Bruce and Cooper (2000) highlight the importance of understanding both hard and soft processes when developing requirements for clients. The document that contains the written instructions/requirements of the client is referred to as the “brief” which should include information on (Kamara and Anumba, 2001):

- The background, purpose, scope, content and desired outcomes of the project;
- The functions of the intended facility and the relationships between them;
- Cost and time targets, instructions on the procurement and organization of the project;
- Site and environmental conditions, safety, interested third parties, and other factors that are likely to influence the design and construction of a facility.

A Client Requirements Processing Model (CRPM) adopts structured methods to facilitate precise definition of the “voice of the customer” that then translates into the “voice of the designer”. The model sub-divides into three main stages: define client requirements, analyze client requirements, and translate client requirements. These stages sub-divide further into activities and utilize appropriate information gathering tools, decision support tools and quality assessment tools (e.g. Quality Function Deployment) to develop solution neutral specifications. CRPM is computerized within a software system called ClientPro and has been received as generally satisfactory in effectiveness. Test feedback reports that requirements generation, prioritization, clarity and visibility were adequately supported within the formal process. Kamara and Anumba maintain that client requirements be:

- Precisely defined, with as little ambiguity as possible, and reflective of all the perspectives and priorities represented by the client body;
- Stated in a format that is solution-neutral (i.e. not based on any design concept that could serve as a solution to the client’s problem) and which makes it easy to trace and correlate design decisions to the original intentions of the client.

## 2.3 Barriers to Effective Collective Knowledge Management

Despite improvement initiatives in project definition and briefing practices, Barrett et al. (1998) argue that rational systematic processes are limited in establishing best practice. Barrett’s investigation into the process of briefing reveals process inefficiencies, much of which are attributed to organizational and human factors. Barrett and Stanley (1999) proposes key solution areas that include: client empowerment to inform, educate and make decisions, management of project dynamics, appropriate user involvement, appropriate information and visualization techniques and appropriate team building.

Hudson (1999) equally argues that further approaches to compliment the rational process are needed to allow for creative client solutions. Project definition requires support for dynamic project goals and organizational change and realizing the importance for developing flexible project definition solutions that support customer value generation is necessary.

The authors have advanced situational studies (Whelton and Ballard, 2002a and 2002b) to argue that project definition performance is impacted by a complex network of decision action by stakeholders over the course of a project definition process. Exploratory case studies illuminate the complexity of formulating project definition problems and generating solutions. The empirical studies support the idea of limited or bounded rationality (Simon 1969) in organizational decision practice. Illustration of complex decision ecologies<sup>2</sup> suggests that greater transparency of decision networks is required in order for cross-functional project definition teams to generate maximum client value at the project definition phase.

Table 1 summarizes the primary organizational factors that impact the successful creation and transfer of knowledge in project definition activity. These quality issues are consistent with those reported in project definition related research literature (Kamara and Anumba, 2001, Barrett and Stanley, 1999, and Koskela et al, 2002).

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<sup>2</sup> March (1999) describes an “ecological” view of decision making which “*considers how the structure of relationships among individual units interact with the behavior of these units to produce systematic properties not easily attributable to individual behavior alone*”.

Table 1: Boundary Objects Inhibiting Effective Knowledge Creation (Whelton and Ballard, 2002b)

<b>Management - Quality Category</b>	<b>Process Inefficiency Instance</b>
<b>Management of the definition process</b>	Lack of shared process model
	Undefined roles and responsibilities
	Poor constraints analysis
	Unrealistic budget and schedules
	Poor use of phases and gates
	Insufficient time for project definition
	Poor change management
	Limited resource allocation to project definition processes
	Lack of formal review and learning processes
<b>Stakeholder involvement &amp; communications</b>	Lack of 'voice' of the user group(s)
	Inadequate stakeholder involvement and participation
	Poor group dynamics
	Misunderstanding of client organization and culture
	Lack of client education of process
<b>Collection and documentation of information</b>	Poor traceability of requirements
	Lack of/poor visualization of needs, criteria and concepts
	Ill structured project memory & Poor transfer of information
<b>Processing of information</b>	Poor programming of needs
	Lack of /poor assessment of clients needs and project life cycle needs - (Trial and error processing methods)
<b>Decision-making</b>	Subjective negotiations in conflict resolution
	Lack of solution expansion and exploration
	Lack of group decision support tools

## 2.4 Understanding Project Definition as a Complex System

Organizational systems have high levels of dynamic complexity (Sterman 2000). Dynamic complexity arises from the interactions among the agents associated with the system over time. These dynamic influences can impede organizational learning and system performance. Client organizations can be composed of complex structures designed to execute labor or knowledge intensive activities based on the client's established business model. These structures facilitate decision making at various levels of the organization, and are instrumental towards informing the project definition process.

Green's (1996) analysis of metaphors by which client organizations operate, offers direction in understanding the socio-technical complexity. Within the context of project definition activity, knowledge is located within: 1) the client's strategic business case; 2) the client organization values and belief systems; and 3) the facility technical systems (Atkin and Flanagan, 1995, cited in Green and Simister, 1999). Green (1999), and Green and Simister (1999) examine the role of soft systems methodologies in the explication of project definition knowledge. Such methodologies can support systematic models of project definition in complex and dynamic environments.

Planning, design and construction organizations need a better understanding of these dynamic and changing influences. These influences set up or determine the main design constraints used in the preliminary stages of project definition. Professional members of project teams have reason to gain greater understanding of these decision-making paradigms by which clients establish project needs and values. Woodhead and Male (2000) document the range of paradigms and perspectives owners use for decision making in the pre-design phases of

capital projects. Woodhead and Male conclude that “*gaining an understanding of the role played by paradigms and perspective is a necessary step towards rethinking the pre-project stage, what we do in the process and why. This understanding empowers decision-makers as they can then avoid having their decisions conditioned by external forces and make more informed choices. To achieve an improved capital proposal stage, design and construction organizations need a better understanding of the organizational and strategic values that direct the core business and its building programmes*”. In order to effectively manage these influencing paradigms and perspectives, it is worthwhile understanding the group processes that manage this knowledge.

### **3. KNOWLEDGE CREATION IN PROJECT DEFINITION GROUPS**

Knowledge is reasoning about information and data to actively enable performance, problem solving, and decision-making, learning and teaching (Beckman, 1999). Knowledge Management (KM) is the formulation of and access to experience, knowledge, and expertise that create new capabilities, enables superior performance, encourages innovation and enhances customer value. KM has emerged as an integrated, multi-disciplinary and multi-lingual discipline providing methodologies and tools for identifying, eliciting, validating, structuring and deploying knowledge within the enterprise. From a management perspective, two major strands have developed within the discipline (Vergison, 2001):

- Micro-scale knowledge management which focuses on the capture, structuring and use of knowledge at local levels;
- Macro-scale knowledge management, which is sensitive to company strategic plans, addresses corporate and transverse inter-business unit concerns.

Micro knowledge management focuses on the creation, capture, validation and diffusion of shop floor knowledge through the use of modern technologies (Leseure and Brookes, 2001). Basic micro-level KM methods can serve as a means of improving information visibility and flow in design decision management.

Central to knowledge management is the learning capability of the project team or organizations. Garvin (1993) defines organizational learning as a process "for creating, acquiring and transferring knowledge, and modifying individual behaviors to reflect new knowledge and insights". Seminal works on organizational learning include that of Senge (1990) and Argyris (1999).

The discipline of organizational learning is gaining prominence in project management (Cooper et al, 2002 & Thiry, 2002) and supply chain management research (Love et al, 2002). Love et al. proposes a useful organizational learning framework that is suitable to project definition groups that form alliances for such activity. The model strategy is based on systems thinking, learning culture, knowledge and communication, changing mental models, joint learning structure/process and development of learning relationships. This model establishes a set of organizational strategies from which to model project definition activity as a learning process.

This research bases its assumptions on the theoretical knowledge creation framework of Nonaka et al. (2000). In order to support project definition groups in knowledge management practices, it is first necessary to understand the knowledge creation process. There is a clear distinction between information and knowledge. Information is a flow messages while knowledge is created by that very flow of information and is anchored in the belief system and commitment of its holder (Nonaka et al, 2001). Knowledge management seeks to achieve not a static management of information or existing knowledge, but a dynamic management of the process of creating knowledge.

Nonaka et al. (2000) identifies a knowledge conversion process that changes tacit knowledge into explicit knowledge and new explicit knowledge into tacit knowledge. The four modes of conversion namely: Socialization, Externalization, Combination, and Internalization (SECI) make up the knowledge creation cycle.

Socialization is a process of joint activities in converting new tacit knowledge through shared experiences. Tacit knowledge is context specific and normally difficult to formalize. Externalization converts tacit knowledge into explicit knowledge. Knowledge becomes crystallized and is able to be shared by others. Dialogue and reasoning are important mechanisms to support externalization. Combination is the process of converting explicit knowledge into more explicit knowledge. Knowledge is exchanged, combined and broken down using various techniques and media representations. The combination mode seeks out knowledge internal and external to the organization. It is then disseminated, edited and combined. Finally internalization is the process of embodying

explicit knowledge into tacit knowledge. This process is closely related to learning by doing. Shared mental models and increased technical know-how develop to form new knowledge assets.

Central to the effectiveness of these conversion processes, is the provision of a space or place for these processes to occur. Nonaka et al. (2000) identify the “Ba” platform as a “place” for knowledge creation. “Ba is a context that harbors meaning”. It can be a physical, virtual, mental space or a combination of all. Central to existence of “Ba” is the interaction of individuals with those operating within the situated environment. Transcending the individual boundary or perspective is necessary in order to participate in Ba and requires the necessary interactions that practice dialogue, collaboration and experimentation.

## **4. A CONCEPTUAL PROJECT DEFINITION FRAMEWORK**

### **4.1 Group Activity Model**

It is significant to identify project definition as a creative process where product innovations can occur opportunely. It offers project definition teams a time phase in the project delivery process to explore and develop creative solutions. The process if seen as a collaborative one is reliant on the collective knowledge of the individuals. Group process management in project definition is particularly relevant when considering the group process to be knowledge work intensive.

The information channels and feedback structures that support the project definition process are dependant on the existing client and stakeholder organizational decision practices. Developing a process that informs client decision makers and stakeholders of timely input to the project definition process is critical to systematic requirements processing. Collaborative project definition is dependant on specific domain knowledge sharing. The business needs of the client may require translation into a common language so as to create clarity and visibility to the decision process. Equally specialized knowledge of design and project requirements is necessary in order to establish feasible project concepts.

Figure 1 displays an input-output model for project definition activity. The process initiates with an initial client brief outlining the perceived purpose of the project. A process is undertaken to model problem formulations and propose alternative solutions.

The group conversation and dialogue model is perceived as the central knowledge creation space for project definition activity. A central approach in understanding cooperative group work is the important topic of language/action (Winograd and Flores, 1986). Within the language action perspective, people are considered to act through language. Organizations are conceived as networks of directives and commissives. Directives include orders, requests, consultations, and offers. Commissives include promises, acceptance and rejections. Conversations for action form the central fabric for cooperative work (Winograd, 1987).

This model identifies stakeholder groups creating and sharing knowledge, as illustrated by the multiple perspectives and paradigms by Woodhead. Such paradigms and perspectives developed in Woodhead’s (1999) PhD thesis work includes: the capital investment paradigm; the cost–benefit analysis paradigm; the financial paradigm; the strategic paradigm; the marketing paradigm; organizational perspectives; management perspectives; the property development paradigm; the planning permission paradigm; and finally the preliminary design paradigm.

Supporting these project definition paradigms are numerous strategies and policies, methods, techniques, and tools. Information is represented in various media and managed through information technology supported systems. Conversations and dialogue develop through the use of these methods and tools.

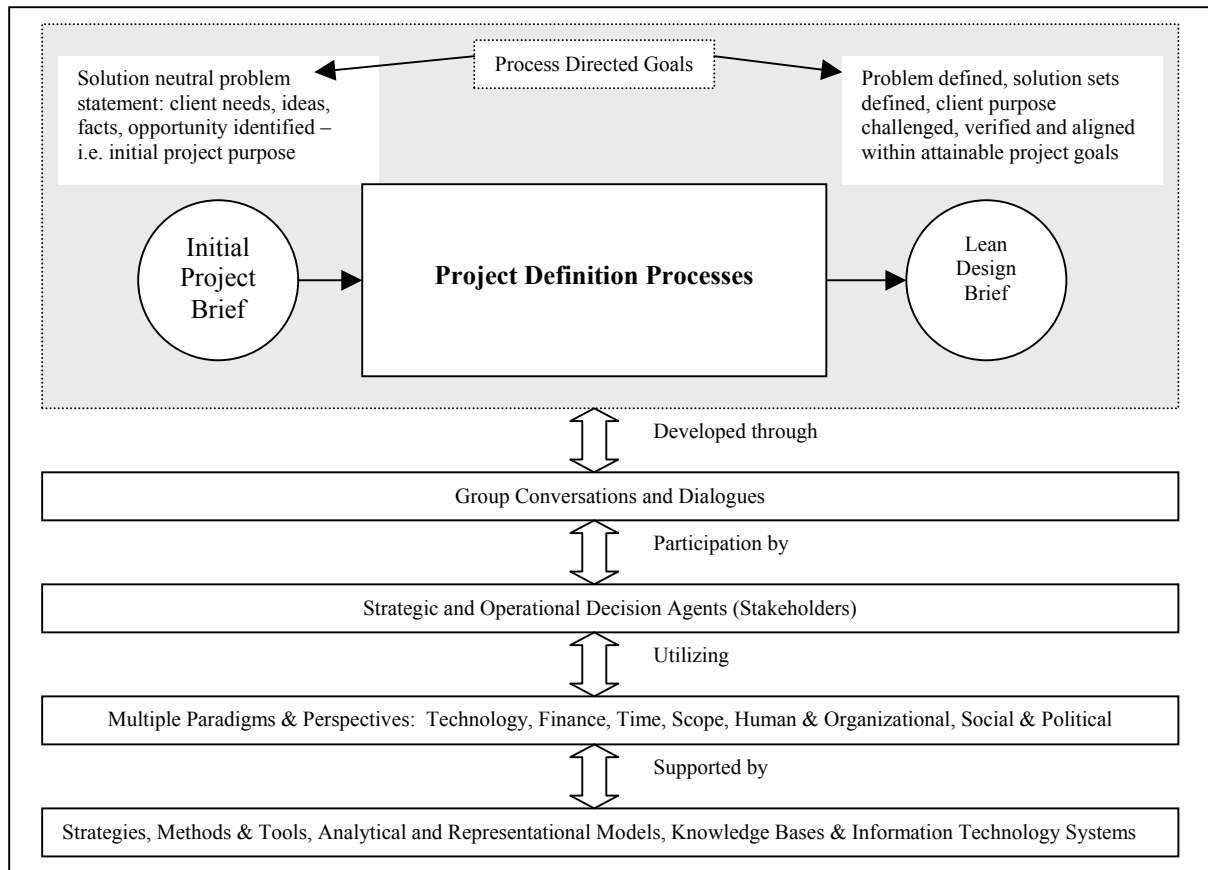


FIG. 1: Project Definition Activity Model.

## 4.2 Knowledge Creating Organizational Unit

Oldfield (2001), and Checkland and Scholes (1999) supports the view of identifying the stakeholders involved in the problem and understanding their environments and project-related needs. Oldfield defines a stakeholder as “any individual or groups with a vested interest in the project process or its outcomes, alternately; they are people who bring influence to the project and its objectives”.

Accurate stakeholder identification reduces uncertainty by minimizing the unavoidable assumptions concerning others’ views and beliefs and highlighting areas of potential conflict. Identifying what is termed the actor-network; a network that makes up human actors, natural and technological agents, creates a systems view for understanding the complex system within which the project definition is situated.

Current practice reveals that these stakeholder groups operate within bounded conditions and opportunity for collective knowledge creation is lacking. The recommended organizational unit for project definition is the cross-functional team (Ballard and Zabelle, 2000). Figure 2 illustrates a possible makeup of project stakeholder that may contribute to project definition activity. Their collaborative association is dependant on the group process design. It is recommended to have as many relevant stakeholders involved in project definition activity.



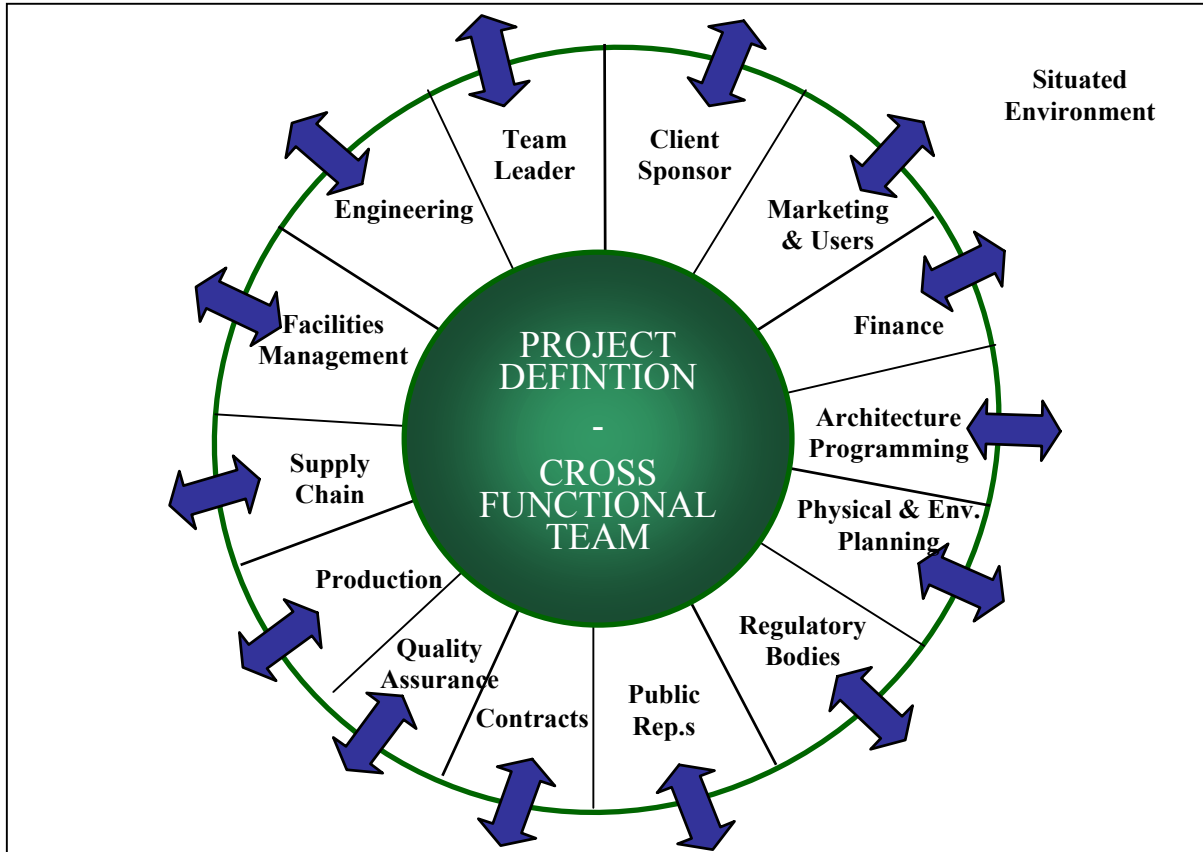


FIG. 2: Knowledge Creating Organizational Unit – Generic Cross Functional Team

**4.3 Managing Group Conversations**

The shared knowledge creation space exists primarily within the group conversation and dialogue component of the model and is the primary focus of this study. Whelton and Ballard (2002b) address project definition group work and propose research propositions centered about task effectiveness and reliability within shared group processes. Developing and explicating stakeholder frames is central to facilitating effective project definition. The creation of a project definition language to support open decision making across client and stakeholder organizations is central to allowing process visibility where necessary.

The process of project definition is developed through group processes. These processes take place within networks of organizational conversations and dialogues as seen through the language action perspective. The participants of the conversations are made up of decision agents or stakeholders. The term decision agent is used here to denote the level of influence the stakeholder may have with respect to making a decision in the process. Strategic decisions and operational decisions are made by appropriate agents.

Figure 3 is a model to identify decision agents that exist in the environment or context. Woodhead (1999) provides an ontology for stakeholders associated with project definition decisions. Decisions have associated decision agent influencers, shapers, makers, takers and approvers, and sponsors that affect the decision process at some point along the course of a decision timeline. Managing the multiple perspectives that are utilized by decision agents in their decision practices is an objective of the project manager.

The dialogue manager interacts directly or creates a dialogue interaction between groups of agents. Operational decision agents, such as product users and the design team, influence and shape purpose based on various “needs elicitation” techniques. Strategic decision agents may develop purposes primarily with regard to the client business and project strategy models.

Brown and Duguid (2002) in identifying components of architecture for organizational knowledge note the need for “translators” in the group process. Translators frame the interests of one community in terms of another community’s perspective. Dialogue is an important tool to utilize in the project purpose development process. Evaluative inquiry, listening, reflection, assumptions elicitation, and suspension of judgment are skills necessary for group dialogue to occur successfully. Innes and Booher (1999) support this ideal of communicative rationality.

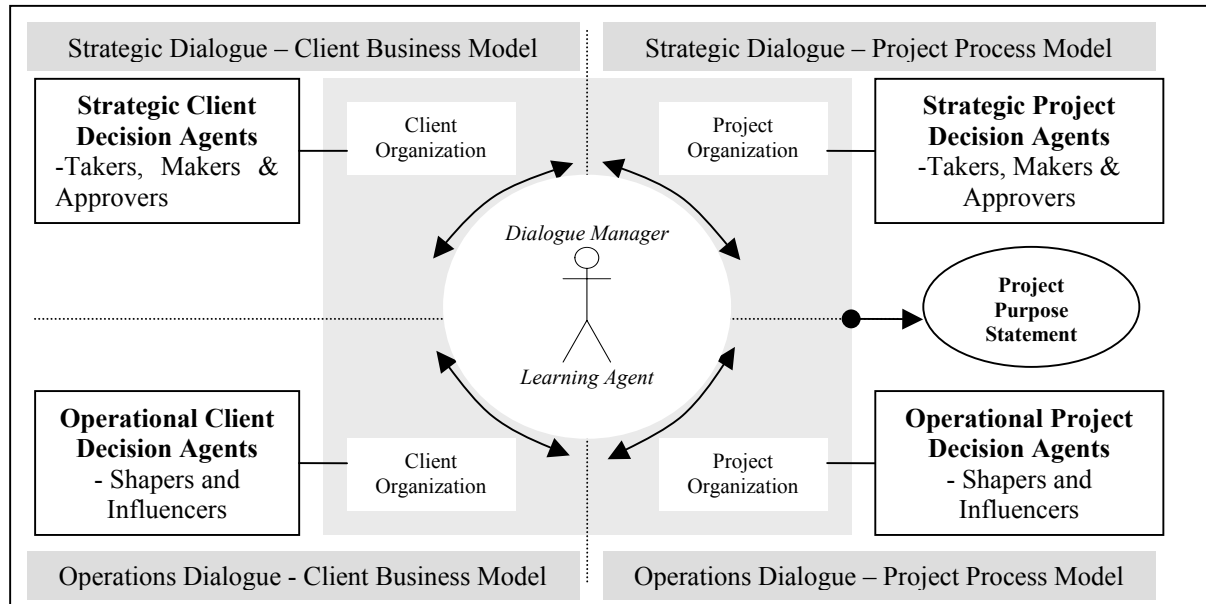


FIG. 3: Project Definition Translator & Mediator Role (Whelton and Ballard, 2000c)

#### 4.4 Project Definition Learning Model

Project definition can be perceived as a learning process so to understand the variables associated with problem formulation. Learning as discussed by Argyris (1999) occurs when an organization achieves what is intended, i.e. when there is a match between intentions and outcomes, and secondly when a mismatch is identified and corrected and turned into a match. The extended process results in double loop learning (understanding the governing problem variables and altering actions) to determine how the original project goals and design criteria were set and established. Single loop learning may focus on changing actions without a focus on the governing variables. To relate this learning model to project definition activity Figure 4 illustrates a set of learning cycles to test project purposes, criteria and concepts. Governing variables may include the initial problem formulations represented in client purpose, team assumptions, stakeholder needs and project constraints.

Depending on the performance of the client organization, information regarding project needs may or may not be crystallized for processing. Depending on the project context, the goals and objectives of stakeholders may compete and conflict once the “need” identification process is undertaken and made explicit. Alignment of client needs with design concepts that are inclusive of project stakeholder criteria is the primary aim of project definition. Testing of client purpose and design criteria can only be fully verified and validated through the development of design concepts. Communication of such learning processes to responsible parties across organizational boundaries demands greater collaboration amongst project definition teams.

While we agree that problems should be stated in solution neutral terms to the extent possible (as proposed by Kamara et al., 2000), full testing of purpose and criteria may be only be validated through concept generation and reflection. By structuring “reflection cycles” into the process, project teams continuously test their reasoning and rationale within their frame structures. Consistent with the wicked nature of the design task, designers are primarily solution focused (Cross 2001). While this may result in premature acceptance of a problem definition, this tendency can also be channeled into sharpening problem definition through exploration of possible solutions.

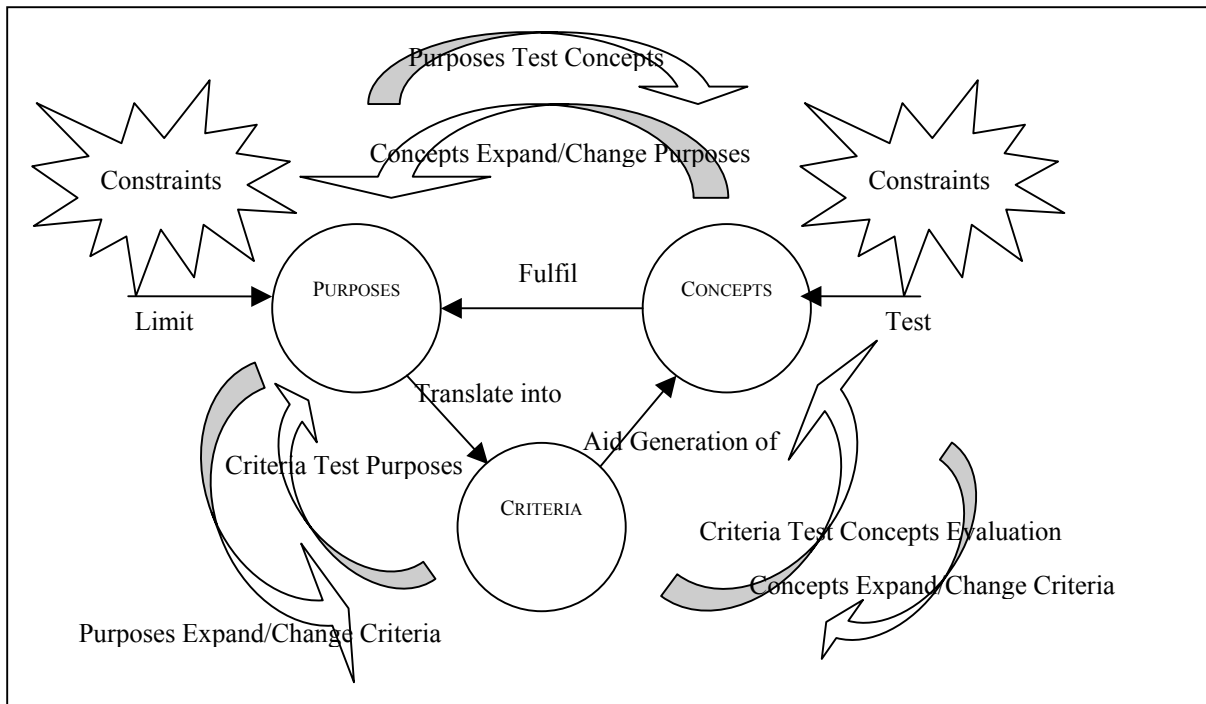


FIG. 4: Project Definition Learning Model (Whelton and Ballard, 2002a)

#### 4.5 Spiral Development Model

Nonaka et al's (2000) dynamic model of knowledge creation identifies group interaction as the key to developing a shared context. Weick (2001) discusses the notion of the "collective mind" that exists within organizations. This construct is located in the heedful interrelating of the individuals within the group and their environment or context. Collective mind is noticeable when individuals create shared fields through interrelations. These interrelations are not given but are constructed and reconstructed continually by individuals. Similarly in the project definition spiral the interrelations between purpose, criteria and concepts are developed within the minds of the group stakeholders. Explicating and sharing these constructs develops and enrich the learning process.

The iterative cycles of group learning spiral upwards in terms of developing a shared understanding of the problem. Figure 5 illustrates the iterative nature of purpose development, criteria transformation, concept generation and evaluation. Cycles of divergent searches for problem formulations and convergence on solutions may occur throughout the process. Final solution convergence is the sought outcome, but is quite often limited by time and resources.

The understanding of project purpose is a critical issue in developing problem formulations. The realization that purpose must be identified and developed in project definition is paramount. The use of the module "purpose" creates a term that interconnects the client strategic business model with the organization's value systems and the facility (in question) design concepts. Validating that the purpose is as necessary as it is to verify its implementation through a design solution (Hooks and Farry, 2001).

Based on this goal, facilitated reflection points (see Figure 5) within the development cycle are necessary to generate new knowledge based on action taken by the group. The dynamic process of purpose elicitation and explication requires the collaborative engagement of the group in context. At these reflection stages of the process, the support of the dialogue manager is instrumental in developing the necessary translations.

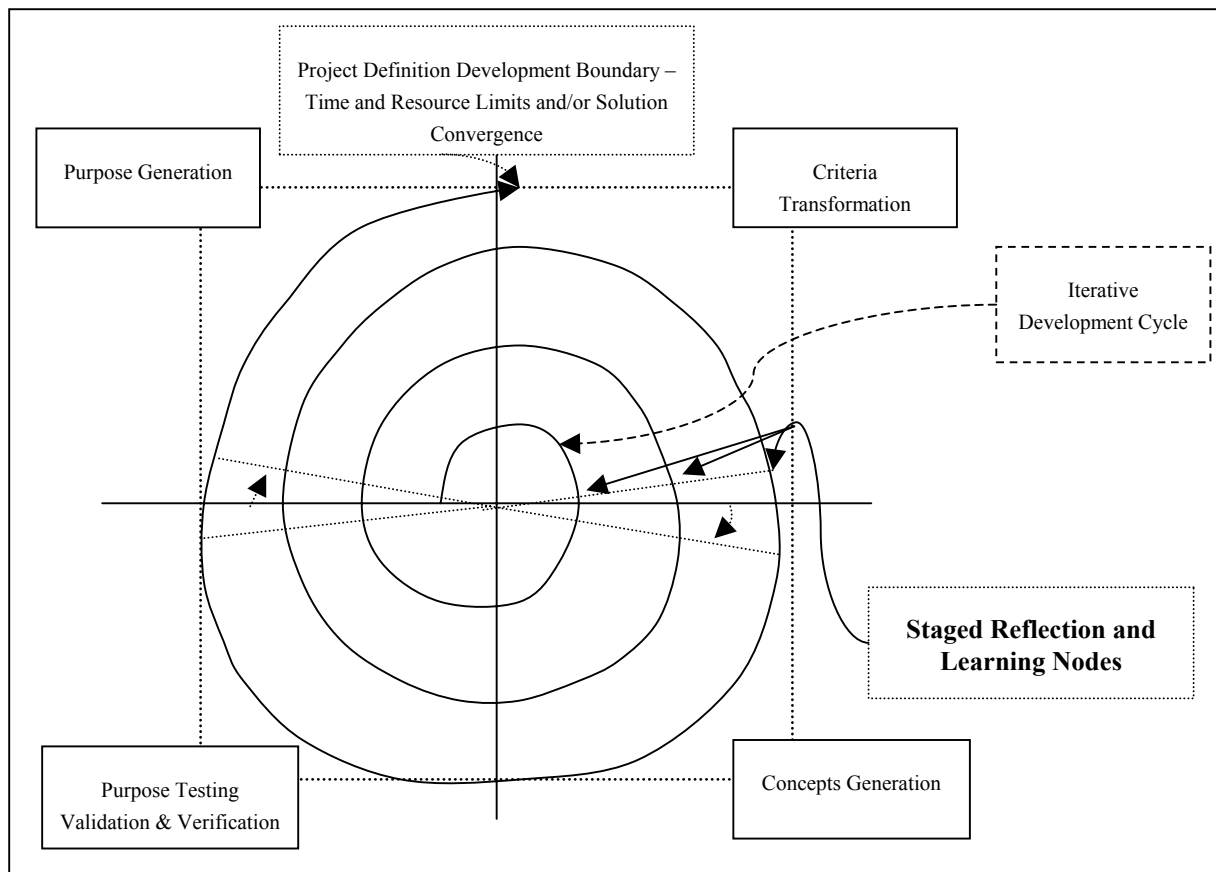


FIG. 5: Project Definition - Spiral Development Model

## 5. KNOWLEDGE ELICITATION TECHNIQUES

Once the development of project purpose initiates, modes of inquiry are used depending on the context of the purpose in question. As shown in Figure 1 a range of tools and methods are adopted in the problem formulation activities. Utilizing the correct methods and tools require careful consideration as these can influence the direction of the problem formulation. Process reliability is important in this instance. Quite often the process fails to frequently reflect and test the quality of the problem formulation<sup>3</sup>. Systems level management of project purpose and supporting the emergence of purpose are key aspects of the group process.

Understanding purpose requires an understanding of the strategy of the client organization. Client strategy provides a framework for handling problems and issues. Understanding the strategic management of the organization creates a basis for understanding project purpose, which in turn acts as a framework for a project definition strategy. Figure 6 illustrates a strategy model adapted from the generic strategy map proposed by Eden and Ackerman (1998). A client strategy may trigger the need for investment in a physical facility. The initial project-based group dialogue establishes a project definition strategy based on the client strategy. Emerging strategy arises from the dialogue. Organizational learning occurs based through performance of the project definition actions and that of the client organization strategy.

In terms of eliciting group knowledge, cognitive mapping is a technique designed to capture the thinking of an individual about a particular issue or problem in a diagrammatic format. It allows the explication of the construct system or current understanding of the decision agent. This technique can follow the natural dialogue of the group, but requires facilitation for development. Numerous cycles of group dialogue are required throughout the

<sup>3</sup> Whelton and Ballard (2002a) identify the wicked problems associated with problem formulation through exploratory case study analysis.

process of alignment. Strategy mapping is proposed to enhance the shared understanding of the group and to provide a framework for collective action.

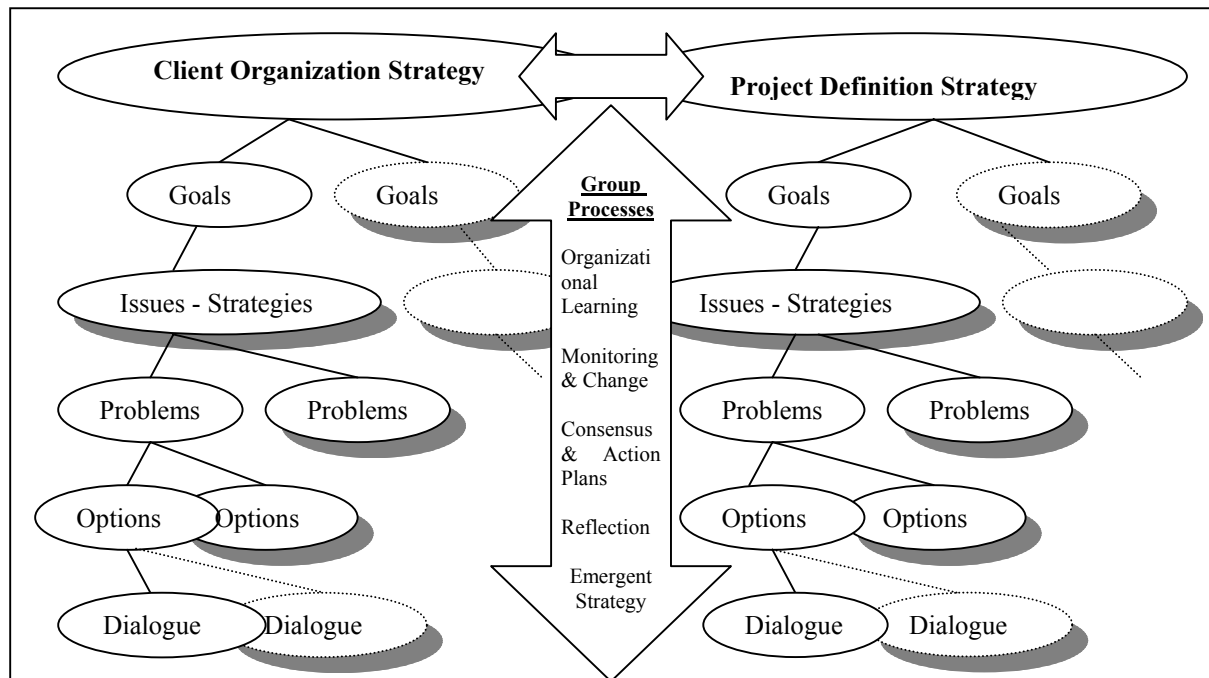


FIG. 6: Alignment of Client Strategy and Project Definition Strategy (Whelton and Ballard, 2002c)

## 6. DEVELOPING A “PURPOSE DELIVERY” SUPPORT METHODOLOGY

This work highlights the importance of developing a shared process model for project definition teams to adopt in industry practice. The use of cognitive mapping tools are identified as support tools for knowledge management in this phase of project development. The future work proposes to experiment with project definition activity within industrial case settings. The experiment seeks to develop insights on how to best leverage group support technologies to support the management and explication of collective knowledge much of which is tacit. Codifying decision making traditionally in industry environments has been difficult due to poor management practice and limited resources. Attention to group meeting management and the provision of a knowledge journalist to support the project definition facilitator may allow enhanced dialogue management. Promoting such tools as quality management support may establish their use in practice.

The research proposes to rely on qualitative research methods as proposed by McGrath (1984) to build the maps through the use of interviews, group observations, and group “mapping together” sessions. Specifically the experimental research seeks to assess the reliability of the group dialogue interaction between the dialogue manager and the individual decision agent(s). Establishing data on the coherence and variance of the developing group mental models is a prime objective of the experiments. The usefulness of the mapping technique as an intervention tool is a secondary objective. Developing insights as to how the project definition team learns is equally important to map and test. Using cognitive mapping tools to measure group understanding and learning may also prove useful as intervention tools in purpose modeling. Codified group knowledge may establish learning cycles within the process.

## 7. CONCLUSIONS

Project definition activity is best facilitated through group work, particularly when dealing with complex systems and organizations. This research proposes to further experiment with group dialogue placing particular emphasis on purpose modelling. Understanding the facilitation role of the project manager and the facility for group learning is a central focus. Effective management of the group dialogue has the potential to offer new knowledge, ideas and collective action when developing purpose. Managing the emergent outcomes in project definition groups offers the potential for increased value generation in the project solution and the associated

client organization and project stakeholders. The research has identified cognitive mapping as a group support tool to help groups manage and deliver collective project purpose statements. Eliciting purpose statements explicates the hidden assumptions, belief and value systems of the group. Dialogue management provides an appropriate means towards developing the necessary shared understanding and project alignment.

Project definition is an opportune phase of a project to generate value for the client. Facility for learning and creativity is necessary in order to develop the best solution for the clients needs. A learning process that not only explores and uncovers latent needs of the client and project stakeholders, but can identify project organizational and process related needs in order to create value within the project structure as a whole is necessary. Design which is an agent of innovation and change requires a system-wide level of approach, not only at the product level, but equally at organizational and process levels, and also within the stakeholder environments.

The reliance on groups to deliver projects has never been greater. Knowledge is created, shared and managed through the interactions of individuals culminating in a collective knowledgebase. In order to create sustainable project support tools such as group information systems, first an in-depth understanding of how group do work is necessary, so to go beyond the current thinking of knowledge management as information systems management.

This paper provides a project definition framework for further development. Testing the model in terms of communication within collaborative teams is the future development work. The use of industrial case data is central for this action research approach. Measuring the performance of the methodology will provide the industry with further insights for process change and improvement.

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