Shared Understanding Management

By Ömer Ertekin, Senior Systems Engineer
Dornier Consulting Engineering & Services GmbH

Because most 21st century projects are distributed across multiple teams, companies, countries, and even continents, communication has the potential to become increasingly problematic. Luckily, communication technologies are keeping pace with these changes, and physical connections and bandwidth needs are not a concern. Furthermore, with the widespread globalization of organizations, a great many people are now learning to speak one or more common/international languages. Cultures are merging very rapidly by means of media and other effectors (e.g., tourism, education and business).

Therefore, the **real problem with communication in project management is not communication itself**, but something beyond it, which we will refer to "understanding."

Background

Understanding, as defined for the purposes of our discussion, is a result of different motivations for the project (the "hidden agendas"—not the requirements but the "desirements"). We believe that problems in achieving this type of understanding are the result of divergent interests, not divergent cultures and languages. We have found that divergent interests are strictly related to the growing complexity of life and systems.

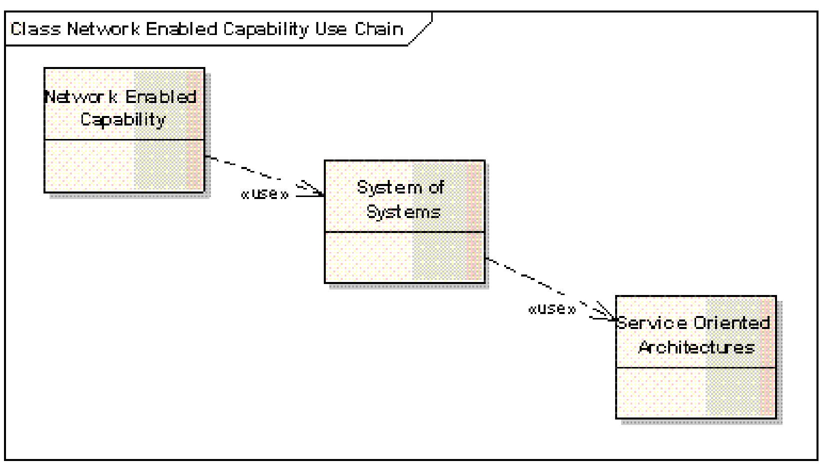

Figure 1: Network-enabled capability use chain

It is possible to examine and understand project management and its context through utilization of a systems approach, and interactions among the stakeholders within a project management system can be analyzed by using a "system of systems" model (every stakeholder is an autonomous system that supplies services to the "project system of systems"). Additionally, understanding these interactions can provide insight into the consequences of actions.

In speaking of systems and the emerging concept of a "system of systems," it is essentially impossible not to mention "service-oriented architectures" and "network-enabled capability." Figure 1 illustrates the relationships among these three concepts.

Network-Enabled Capability

The word *network* is defined by Webster's dictionary (Merriam-Webster, 2009) as:

1. A usually informally interconnected group or association of persons (as friends or professional colleagues)
2. An interconnected or interrelated chain, group or system (e.g., a network of hotels); a system of computers, terminals and databases connected by communications lines

Both of these definitions imply that the term *network* can be considered in the context of social relations (social networks comprised of thinking individuals), information exchanges (information networks) and physical connectedness (physical networks).

Network-enabled capability (NEC) is defined as "the ability to gather knowledge; to share it in a common and comprehensible form with our partners; to assess and refine it to turn into knowledge; to pass it to the people who need it in

> **"Using project management terminologies, a "system of systems" is analogous to "matrix project organizations.""**

an edited, focused form; and to do it in a timescale necessary to enable relevant decisions to be made in the most economic and efficient manner." (iwar.org.uk, 2009)

System of Systems

System of systems is a moniker for a collection of task-oriented or dedicated systems that pool their resources and capabilities together to obtain a new, more complex, "meta-system" that offers more functionality and performance than simply the sum of its constituent systems (Figure 2).

It is "a set or arrangement of systems that results when independent and useful systems are integrated into a larger system that delivers unique capabilities" (DoD AT&L, 2006).

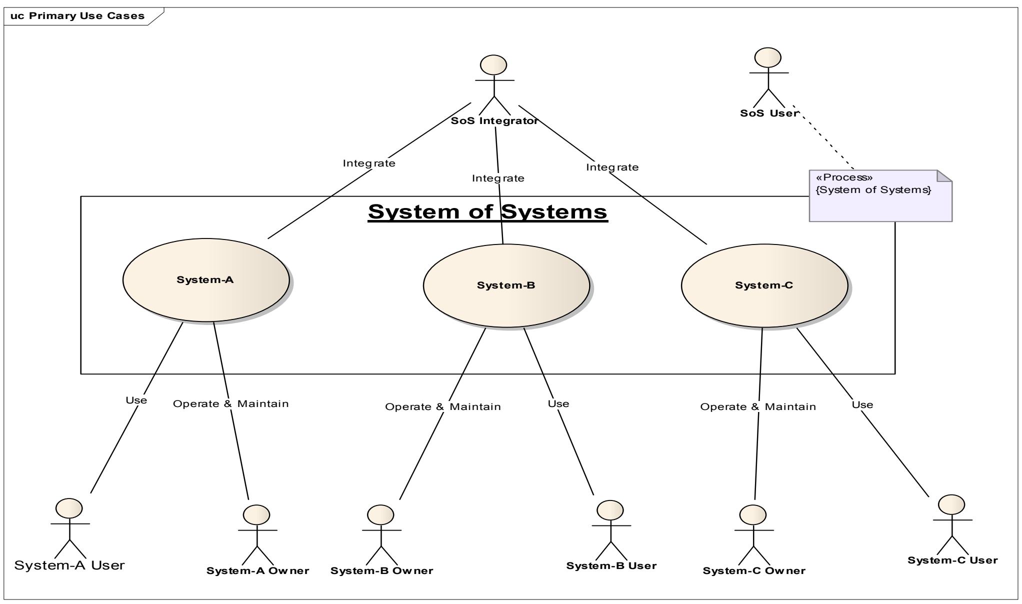

Figure 2: "System of systems" use/activation model

Using project management terminologies, "system of systems" is analogous to "matrix project organization." System of systems deploys the functionalities (all or some) from autonomous systems to form a new system, executing for a given mission (Figure 3). Analogously, matrix project organizations use persons (or some of their time/abilities) from different functional units to form a project organization for the given customer requirements.

According to Sage and Cuppan (2001) "Systems of systems exist when there is a presence of a majority of the following five characteristics: operational and managerial independence, geographical distribution, emergent behavior, and evolutionary development."

Service-Oriented Architecture

In terms of systems engineering terminology, a *system* is a collection of services (capabilities/functions). *Service* is a set of actions that form a coherent whole for both service providers and service requesters.

Service-oriented architecture (SOA) is an architectural style, the goal of which is to achieve loose coupling among interacting services. "In an SOA, resources are made available to other participants in the network as independent services that are accessed in a standardized way. This provides for more flexible loose coupling of resources than in traditional systems architectures" (Looselycoupled.com, 2009).

Loose coupling describes a configuration in which coupled systems may work without real connections and dependency between systems is minimal.

SOA enhances business agility, allowing creation of enterprise business solutions that can be extended or changed on demand to respond to business opportunities or threats by composing large-grained business services into higher-level enterprise business processes (Figure 4).

Shared Understanding

To have a "shared understanding," all of the project's stakeholders should be connected via a network (any kind of communication). All of the project data needs to be circulated using this network. Based on predefined roles and based on their "learned cognition map," different stakeholders will use

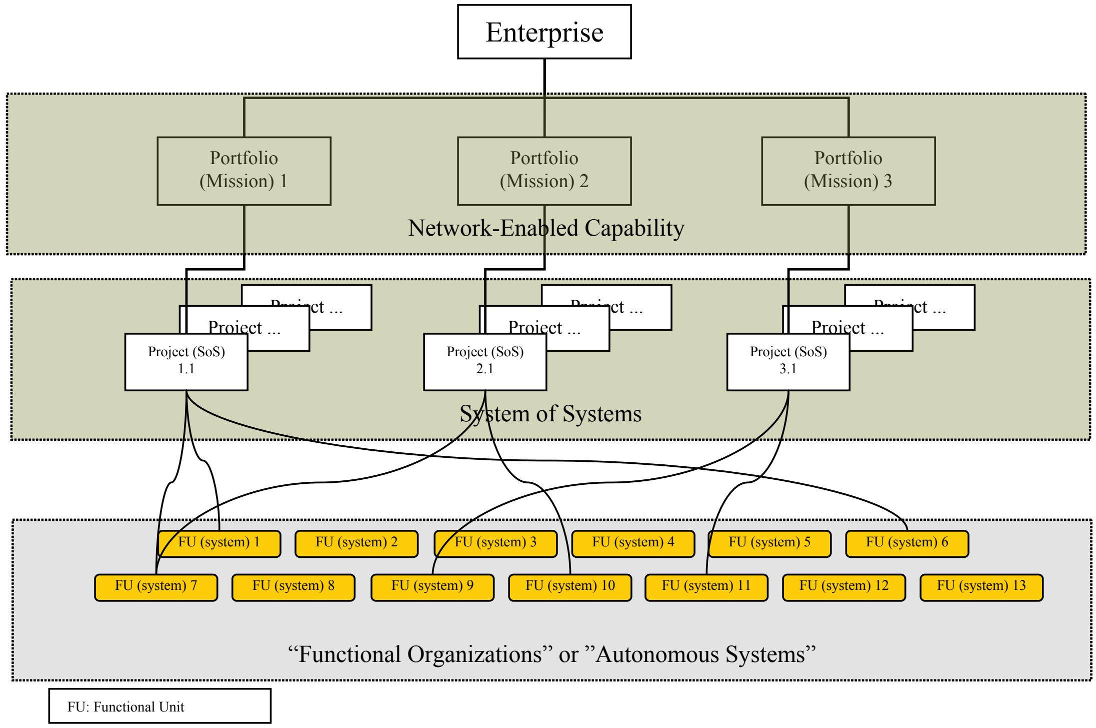

Figure 3: Project-centric enterprise in terms of "system of systems"

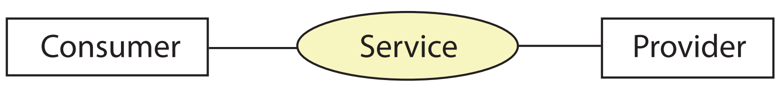

Figure 4: Consumer-provider basis of the SOA

different parts of these data (it may even be the same data, but having different meaning), and these data will create different senses (or, measures) to different individuals. Shared understanding is the "understanding to reach to the common target" based on embedded cognition maps and predefined roles.

As with all operations or control systems, a project system is also a closed-loop control system with disturbances. However, measurements and production of corresponding information (fusion) is very important to feeding the main process factory for corrections. In a project system or in a social/human-based operation, the human itself fuses measured data. Therefore, creating a shared understanding is vital for arriving at the appropriate answer/action. This is because shared understanding is not merely two or more persons understanding exactly the same thing (e.g., the same concept) and acting in response to this understanding in exactly the same way; rather, shared understanding is two or more persons having an understanding (possibly the same or possibly a different understanding, but arriving at the same goal) of related parts (of the entity in question) based on the common top-level goal, arriving at the same solution/action.

In Figure 5, the *ground truth* is the actual project status, *measurement*

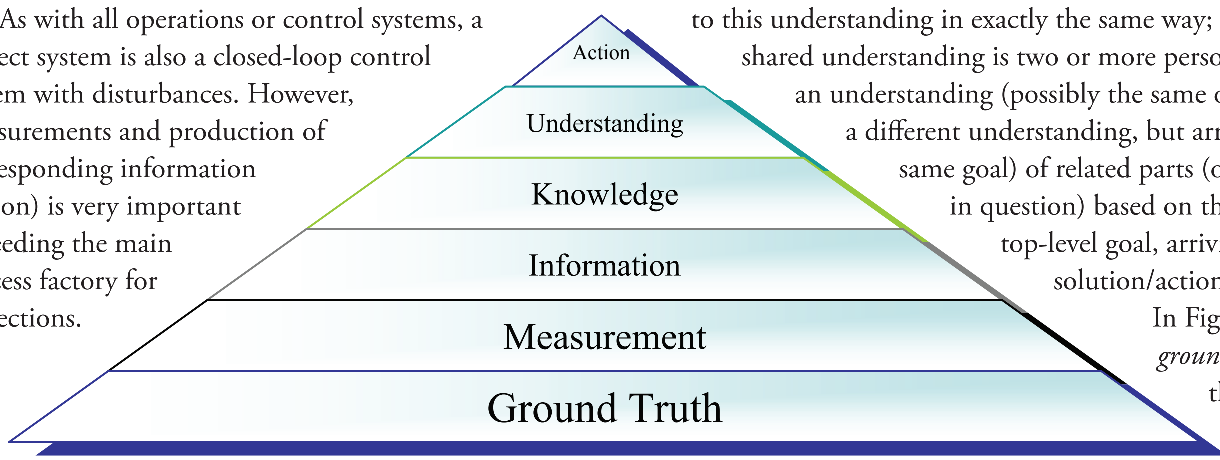

Figure 5: Cognition, from sensing to action

is the measured values from the predefined measures, and *information* is the metrics/graphics calculated based on these measures. Based on these, some mathematical models could be used to achieve common results. Knowledge and understanding, on the other hand, are more complex and totally dependent on the human being.

While sense-making[1] appears to be a simple process using prior knowledge with available information to develop situation understanding, to frame decisions and to guide action in a multifaceted project environment is complicated by a number of technical, cognitive, social, organizational, cultural and operational factors.

Shared Understanding Management

Definition

To have a shared vision ("this involves individuals building a sense of commitment within particular workgroups, developing shared images of common and desirable futures, and the principles and guiding practices to support the journey to such futures" [du Plessis, du Plessis, & Millett, 1999]), a common target that all of the stakeholders should have is a shared understanding.

There are some very well-defined project management processes (competence areas) that aim to align all stakeholders with the project targets. However, what is not defined is how to qualify/measure the lack of alignment/communication in the project. We will try to develop a measurement process connected to all legacy project management processes, which probe communication quality and shared understanding (Figure 6).

Because shared understanding is the most important issue for modern project organizations, we suggest using a subprocess called "shared understanding management."

Shared understanding management (SUM) is a process used to verify *consistency* for all project processes (e.g., requirements management, risk management, subcontract management). Therefore, this process needs to be inserted into the feedback control loop of each process.

As SUM communicates (Figure 6) all of the project management processes for their consistency verification, stakeholder management and risk management processes directly use their products.

Process

See Figure 7: SUM, basic process flow.

Metrics

Related to this process, a new metrics needs to be developed. Some of the example metrics are given below:

Goal: Maximize shared understanding within the organization
Indication: Total inconsistency for all project deliverables (inner and outer)
Metric 1: Number of inconsistent comments on requirements
Submetric 1.1: Number of inconsistencies between customer and project team
Submetric 1.2: Number of inconsistencies between systems engineering team and development teams
Metric 2: Number of inconsistent comments on risk assessments
…

Project management should define a maximum based on project complexity. In the case of inconsistency exceeding limit value, some preventive and proactive measures need

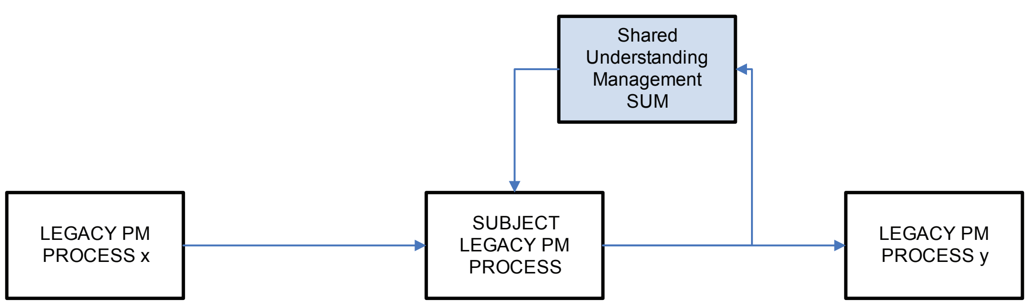

Figure 6: Communication with legacy processes

[1] A term used in Network Centric Warfare and Information Fusion, sense-making is the fusing of the data and creating a single integrated picture about the system that is observed.

> “Inconsistency can be measured using peer review comments, issue records and action items.”

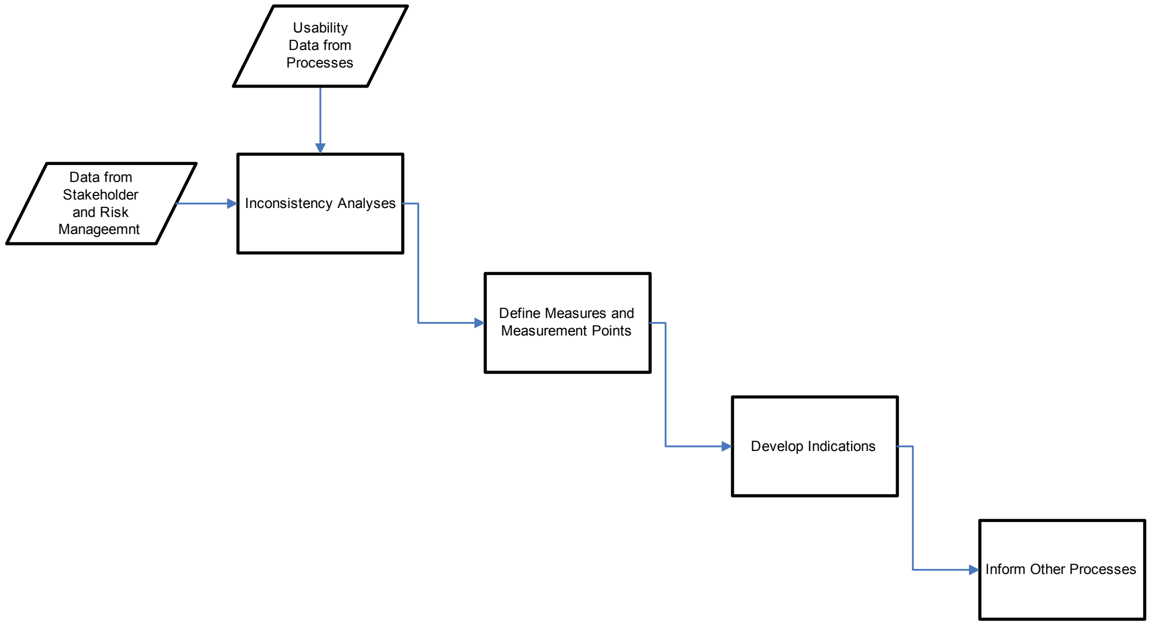

Figure 7: SUM, basic process flow

to be introduced. One such measure may be periodic orientation/normalization meetings.

How to Measure Inconsistency

Inconsistency can be measured using peer review comments, issue records and action items. It will be enough to add one “variance” column into the peer review form (Table 1). Using this variance column, the peer reviewer will also indicate how different his or her ideas are from those of the author. In the case of multiple peer reviewers, multiple variance columns will be used and average value will be used in calculations.

In Table 1, Weighing for Major (x1) and Minor (x0.5) are just indicative numbers and project managers can choose weights based on their experiences and project facts. It is important to have more than one category (e.g., Major, Minor) and one and only one of these categories should be set to x1.

SRS Defects								
#	Init	Location(s)	Description	Defect Type*	Major (×1)	Minor (×0.5)	Variance (0-10)	Effect *10
1	ÖE	Global	The “team leader” should be the “technical lead”	Editorial	X		3	30
2	ÖE	Title page	No signature line for author and approval authority	Editorial		X	3	15
3	ÖE	23	No reference to company’s “Software Project Planning Process” in the referenced documents	Technical		X	8	40
4	ÖE	58	No corrective action system identified	Technical		X	9	45

Table 1: Generic peer review form

> "Applying shared understanding management will be a key step to using lean/agile processes in projects."

Variance setting exactly depends on the feelings of the individuals; exact purpose is to let people set their variances even if mathematical variance is 0. Because we are trying to measure shared understanding and project team alignment, it is very important to know what they feel.

Wf = Weight factor (major 1; minor 0.5)
V = Variance
In = Inconsistency

$$In = \frac{1}{n}\left(\sum_{1}^{n} Wfn.\times Vn\right)\frac{1}{100}$$

In = (30+15+40+45)/400
In = 32.5%

Therefore inconsistency for the SRS document subject to peer review in Table 1 is
In (A) = 32.5%

Using all of the relevant project documents, the project controller may create a table (Table 2). This table may be created anytime, based on project requirements. Basically, there would be two types of creation: instantaneous (single or cumulative) and milestone-based. In the instantaneous case, the entire project document (cumulative) or current versions (single) will be used in calculation. In the milestone case, only milestone-related, released versions of the documents will be used.

Analysis Date: 20.10.2008		Analysis Type: Milestone-Based	
#	Document name	Version	Inconsistency
1	System requirements specs	1.0	32.5
2	Project status report	1.0	45

Table 2: Project inconsistency report

Based on this table, total inconsistency will be calculated again as the arithmetic mean of the inconsistencies. In accordance with the project facts, every document can be given a weight, and then inconsistencies can be calculated.

In terms of inconsistency, project complexity is an important factor that needs to be taken into account; because current projects and environments are nonlinear and have multiple parameters, it should be noted that perfectly shared understanding is impossible. Before setting the goals, the project manager should define his or her project's complexity level and then set the project's shared understanding level.

On the other hand, for critical applications (this occurs most often in operations rather than in projects), complexity does not set the shared understanding level; the projected shared understanding level therefore needs to be fixed to the maximum inconsistency.

In Figure 8, a typical inconsistency graph is shown. Twenty percent is the percentage set by the project manager during the project planning; this means that 20 percent of inconsistency is tolerable in this project.

At the start of the project, there is a growing inconsistency; next, during the concept exploration (requirements analysis and conceptual design) phase, this inconsistency decreases; in the development phase, it decreases more than normal, since everyone is very busy with the first developments; and starting with the testing phase, it increases. (How to control this will be a subject for future papers.)

The reader should also note that the graph needs to be read in two ways: first, according to its static value (what is the current inconsistency), and second, according to how is it progressing, and whether it tends to decrease or to increase into conflicts.

Conclusion

This article is a result of the actual problems of big and complex projects. Most of the project status reports/dashboards are focused on the famous three project management values: cost, schedule and scope/quality, and earned value analysis is widely used to calculate the values to be shown on the project status reports. However, it is never shown if the project stakeholders are aligned with each other and with the project goal.

We are proposing:

1. To embed/use shared understanding management metrics into all project management processes
2. To report inconsistency as the fourth dimension to show the project shared understanding level

Applying shared understanding management will be a key step to using lean/agile processes in projects.

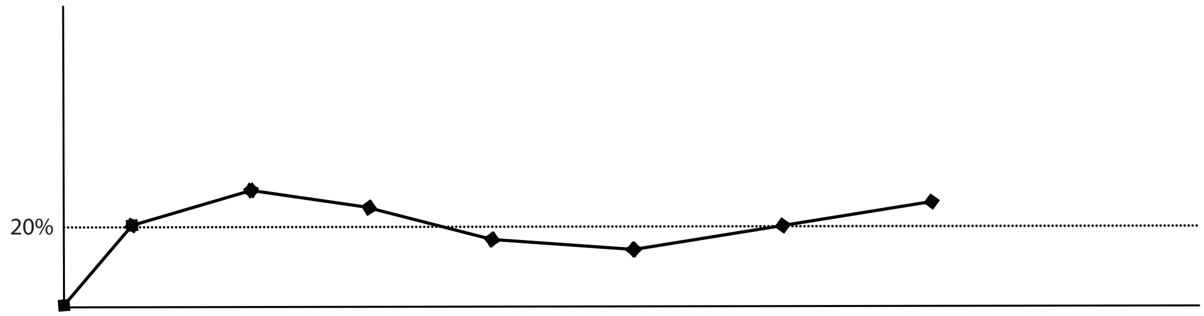

Figure 8: Inconsistency graph

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About the Author

Ömer Ertekin, BSc, EE, is working as senior systems engineer for Dornier Consulting Automotive Systems GmbH in Germany. He has worked as systems engineering lead and project manager for various projects in defense industry. During these projects he has successfully customized and used the processes defined in DOD-extended PMBOK®. Mr. Ertekin is a systems engineering fellow and founder of Turkish Chapter of INCOSE. He is researching on systems science to understand the complex behavior of the socio-technical systems.