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Communication and Meta-Communication in Software Engineering

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Abstract

This paper examines and focuses on some issues and questions relating to how the use of meta-communication concept in "Software Engineering Process". In addition, the role of IT project communication and the project management tools which can be regarded as vital for "Software Engineering", primarily the internet, email, printed materials and the categories by which development team interacts are also investigated. In the field of "Software Engineering" the perception of the role of socio-cognitive engineering (SCE) is continuously increasing. Today, the focus is especially on the identification of human and organization decisional errors caused by software developers and managers under high-risk conditions, as evident by analyzing reports on failed IP projects. "Project Communications Management" plays a key role in keeping all members of the project management team on the same page. Without communication among all team members and project stakeholders there can be a breakdown in processes which could have a negative impact on the final product. At present, the engineering and social safety requirements need to enlarge their domain of interest in such a way to include all possible losses generating events that could be the consequences of defective software. Socio-cognitive modeling of Integrated Software Engineering using the TOGA meta-theory has been discussed. In this paper, more detailed aspects of the cognitive decision-making and its possible human errors and organizational vulnerability are presented. The formal TOGA-based network model for cognitive decision-making enables to indicate and analyze nodes and arcs in which Software developers and managers errors may appear. As the nature of human errors depends on the specific properties of the decision-maker and the decisional context of IT project processes, a classification of decision-making using is suggested. Several types of initial situations of decision-making useful for the diagnosis of Software developers' errors are considered. The developed models can be used for training the IT project management executive staff.

Keywords: *Engineering Science, knowledge building, communications systems, expressing, formulas, defect prevention, socio-cognitive modeling, software engineering, IT, IT project processes TOGA meta-theory, socio-cognitive engineering, project communications management.*

1. Introduction

Bateson is typically said to have invented the term, but in fact, he credits Benjamin Lee Whorf. Bateson suggested the term's significance in 1951, and then elaborated upon one particular variation, the message "this is play," in 1956a critical fact for Bateson was that every message could have a meta-communicative element, and typically, each message held meta-communicative information about how to interpret other messages. He saw no distinction in type of message, only a distinction in function.

Some meta-communicative signals are nonverbal. The term Kinesics, referring to body motion communication and occasionally employed by Bateson, was first used by Ray Birdwhistell an anthropologist who wished to study how people communicate through posture, gesture, stance, and movement. Part of Birdwhistell's work involved filming people in social situations and analyzing them to show different levels of communication not clearly seen otherwise. Birdwhistell's research was influenced by Margaret Mead and Gregory Bateson; all three were participants in the Macy Conferences in Group Processes,[1] and both Birdwhistell and Bateson were part of a later multidisciplinary collaboration.

From 1952-1962, Bateson directed a research project on communication. This paid particular attention to logical paradoxes including Russell's paradox 1901 and to of Bertrand Russell's, Theory of Types, Russell's solution to it. Bateson (1972) and his associates here pioneered the concept of meta-

communication, something that means different (often contradictory) things at different levels. Meta-communication is thought to be a characteristic feature of complex systems. (Available fromhttp://www.meta-communication.readwithhelp.com, retrieved on 20.08.2015, please visit for detail)

Frits Staal related the term to meta-language concept that is found in logic both in Western and Indian traditions. Staal considered the term meta-language, or its German or Polish equivalent, to have been introduced in 1933 by the logician Alfred Tarski, whom he credits with having made apparent its real significance. Russell's 1902 solution to his logical paradox [14] comes in large part from the so-called *vicious circle principle*, that no propositional function can be defined prior to specifying the function's scope of application. In other words, before a function can be defined, one must first specify exactly those objects to which the function will apply (the function's domain). For example, before defining that the predicate “is a prime number,” one first needs to define the collection of objects that might possibly satisfy the predicate, namely the set, N, of natural numbers. It functions as a formal definition of the function of Meta-communication in communication.

Ivan Pavlov had learned that the ringing of the bell signaled "food is on the way" in his experiment in which dogs were trained to salivate upon hearing a bell ring. This was accomplished by ringing a bell just prior to feeding the dogs. After repeating this procedure for some time it was found that the dogs would salivate after hearing the bell -without the need for food being presented.

Something that is not often discussed in context with this experiment is the fact that the dogs would not salivate unless they were wearing a special harness. When exposed to the bell ringing without wearing the harness, the dogs did not salivate. The dogs only salivated upon hearing the bell *while wearing the harness*. The bell ringing was direct communication of information, but the context of the communication also conveyed information.

In 2001 study, it was used to discuss self-referentiality in mass media covering politics and was explained as a consequence of the political public relations' presence in media themselves. In 2013 study about supervision in higher education, authors recommended meta-communication as part of a transparent communication (wikipedia, available from http://en.wikipedia.org/wiki/Meta-communication, retrieved on 20.08.2015, please visit for detail).This is what’s called “meta-communication” in action. In the early 1970s, Gregory Bateson coined the term to describe the underlying messages in what we say and do. Meta-communication is all the nonverbal cues (tone of voice, body language, gestures, facial expression, etc.) that carry meaning that either enhance or disallow what we say in words. There’s a whole conversation going on beneath the surface.

In Bateson's works, meta-message was defined (1972) as a refinement of his earlier notion of "mood sign[al]"s from his works of the 1950s. Invoking Bertrand Russell's Theory of Logical Types, Bateson envisaged a potentially infinite hierarchy of messages, meta-messages, meta-meta-mesages and so forth, each meta-message deterministically providing the full context for the interpretation of subodinate messages. Being rather technical, his definition was misunderstood,[21] and *meta-message* appropriated with the same meaning as subtext, especially in the field business communications.[22] Additionally, Bateson's strictly hierarchical theory was criticized for not reflecting some real-world communication phenomena, where any signal (regardless of level) can be deceitful. (wikipedia, available from http://en.wikipedia.org/wiki/Meta-communicationretrieved on 21.10.2015, please visit for detail).

The prefix can have various meanings but as used in communication, philosophy and psychology its meaning is best recognized as *about*. Thus, *Meta-communication* is communication about communication; *meta-language* is language about language; *meta-message* is a message about a message. Take it this way! You can communicate about the world - about the desk you’re sitting at, the computer you are using, or the passage you’re reading right now. We refer to this as *object communication*; because you are talking about objects. And the language you are using is called an *object language*. But notice that you are not

limited to talking about objects; you can also talk about your talk; you can communicate about your communication. And this is referred to as meta-communication. In the same way, you can use language (i.e., meta-language) to talk about language (i.e., object language). And you can talk about your messages with meta-messages.

The distinction between object communication and meta-communication is not merely academic; it's extremely practical, and it is recognized that the difference between these two forms of communication is essential in untangling lots of conflicts and understanding a wide variety of interpersonal communication interactions. Actually, we use this distinction (as a meta-communication) every day, mostly without realizing it. For example, when you send someone an e-mail with a seemingly sarcastic comment and then put a smiley at the end, the smiley communicates about your communication; it says something like "this message is not to be taken literally; I'm trying to be humorous."

The smiley is a meta-message; it's a message about a message. When you say, in preface to some comment, "I'm not sure about this but...." you're communicating a message about a message; you're commenting on the message and asking that it be understood with the qualification that you may be wrong. When you conclude a comment with "I'm only kidding" you're meta-communicating; you're communicating about the communication.In relationship communication you often talk in meta-language and say things like, "we really need to talk about the way we communicate when we're out with company" or "you're too critical" or "I love when you tell me how much you love me."

In fact, it might be argued that relationship or couples therapy is largely (though not entirely) a process of exploring your communication patterns through communication, through talking about the way you talk to and about each other. And, of course, you can use nonverbal messages to meta-communicate. You can wink at someone to indicate that you're only kidding, look longingly into another eyes when you say "I love you" to show that you really mean it, or sneer after saying "Yeah, that was great," with the sneer contradicting the literal meaning of the verbal message.

All non-verbal elements of communication are sometimes called as a 'meta-communication' which its root comes from the Greek word 'meta' meaning is 'beyond' or 'in addition to'. 'Meta-Communication' is therefore something 'in addition to the communication' and we must always be aware of its existence. It is essential to remember that the meta-communication which accompanies any message is very powerful. The receiver will use these clues to help them to interpret what you mean, but more importantly they will often take the meaning from the meta-communication rather than from the words themselves, particularly when what you are saying conflicts with what you are doing. If, for example, you are angry but trying to hide your anger you must be aware of your body posture, the way you use your eyes, gestures and facial expressions, and the tone of your voice, which may well give you away. Similarly, in writing, the 'tone of your voice' may show(Istifci & Demiray, 2011).The word 'disabled' is unnecessary. We understand meaning of these symbol very brief and than behave how it necessary in social perspective.

Other examples are useful to clarify understanding of meta-communication concept and its function in life long learning process with our daily life. For example (Demiray, 2010)some signs dealt with disabled person which are conveniently understand each others in same the meaning of parking for disabled person, toilet for disabled person, meal for disabled person, path for disabled person, reserve for disabled person, line for disabled person which we can meet anywhere.



The truth is that people communicate all the time. It's not possible to avoid it (Vygotsky,1978). Social creatures that we are, we are always sending out signals that others read, interpret, and respond to while we are reading, interpreting and responding to theirs.

When two people who want to be close to each other instead find themselves in constant turmoil, it is not because they aren't communicating. In fact, they are probably communicating far too much in their frantic efforts to try to get through to each other.

The issue is that they don't understand each other's code. Verbal communication is supported by a raft of non-verbal signs and cues that reinforce what we are saying or clear up any ambiguities. For example, we may cross our arms when we feel threatened by what somebody else is saying, or we nod our heads when we agree with what they are saying.

"Meta-Communication" is the process between message designers when they are talking about the learning process, as distinguished from their articulation of the "substantive" learning, itself. The hope is to increase the focus on the substantive knowledge and understanding being developed, by providing a separate channel for the support communication, and to do it in an easy, focused, and context aware manner. This may be particularly useful when the opportunity for face-to-face Meta-communication is missing, as in much distance teaching(McLean, 2005).

Although nonverbal communication gives clues to what speakers are thinking about or enhances what they are saying, cultural differences may also interfere with understanding a message (Pennycook, 1985). The rules are brought to our attention only in formal discussions of nonverbal communication, such as this one, or when rules are violated and the violations are called to our attention-either directly by some tactless snob or indirectly through the examples of others.

While linguists are attempting to formulate the rules for verbal messages, nonverbal researches are attempting to formulate the rules for nonverbal messages-rules that native communicators know and use every day, but cannot necessarily verbalize. It must be mentioned that nonverbal behavior is highly believable. For some reasons we are quick to believe nonverbal behaviors even when these behaviors contradict verbal messages. Nonverbal reports on research demonstrating that compared to verbal cues, nonverbal cues are four times as effective in their impact on interpersonal impressions and ten times more important in expressing confidence. From a different perspective, Albert Mehrabian (1976) argues that the total impact of a message is a function of the following formula is: total impact = 7% verbal + non-verbal 38% + 55% facial.

This formula gives very little influence to verbal messages. Only one third of the impact is vocal (that is, paralanguage elements such as rate, pitch, and rhythm) and over one half of the message is communicated by the face. The formula, developed by Mehrabian and his colleagues from their studies on the emotional impact of messages, is not applicable to all messages. It is applicable only to the expression of feelings. Although it is interesting to speculate on what percentage of message impact is due to nonverbal elements in other kinds of messages, there is no valid and reliable answer at this time.

In using the meta-communication concept for model of interactivity, collaboration, and communication in a distance learning environment, technology is the tool that both delivers content and allows the learner to interact and communicate with others in the learning environment. Modes of communication can be either asynchronous or synchronous. Appropriate technologies can help encourage peer-to-peer interactions and learner-instructor interaction with content (Cooper & Robinson, 1998).

Emblems are nonverbal behaviors that translate words or phrases rather directly. Emblems include the nonverbal signs for OK, peace, come here, go away, who me?, be quiet, I'm warning you, I'm tired, it's cold. Emblems are nonverbal substitutes for specific verbal words or phrases and are probably learned in essentially the same way as are specific words and phrases, without conscious awareness or explicit teaching and largely through imitation.

Although emblems seem rather natural to us and almost inherently meaningful, they are as arbitrary as any word in any language. Consequently, our present culture's emblems are not necessarily the same as our culture's emblems of 300 years ago or the same as the emblems of other cultures. The OK sign may mean "nothing" or "zero" in France, "money" in Japan, and something sexual in certain Latin American cultures. Just as the English language is spreading throughout the world, so too is English nonverbal language.

The meaning of the thumb and index finger forming a circle meaning "OK" is spreading just as fast as English technical and scientific terms. Emblems are often used to supplement the verbal message or as a kind of reinforcement.

At times they are used in place of verbalization, when there is a considerable distance between the individuals and shouting would be inappropriate or when we wish to communicate something behind someone's back. Illustrators are nonverbal behaviors that accompany and literally illustrate the verbal messages. Illustrators make our communications more vivid and more forceful and help to maintain the attention of the listener. They also help to clarify and make more intense verbal messages.

In saying "Let's go up", for example, there will be movements of the head and perhaps hands going in an upward direction. In describing a circle or a square, you are more than likely going to make circular or square movements with your hands (Veliyeva, 2011).

Thus, there can be misunderstandings in communication. It is essential to remember that the meta-communication which accompanies any message is very powerful. The receiver will use these clues to help them to interpret what you mean, but more importantly they will often take the meaning from the meta-communication rather than from the words themselves, particularly when what you are saying conflicts with what you are doing. Hence, understanding or interpreting nonverbal messages accurately is especially important for second/foreign language (L2) learners whose comprehension skill is more limited. Since meta-communication is creating meanings to solve relationships of body language (Demiray, 2009), listening and speaking teachers may also concentrate on exposing students to the samples of body language, gesture, facial expressions, posture, eye-gaze and interpersonal distance by showing authentic videos of real life use.

We all know how personal codes work. Ask someone how she is. She responds, "Fine." If said simply, we take it to mean that she really is fine or at least fine enough or maybe that she doesn't think you're the person to tell how she's really doing these days. It doesn't require a response and we both just move on. It's the kind of exchange we do all the time. It just keeps the social wheels moving. (Available from http://www.meta-communication.readwithhelp.com Rerieved on 6.10.2015, please visit for detail).

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This may be particularly useful when the opportunity for face-to-face meta-communication is missing, as in much distance learning. (McLean, R. S. (2005)

This is what's called "meta-communication" in action. In the early 1970s, Gregory Bateson coined the term to describe the underlying messages in what we say and do. Meta-communication is all the nonverbal cues (tone of voice, body language, gestures, facial expression, etc.) that carry meaning that either enhance or disallow what we say in words. There's a whole conversation going on beneath the surface.In the case of our young couple: her "fine" with a shrug and a sigh is code for "I've had a miserable day. I need to talk to someone who loves me.

Meta-communication a kind of process which is never does not need feedback. We can give "Dart Game" as a good example for the meta-communication to tell easier.Let's suppose that A, B, and C persons playing dart. Each of them has three shot options for to take their highest score in total, at the end of three shoots. In order to get the first shot of the person A and he hit tree times from 12 point, so collected a totally of 36.0 points. Second row belongs to the B people. Person B hits from12 in his first throw, than his second throwhe hits from 8 point. His last throw hits to out of board, than he picks up totally 20 points. C is the third person shoot hits from12 in the first throw and second shot hits again from 12 the last shot hits 11.9 points than he is collected totally 35.9 points.

At the end of the game scores are as indicated here such as; A=36.0 points collected, B=35.9 points collected and C=20 points collected. Its mean is thatA is won the game.Meta-communication a kind of process which you have to design your message "not good" you have to design more tan good you should design "an excellent". A person who wishes to effect someone he/she has to design his messages very well excellent" he has an opportunity to hit its target from 12 point every time.

Another ways of explaining of meta-communication are here. Please give me a hug and a kiss and don't ask much of me for a little bit while I unwind. How about a glass of wine?" If he is already pouring that wine and smiling at her sympathetically, she'll melt into his arms. If he says, "I'm hungry. What's for dinner?" they're headed for a fight.

Couples that work are couples who take the time to learn each other's nonverbal code as well as each other's verbal language. Making the effort to truly understand the other's meaning is one of the most significant acts of love. When both people put aside their defensiveness and work hard to get each other on the meta-level, the couple becomes more and more secure. Knowing how to interpret each other's signals is the basis of trust and intimacy.

In the early years of a relationship, conversations about what was said versus what was meant can be frequent and can go into the wee hours of the morning. As a couple matures, these conversations are apt to happen less often and be less loaded but they are still important. Communication about what we mean by our communications is complicated. A new life stage, new experiences, or new information can subtly shift our meaning.**How To Learn Each Other's meta-communication**

- Don't assume that your partner means what you mean by the same words and phrases, gestures, or tone of voice. Each family has its own family code. You learned yours. Your partner learned his or hers. Each of you takes it for granted what some things mean. If your partner looks mystified, resist the temptation to get frustrated or judgmental. Instead, stop and ask what your partner heard. Explain what you meant by what you said.
- Don't conclude your partner isn't interested, doesn't love you, or is a dolt when he or she doesn't get what you mean. Trouble with each other's codes doesn't have to escalate to questioning the whole relationship.
- Do slow your conversation down. When people don't understand each other, they tend to get anxious. When people get anxious, they tend to speed up. Instead, take a deep breath and ask your partner to say back what he or she thinks you meant. If they got it wrong, calmly and patiently clarify.

- Do listen with curiosity and interest. Explain yourself with caring. This isn't a fight. It's a lesson in each other's language. Listening well doesn't always come naturally, but don't fret, listening is a skill you can learn.
- Do put aside defensiveness. When accused of not understanding, admit that it's probably true. Ask for help in understanding your partner's code (available from http://psychcentral.com/lib/meta-communication-what-i-said-isnt-what-i-meant Retrieved on 8.10.2015, please visit for detail).

Science Language Is Perfect
Sample for meta communication?

Since is language itself. It tells or passes us information and data by showing and serving some code, figures, charts and graphics also etc. It accepts that if we know these codes than lean to us concepts, thoughts and idea. By many organizations this has been termed "Science for All," and those who promote this idea also advocate the connection to science literacy. Teaching science in the online environment has been one way to offer science content to many different individuals who do not necessarily need to be in the same location.

Discourse in the science classroom is framed under situated cognition theory, whereby interactions between individuals are part of the normal culture of the classroom. For science knowledge to be adequately constructed by a student, these interactions must be meaningful ones. This is especially important in an online science course where typically learning occurs through interactions between the students and the instructor, the students with one another, and within the individual themselves. As part of these online interactions, good reflective practice includes the different forms of feedback and the quality of this feedback.However, even with quality reflective interactions, there are barriers to science concept construction in an online environment. These barriers are discussed, and future research directions are suggested based on this review.

Given that scientific inquiry is grounded in the previously discussed models for the learningof science concepts -situated cognition and constructivism- there are four elements aboutinquiry in the science classroom that are generally accepted (Anderson, 2007; NRC, 1996). Thesefour elements as described by Anderson are:

- Learning is an active process of individuals constructing meaning for them; significant understandings are not just received.
- The meanings each individual constructs are dependent upon the prior conceptions this individual already has. In the process, these prior conceptions may be modified.
- The understandings each individual develops are dependent upon the contexts in which these meanings are engaged. The more abundant and varied these contexts are, thericher are the understandings acquired.
- Meanings are socially constructed; understanding is enriched by engagement of ideas.
- in concert with other people. (Anderson,2007, p. 809)

Given these four elements as necessary for inquiry in the science classroom it is clear that the environment for learning science is not limited to the face-to-face classroom, but can be other environments such as online or informal Education environments.

In teaching of science, inquiry it is also generally accepted that students need to participate in activities that promote the active role of the student. Activities need to provide opportunities for students to: ask their own questions, design their own activities, interpret, explain, hypothesize, and share authority for answers. The work that students do need to emphasize reasoning, reading and writing for meaning,

solving problems, build from existing cognitive structures, and explain complex problems (Anderson, 2007).

How these characteristics of science inquiry look in practice in both the face-to-face and online classrooms has been discussed elsewhere by the authors (Baptiste, Neakrase& Ryan, 2011).Software processes are specified for a number of reasons: to facilitate human understanding, communication, and coordination; to aid management of software projects; to measure and improve the quality of software products in an efficient manner; to support process improvement; and to provide a basis for automated support of process execution (SWEBOK 3.0, 2014,p. 148).Enable Effective Communications: modeling employs the application domain vocabulary of the software, a modeling language, and semantic expression (in other words, meaning within context). When used rigorously and systematically, this modeling results in a reporting approach that facilitates effective communication of software information to project stakeholders(SWEBOK 3.0, 2014,p. 164).

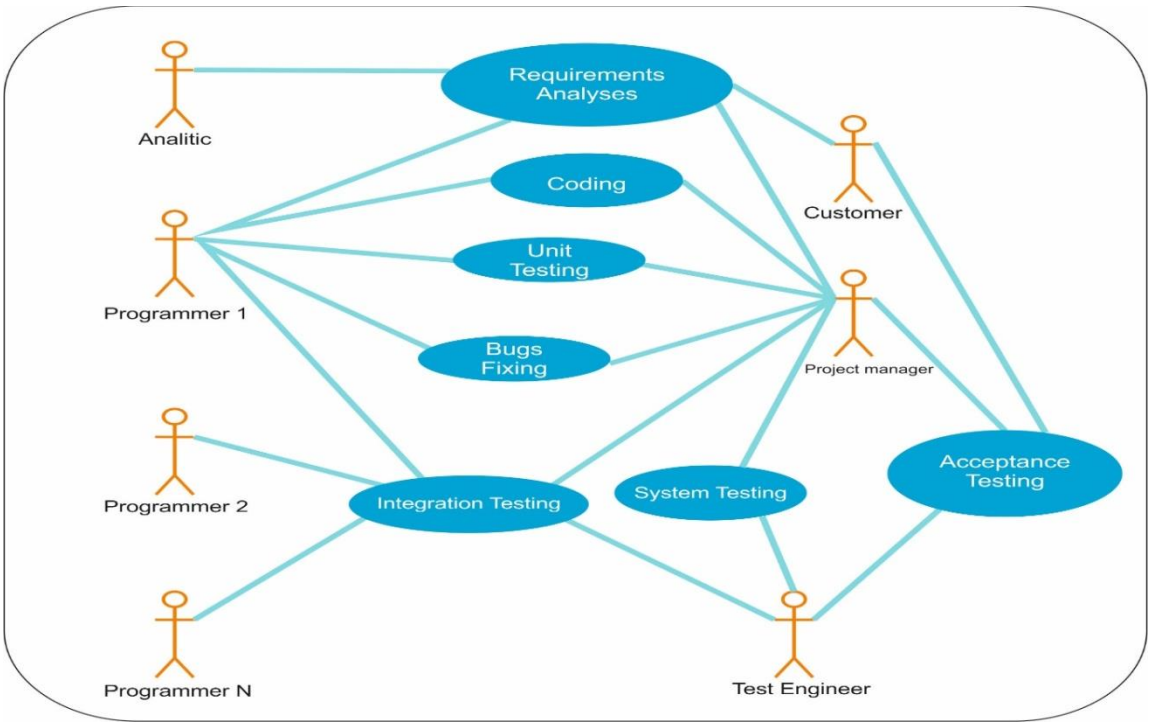


Figure 1.
Communication by Roles in Software Engineering Project (1-means one, * - many).

Management sponsorship supports process and product evaluations and the resulting findings. Then an improvement program is developed identifying detailed actions and improvement projects to be addressed in a feasible time frame. Management support implies that each improvement project has enough resources to achieve the goal defined for it. Management sponsorship is solicited frequently by implementing proactive communication activities (SWEBOK 3.0, 2014,p. 177). Different types of reviews and audits are distinguished by their purpose, levels of independence, tools and techniques, roles, and by the subject of the activity. It is easy to get overwhelmed with our personal and professional tasks. We often forget that there is only one of us and a million things we need to get done. We can't possibly do it all or be everywhere we need to be. In order to get things done, we have to learn to let go and let others assist us. It is the only way we can focus on those tasks to which we uniquely add value - versus tasks that one does well but that others are able to do. Letting go can be hard at first.

We sometimes feel like the tasks or projects in front of us our are babies or our special challenge to overcome. Initially, we may feel like we are the only ones who can do the job properly. But, other people can get the job done. It is hard at first but as time goes on it gets easier. (Retrieved on 21.9.2015, please visit for detail, available from http://www.theairlinepilots.com/forum/viewtopic.php?p=853&sid=f89e81f7e590ee23685aaec0ae85941d). Success of a software engineering endeavor depends upon positive interactions with stakeholders. They should provide support, information, and feedback at all stages of the software life cycle process. Therefore, it is vital to maintain open and productive communication with stakeholders for the duration of the software product's lifetime. (SWEBOK 3.0, 2014, p. 200).

Tam & Duly (2005) highlight that differences exist between western and non-western crews in attitudes, working practices, behavior, responsibilities and roles. They note that these differences will have global implications for training, safety and communications in aviation operations. It was found that current research of human factors in the flight deck generally used participants from Europe or America, suggesting it did not take into consideration human factor issues in non-westernized countries and flight decks with a mixture of both.

Multicultural environments can have an impact on the dynamics of a group. This is especially true when the group is geographically separated or communication is infrequent, since such separation elevates the importance of each contact. Intercultural communication is even more difficult if the difference in time zones make oral communication less frequent.

Multi-cultural cockpits will also come into strife with communicating when it comes to the different power gradients they might have been brought up in. In cultures with a high power gradient, not much information is shared between team members, especially not with subordinates. Effective communication is vital for the safe operation of an aircraft. This means that all information needs to be shared amongst the crew. If a co-pilot comes from a country with high power distance for example, Malaysia (Clearly Cultural, 2009), then they are less likely to share information with their Captain. If the captain comes from a culture of low power distance then they would be expecting a better sharing of information.

This lack of communication and understanding can lead to poorteam work (Anderson, et al, 2001)which in not an ideal situation on the flight deck. (Quated from the Flight Safety Foundation (2003)claim that without friendly chatter amongst flight crew, boredom can become a problem; this boredom can then lead to undesired flight states. If the crew is made up of different cultures then they may be uncomfortable or even unable to engage in friendly conversation to deter boredom.

Power distance can also be a problem when the crews are from the same culture. If their culture is one of high power distance, then the Captains decisions are not questioned nor will he or she ask for advice from their First Officers. There has been a strong correlation found between countries with high power distance and the occurrence of plane crashes (Woessner, 2009). This could be due to a severe lack of effective communication between the flight crews.The power distance in the cockpit needs to be understood and recognised by not only the flight crew but also management. Where multi-cultural crews are concerned, efforts need to be made to reduce the power gradient so, while the Captain still retains authority, the First Officers feel comfortable, are willing and able to communicate with their Captains.

For example is true for the captain pilot and co-pilot conversation in the cabin during control period in cockpit, before take off the plain. In a glass-cockpit aircraft, communication between the crew as pilot and co-pilot do not lose its importance. If this couple is from different cultura or different nationality, success in achieving the objectives of a message requires in their communication exactly should be matching of verbal, non-verbal and contextual meanings. With regard to communication in a cockpit, we can say that communication uses up resources, thus limiting the resources allocated to work in progress for them.

Decisions are taken by the captain, but prepared by the cabin crew fluid, consensual boundaries exist in regard to leadership-style, which fluctuate between authority and laissex-faire (Retrieved on 21.9.2015, please visit for detail, and also available fromhttp://www.theairlinepilots.com/forum/viewtopic.php?p=853&sid=f89e81f7e590ee23685aaec0ae85941d please vist for detail)

Also, Captain Pilot and ground tower communication should be so clear during take off and take on times between them successfully must base on crew performance being as perfect meta-communicably conversation as indicated here an example of conversation pilot and ground tower at Istanbul Ataturk Airport(Istanbul, Turkey) Ground Tower:

"Pilot/Yeşilköy Ground TCAUF (Tango Charlie Alpha Uniform Foxtrot) Request start up with information Alpha

Pilot/ Ataturk Ground TCAUF (Tango Charlie Alpha Uniform Foxtrot) received information Alpha request start-up

ATC/ TCAUF Yeşilköy Ground start-up approved

Pilot/ Ataturk Ground TCAUF Roger starting Engines". (Ergul, 2009, p. 101)

If does not realize carefully that verbal conversation as mentioned above, it can be reason of the problem, even for terrible accident or crash. The typical example is Tenerife Airport Accident in 1977. Wrong usage of the standard conversation during take ff has been a reason for die 583 person between pilot and ground tower (Retrieved on 16.10.2015http://aviationsafety.netplease visit for detail).

Source: (Retrieved on 16.10.2015 http://aviationsafety.net please visit for detail).

Another example here is between pilot and ground tower about giving action to the pilot: If Ground tower let to the pilot for action message, the pilot has to do reply again the same message to the Ground tower. Maybe this is meaningless for us but this reply is very important for them that message is taken clearly or not for apply given action.

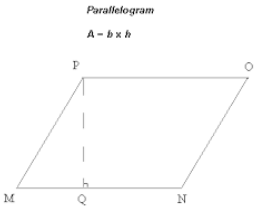
Pilot/Atatürk Airport Ground TCAUF ready to taxi (Yeşilköy Meydan TCAUF Taksi'ye hazır)

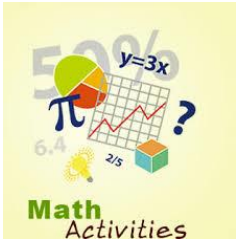
Pilot/Atatürk Airport Ground TCAUF request taxi

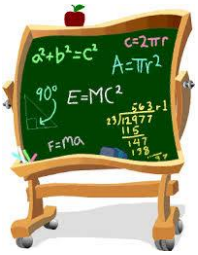
ATC/ TCAUF Atatürk Airport Ground taxi to holding point runway zero six

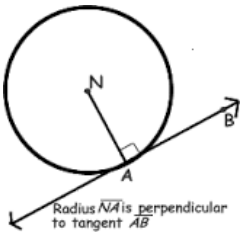
Pilot/ Atatürk Airport Ground TCAUF roger taxi to holding point runway zero six. (Ergul, 2009, p. 102)

More frequent communication, including face-to-face meetings, can help to mitigate geographical and cultural divisions, promote cohesiveness, and raise productivity. Also, being able to communicate with teammates in their native language could be very beneficial.It is vital that a software engineer communicate well, both orally and in reading and writing. Successful attainment of software requirements and deadlines depends on developing clear understanding between the software engineer and customers, supervisors, coworkers, and suppliers.Let's have look deeper to examples from the math course world. Usually 2x2 is 4 on2+2=4 in every corner of the world or to take area of square into consideration can be formulating square of on side length in everywhere(Demiray, 2010).

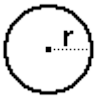




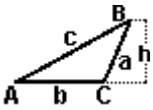


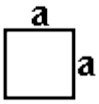


If formula of square' area indicates or shows, it means computing of square' area in any language, even change of the length of the sides does not chance way of computing of square' area. Only numbers change and formula stay in the same body. When we sow formula of square' area, we think and animate in our mind that square' area is equal to one side's square. These formulas are bringing a picture to our mind as automatically.

for circle = 

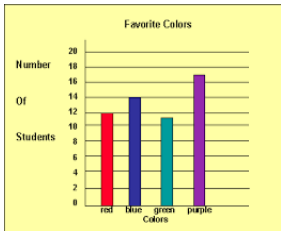
πr^2

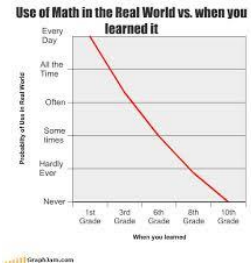
triangle=	$\frac{1}{2}(bh)$		one half times the base length times the height of the triangle

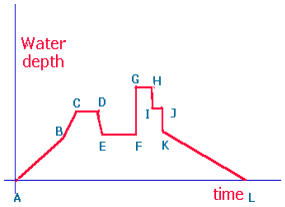
For area of square = a^2, 

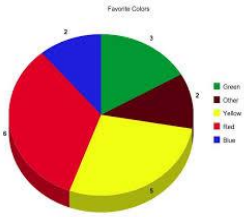
for area of rectangle = ab

They known by us or we had imitated this formulas in math course around 4th primary level education. We still remember these formulas as certain concept in picture form. It is just like traffic signs. Some formulas are important for life science have the same importance for our daily life, so we do not forget them any time. We use them automatically such as reflex. These are examples from the certain life science which learned at certain education level in our education life.Some graphs are tell us very briefly what is happening in the diagram on some increasing success, increasing producing, increasing for population or decreasing success, decreasing producing, decreasing dead rate, increasing birth rate and increasing child dead rate etc.









On graphing functions, with examples, try to give detailed info and matched mentioned subjects. The properties of the graphs of linear, quadratic, rational, trigonometric, absolute value, logarithmic, exponential and piecewise functions are analyzed in details. Detailed info and explanations to the examples are included. As seen in these examples we do not need to talk or tell much. Concepts such as asymptotes or colors for graphs of rational, logarithmic and exponential functions are explored numerically. It gives the main idea in general info at initial seeming. They help us to tell very complex results in basic and brief explanation. Asymptotes, colors, legends and charts have their own meanings which are decode in our mind immediately. This decoding tells us correlations and differentiations with each other.

Another example deals with etiquettes. Etiquettes are practicing in good manners or to know how to behave in given situation and to know how to interact with the people or others. Proper etiquette helps you make a great first impression and stand out in a competitive with others. From point of communication science, etiquettes have meta comommunical function in communication process. In this process etiquettes are verbally have a meaning dealt with what you say and how you say it and nonverbally Etiquette has a handshake, posture, eye contact, facial expressions meaning. In other words etiquette is defined as the forms, manners, and ceremonies established by convention as acceptable or required in social relations, in a profession or in official life. The importance of etiquette is to learn displaying a knowledge of proper etiquette helps make a wonderful first impression, whether in a business or personal setting.

Also, having good manners makes you more confident of yourself in situations that may otherwise be more difficult to relax in.

Optimal problem solving is made possible through the ability to investigate, comprehend, and summarize information. Customer product acceptance and safe product usage depend on the provision of relevant training and documentation. It follows that the software engineer's own career success is affected by the ability to consistently provide oral and written communication effectively and on time.

Reading, Understanding, and Summarizing

Software engineers are able to read and understand technical material. Technical material includes reference books, manuals, research papers, and program source code. Reading is not only a primary way of improving skills, but also a way of gathering information necessary for the completion of engineering goals. A software engineer sifts through accumulated information, filtering out the pieces that will be most helpful. Customers may request that a software engineer summarize the results of such information gathering for them, simplifying or explaining it so that they may make the final choice between competing solutions.

Reading and comprehending source code is also a component of information gathering and problem solving. When modifying, extending, or rewriting software, it is critical to understand both its implementation directly derived from the presented code and its design, which must often be inferred.

Writing

Software engineers are able to produce written products as required by customer requests or generally accepted practice. These written products may include source code, software project plans, software requirement documents, risk analyses, software design documents, software test plans, user manuals, technical reports and evaluations, justifications, diagrams and charts, and so forth. Writing clearly and concisely is very important because often it is the primary method of communication among relevant parties. In all cases, written software engineering products must be written so that they are accessible, understandable and relevant for their intended audience(s).

Software engineers rely on their presentation skills during software life cycle processes. For example, during the software requirements phase, software engineers may walk customers and teammates through software requirements and conduct formal requirements reviews (see Requirement Reviews in the Software Requirements KA). During and after software design, software construction, and software maintenance, software engineers lead reviews, product walkthroughs (see Review and Audits in the Software Quality KA), and training. All of these require the ability to present technical information to groups and solicit ideas or feedback.

The software engineer's ability to convey concepts effectively in a presentation therefore influences product acceptance, management, and customer support; it also influences the ability of stakeholders to comprehend and assist in the product effort. This knowledge needs to be archived in the form of slides, knowledge write-up, technical whitepapers, and any other material utilized for knowledge creation(SWEBOK 3.0, 2014, p. 201-202).

Off shoring means executing a business activity beyond sales and marketing outside the home country of an enterprise. Outsourcing is site-independent. The supplier can reside in the neighborhood of the enterprise or offshore (outsourced off shoring).

For instance, using an outsourcing supplier for software development and maintenance might reduce the cost per hour of software development, but increase the number of hours and capital expenses due to an increased need for monitoring and communication.

Written communication is also extensively used in air transport operations, such as flight deck documentations which included operation manuals, check liksts, data cards etc, and these are all a part of daily flight operations. It is a one way communication, the checklist or documents send the information but it is up to the pilots to interpret the message and then take actions based on their understandings

(Picture embedded from Game Pressure on 10.10.2015)

Team and Group Communication

Effective communication among team and group members is essential to a collaborative software engineering effort. Stakeholders must be consulted, decisions must be made, and plans must be generated. The greater the number of team and group members, the greater the need to communicate. The number of communication paths, however, grows quadratically with the addition of each team member. Further, team members are unlikely to communicate with anyone perceived to be removed from them by more than two degrees (levels). This problem can be more serious when software engineering endeavors or organizations are spread across national and continental borders. Some communication can be accomplished in writing. Software documentation is a common substitute for direct interaction. Email is another but, although it is

useful, it is not always enough; also, if one sends too many messages, it becomes difficult to identify the important information.

One of the fundamental principles of a good requirements elicitation process is that of effective communication between the various stakeholders. This communication continues through the entire Software Development Life Cycle (SDLC) process with different stakeholders at different points in time. Before development begins, requirements specialists may form the conduit for this communication. They must mediate between the domain of the software users (and other stakeholders) and the technical world of the software engineer. A set of internally consistent models at different levels of abstraction facilitate communications between software users/stakeholders and software engineers. (SWEBOK 3.0, 2014, p.36).

It is typically necessary to validate the quality of the models developed during analysis. For example, in object models, it is useful to perform a static analysis to verify that communication paths exist between objects that, in the stakeholders' domain, exchange data.

If formal analysis notations are used, it is possible to use formal reasoning to prove specification properties. Applying external or internal development standards during construction helps achieve a project's objectives for efficiency, quality, and cost. Standards that directly affect construction issues include communication methods (for example, standards for document formats and contents).(SWEBOK 3.0, 2014, pp. 68-69).

Construction languages include all forms of communication by which a human can specify an executable problem solution to a problem. Programming languages are the most flexible type of construction languages. They also contain the least amount of information about specific application areas and development processes -therefore, they require the most training and skill to use effectively. The choice of programming language can have a large effect on the likelihood of vulnerabilities being introduced during coding- for example, uncritical usage of C and C++ are questionable choices from a security viewpoint.

Organizational aspects describe how to identify which organization and/or function will be responsible for the maintenance of software. The team that develops the software is not necessarily assigned to maintain the software once it is operational. Communication management is also often mentioned as an overlooked but important aspect of the performance of individuals in a field where precise understanding of user needs, software requirements, and software designs is necessary.(SWEBOK 3.0, 2014, p.134).

Communication tools can assist in providing timely and consistent information to relevant stakeholders involved in a project. These tools can include things like email notifications and broadcasts to team members and stakeholders. They also include communication of minutes from regularly scheduled project meetings, daily stand-up meetings, plus charts showing progress, backlogs, and maintenance request resolutions.

2. Literature Review

Meta-communication studies in Computer Science mostly are related to Human Computer Interaction (HCI) and Semiotic Engineering. Semiotic perspectives on HCI take human-computer interaction as a special case of computer-mediated human communication.

Through the interface, systems designers communicate to users their design vision as well as how the system can or should be used for a variety of purposes. To date, there hasn't been enough empirical research in HCI exploring this complex phenomenon.

This paper "Meta-communication and Semiotic Engineering: Insights from a Study with Mediated HCI" reports an empirical research about meta-communication in HCI and discusses how and why semiotically-inspired research can contribute to advance knowledge in this field (Ingrid Teixeira Monteiro, 2013).Another area related to meta- communication is values and culture in interactive systems design. Depending on the way technologist designed, it will afford behaviors that are intrinsically related to individuals and the complex cultural context in which they are using it (Jennifer, J. Et al., 2013).

Individuals will interpret and behave through the technology influenced by the cultural systems (e.g., values, beliefs, behavioral patterns).Their behavior may be in disagreement or agreement with their values and the values of other people. This, in turn, will promote or inhibit certain values over others.The meta-communication research in Software Engineering is also related to the integration of architectures, protocols, and systems.

It is argued that meta-communication, i.e. communication about communication rules, is a general integration methodology that is applicable to the integration of architectures, protocols, and systems. Efforts towards the development of an automated methodology for meta-communication are discussed. The authors view meta-communication as a design problem. Meta-communicating entities exchange partially specified communication rules. Each entity, or a meta-communication center, applies a standard composition principle on the individual partially specified rules in order to derive the complete protocol architecture (Meandzija, B., 1990).Some authors study cultural values in Software Engineering as meta-communication entities (Pereira, Baranauskas, & Almeida, 2011; Pereira & Baranauskas, 2015). Value-oriented and Culturally Informed Approach (VCIA) to sensitize and support Computer Science and Engineering professionals in taking values and culture into consideration through out the design of interactive systems.

Over the next few years, the robotics industry is aspiring to introduce more 'service' robots into shopping centers, hospitals, schools; elderly-care facilities and other public places. But what happens when people come face to face with actual robots? How do they establish and sustain connections with their new autonomous friends?

The imaginary representations from science fiction and popular culture are no guide. Interactions with even the most advanced current robots are generally quiterudi mentary. Formal studies of Human Robot Interaction (HRI) are now common in engineering, design and social robotics; seek technical solutions to enhancing robots' social skills. However, these typically follow instrumental strategies rather than understanding the situated dynamics of interaction. In this paper I ask how approaches in the broad tradition of media studies might help analyze robots as media, and particularly how humans and robots establish the conditions for communication through meta-communication.

Approaching a new robot, people will seek cues to help establish what kinds of relationship they might form with it. Is this a social actor or a machine? What is this body capable of? This inquisitiveness is necessary in processes of 'meta-communication', which Bateson explores in the classic work of cybernetic media psychology and anthropology;meta-communication is communication about communication. It helps regulate communication between animals, humans, and (I will argue) machines.

FURO's physical design communicates even before she is switched on. She is a full-scale humanoid capable of complex movements in the head and neck. Her arms move the screen up and down, and she can bow at the waist. Her profile is a stylized maternal body, with a wide rigid plastic skirt descending from broad hips, and minimal hint of breasts. She communicates with visitors through a combination of modes: movement, flashing lights and speech both attract and communicate.

Here the importance of meta-communication in the asymmetrical interactions between human and robot actors as an example of robot media studies. The black-boxed robot FURO robot performed an ongoing

modulation of meaning swith Robot world visitors; the approach is grounded on theoretical and methodological bases of Organizational Semiotics, Building Blocks of Culture, and Socially Aware Computing.

FURO at Robotworld:
Human-robot meta-communication and robot media studies.
Source of Robot FURO. Retrieved on 19.10.2015 and also avaiable from
https://www.google.com.tr/search?q=robot+FURO&biw=1113&bih=594&tbm=isch&tbo=u&source=univ&sa=X&ved=0CBkQsARqFQoTCIG3jbL928gCFYqPcgodeZMJUw

Here the importance of meta-communication in the asymmetrical interactions between human and robot actors as an example of robot media studies. The black-boxed robot FURO robot performed an ongoing modulation of meaning swith Robot world visitors; the approach is grounded on theoretical and methodological bases of Organizational Semiotics, Building Blocks of Culture, and Socially Aware Computing.

The reflective practice becomes more important the more the differences in technologic standards, social values, norms, assumptions and interests, etc. in global contexts interfere the sphere of the Information Systems Development (ISD).

The paper (Yetim 2004) extended the framework for reflective practice proposed by Ulrich (2001). Three different types of meta-communication are described:

- Ex ante meta-communication (taking place before action),
- Meta-communication in action (taking place during action), and
- Ex post meta-communication (taking place after action).

The meta-communication model itself consists of two levels:

- Clarification level (where conversation for clarification takes place). At this level there are eleven clarification issues to be reflected on.
- Discourse level (where the discursive examination of contested claims takes place). At this level, there are eight discourses, which are related to the clarification issues.

In his work Ulrich suggested philosophical staircase of ISD. The philosophical staircase is a conceptual framework that arranges basic philosophical issues of ISD in a flight of stairs that can be taken step by step, although each consecutivestep depends on all the previous ones.

Table 1: Three core philosophical problems posed by information systems design

Core concept	Basic issue	Basic theory
"Information"	**The philosophical step from symbolic systems to "information"** How do we know that some signal or message (a stream of signs or symbols) represents information?	***Semiotics:*** the theory of signs and symbols ≠ "information theory"
"Knowledge"	**The philosophical step from information to "knowledge"** How do we know that some information represents valid and relevant knowledge?	***Epistemology:*** the theory of knowledge ≠ "science theory"
"Rational" action	**The philosophical step from knowledge to "rational" action** How do we know that the knowledge we rely on is conducive to rational action?	***Practical philosophy:*** the theory of rational action ≠ "applied science"

Source: Ulrich, W. (2001). A Philosophical Staircase for Information Systems Definition, Design and Development. *Journal of Information Technology Theory and Application* 3(2001), 55-84.

3. Methodology of the presentation

The methodology of the presentation is a heuristic application of TOGA (Top-down Object based Goal oriented Approach).TOGA is the goal-oriented knowledge ordering (conceptual modeling) tool for the specification and system/process identification (s/i) of real-world complex problems.

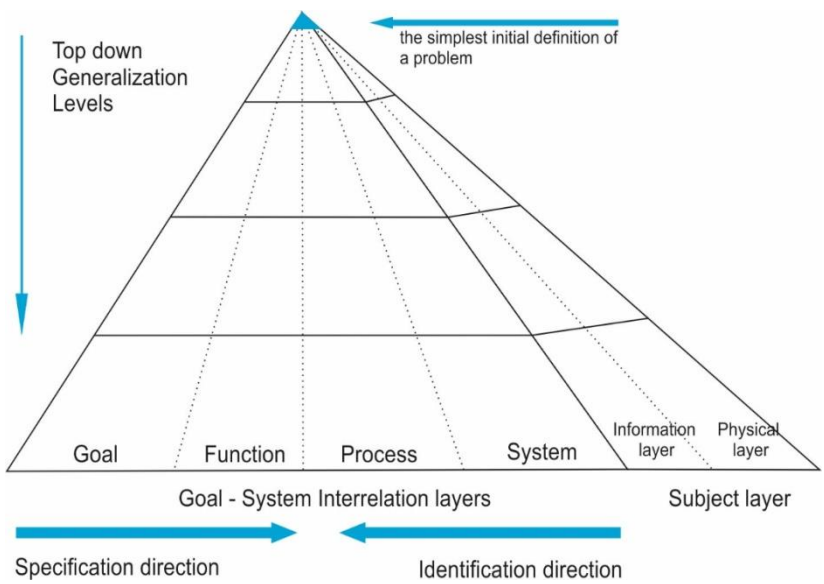


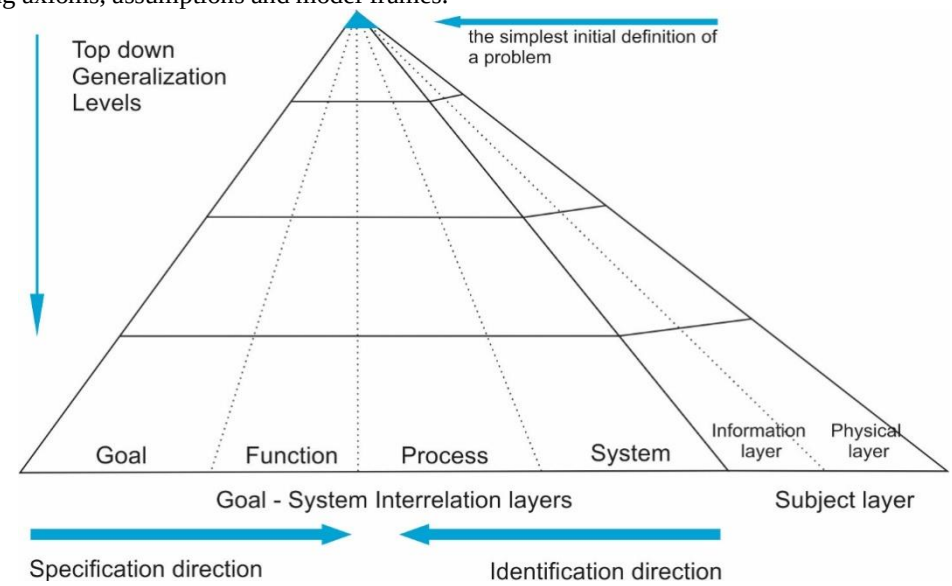
Figure 2. The methodology of the presentation is a heuristic application of TOGA.

Source Gadomski, Adam Maria.*TOGA: A Methodological and Conceptual Pattern for Modeling Abstract Intelligent Agent* [online]. "First International Round-Table on Abstract Intelligent Agent", Rome : ENEA, 25-27 January 1993. [cited 2009-04-27]. Available: http://erg4146.casaccia.enea.it/wwwerg26701/AIA-toga3.pdf.

In such sense, it can be seen as an initial top/generic and axioms-based meta-model, and subsequently, the methodology of problem decomposition and specialization using available knowledge.

Top-down means: From most general minimal information on a problem to its detailed specification/identification (s/i). Such approach enables a control/check of the completeness and congruence of s/i in every problem specialization step.

It requires an initial sufficient amount of information, knowledge and preferences related to the problem, their subsequent acquisition during the problem s/i, and the additional specialization patterns assembled in TOGA as Knowledge Ontology Conceptualization System (KNOCS). KNOCS includes top: meta-modeling axioms, assumptions and model frames.



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Object-based indicates a fundamental conceptualization platform of the meta-theory, called the Theory of Abstract Objects (TAO). It is not object-oriented, it assumes that every problem can be represented using the frameworks of world of abstract objects and these worlds universes. The concept of abstract object is defined as everything what can be conceptualized as (<names>,<attributes list>, <values>). Attributes result from objects relations and the change concept. This assumption consists of the primary axiom of the perception of the real world and is considered as the basis of the conscious reasoning of an intelligent entity/agent.

Goal-oriented; it is equivalent to goal-driven, goal-based, goal-directed, teleological and similar approaches, where the methods and methodology applied, in the real-time of the problem solving,

confront the attributes of the pre-defined activity/design goal with those which result from candidates on the problem sub-models.The dominating top-goal is defined from the socio-cognitive perspective, and it is always the goal of the human or artificial problem solver, decision-maker or designer.

The goal-oriented and top-down rules of s/i are included in the Methodological RUles System (MRUS)- the third TOGA component(Gadomski, 1997).For software engineers, TOGA aims to provide the designer of complex engineering system, an intelligent-agent-based conceptualization with a structured set of methods and rules to allow him to control top-down and goal-oriented conceptual modeling process/activity. It enables to specify formally agent-based systems that can be implemented within an agent-based programming platform.

For such tasks, TOGA also provides a global identification and design methodological framework for human-computer intelligence-based systems. Its level of meta-formalization, top-down and goal-oriented requirements enable together to cope with a symbolic (not a sub-symbolic) design and to develop a general incremental intelligence (an abstract or synthetic intelligence).From the top systemic meta-philosophical perspective, the TOGA computational philosophy is funded on the set of meta-assumptions/meta-axioms leading to the plausible motivations and choices of the TOGA axioms. Using philosophical terminology;

- TOGA is holistic (top-down) and teleological (goal-oriented).
- TOGA is goal-oriented, therefore «objective reality are not taken into account" (Husserl).

TOGA is composed with three basic components:

- ontological,
- epistemological and
- axiological (including ethics).

Its main reference-point is a subjective perspective of an intelligent;entity, i.e. it assumes that humans acts on the base of always limited available domain-knowledge, therefore every intelligent; agent/entity has his/her/its individual philosophy and it evolves according to their dynamics and different fusions into intelligent aggregates.

"How We Use Former Science Concepts by Accepting and Unquestioning To Produce"a New Knowledge as an Expert Our Profession?

Knowledge is found in the minds and bodies of thinking beings (Johnson, 1987). Learning is the construction of knowledge by individuals as sensory data are given meaning in terms of their prior knowledge. It is an interpretive process, involving constructions of individuals and social collaboration (Tobin, Briscoe, & Holman, 1990, p. 411).Dynamic models of meta-communication are discussed in the book (Demiray, Kurubacak, Yuzer, 2012). The concepts of the meta-communication model are mainly based on Avatar Manager and Student Reflective Conversations pedagogical theory.

Created software of meta-communication Model is applicable for using in virtual education process and in virtual research collaboration (Alexander, G. O., 1972). It works at several universities for the development of avatars and has significant potential to enhance realism, automation capability, and effectiveness across a variety of training environments.

What are the clear and brief examples and how of using meta-communication actors or samples in engineering sciences? Like human-machine interaction, computer and human interaction or in pure science text how we understand and tell the thoughts, knowledge, expressing, formulas?

As analytical categories, genres have traditionally occupied a middle ground-between media as technologies and institutions, on the one hand, and discourses as material and modal forms of expression and interaction, on the other.

With digitalization, the very concept of genre is in doubt: is the world wide web (WWW), Facebook, or the writing on its walls the genre? New, digital media return the field to classic questions, for one thing, about genre. In retrospect, genre studies have witnessed a growing differentiation of their domain of study, following the equally differentiated development of print, electronic, and digital media as technologies and institutions -from dramatic, epic, lyrical, and didactic prototypes; via the genre systems of nineteenth-century print fiction and twentieth-century Hollywood cinema; to the current variety of genres across one-to-one, one-to-many, and many-to-many communications.

'Going meta,' in one sense, could be seen an evasion of issues that arise from classic typologies of genre- and of media and texts.

In another sense, a consideration of meta-genres represents an acknowledgment that digitalization shifts some of the conceptual boundaries that used to work for spoken, written, print, and electronic communication.

We might like to map a 2.0 version of media-genre-text hierarchies and theories onto the digital media environment; we just do not have them-yet. In the meantime, humanistic media and communication researchers, who have traditionally given special attention to genre as a qualitative phenomenon, may take advantage of the digital media environment, also as a tool of analysis.

Genres give off clues that can be counted, analyzed, and visualized through socalled data mining (Han & Kamber, 2006). Genres constitute patterns of information and communication; as such, they indicate structures in the production and circulation of meaning across time and space. One recent study examined "a corpus of digitized texts containing about 4% of all books ever printed" in order to "investigate cultural trends quantitatively," documenting changes in, for example, language use, the understanding of fame, and the practice of censorship between 1800 and 2000 (Michel et al., 2010). Genres are among the most stable indicators of communication and culture, and invite comparative studies of how different periods and societies have chosen, and been able, to communicate. One way of understanding present meta-genres would be to mine past genres.

The project manager must know the communication processes involved in effective project management. First of all there should be planning to determine what information needs to be communicated to all stakeholders in the project.

Next, that information must be made readily available to the stakeholders and generated in a timely fashion. Performance must also be accounted for by reporting the project status, measuring progress and forecasting.

Finally, communication with project stakeholders must be managed so that all requirements are met and issues are promptly resolved. Interactions and overlap among the communication processes are inevitable and expected throughout all phases of project management.

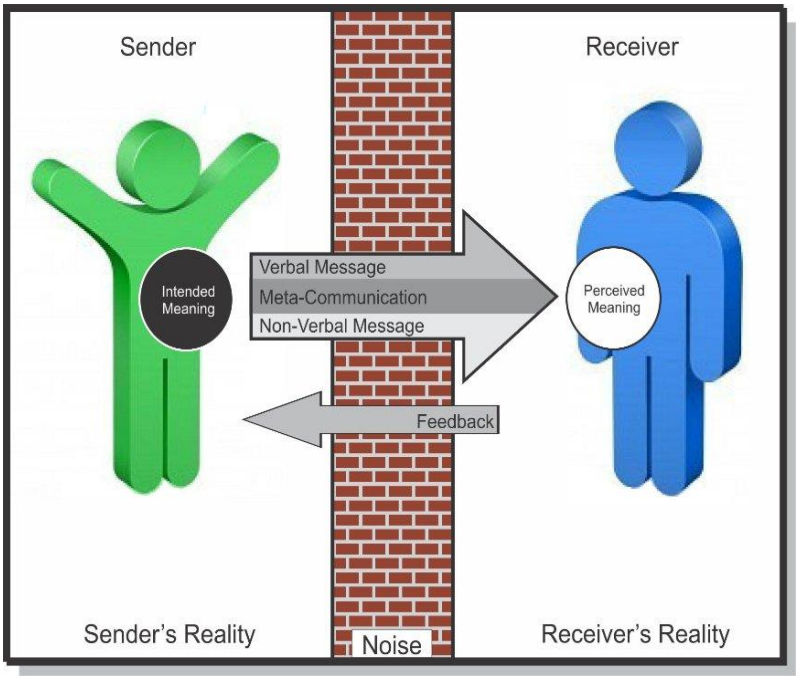

Figure 3. Typical communication process
(Source: https://www.linkedin.com/pulse/20140503151654-23626116-effective-communication-model retrieved on 6.10.2015)

Here are several examples of Software Engineering activities related to different communications:

- Communication: face-to-face vs. email: Through all phases of project management there must be effective communication taking place. The method of communicating is a question...
- Communications Planning: Communications planning is the process in which the specific directives that will appear on the final communication management plan are...
- Avoid Communication Pitfalls In Project Management: One of the most complex and challenging aspects of project management is undoubtedly communication. Unlike other factors that can be...
- Project Management Glossary Tips Project management has a language all its own that is sometimes opaque to outside parties. Find glossary creation tips here....

This is a model of the communication process including sender, receiver, verbal and non-verbal communication, meta-communication, feedback and noise.

Effective communication means that each and every project team member should be fully apprised of the project status (at least on a macro level) at all times. Project managers make careful plans to outline who receives which communications, who is responsible to deliver and respond to communication content, and how and when communications will be delivered.

These details are summarized in a communications plan, which is created during in the planning phase. Communications plans are then executed and monitored over the course of project implementation.

Communication Requirements

Some of the most non-productive time spent on a project can be meetings. Take a tip from professional business process engineers on conducting meetings (Gaitros, 2004).This research looks to improve software quality in a new way by assuming that human error is a key cause of software defects.

Research from cognitive psychology is used to develop a deeper understanding of the human errors that occur during the software development process and to develop techniques that detect and prevent those errors early in the software development lifecycle. Early elimination of mistakes will improve software quality and reduce overall development cost. (Carver, Walia, 2014).

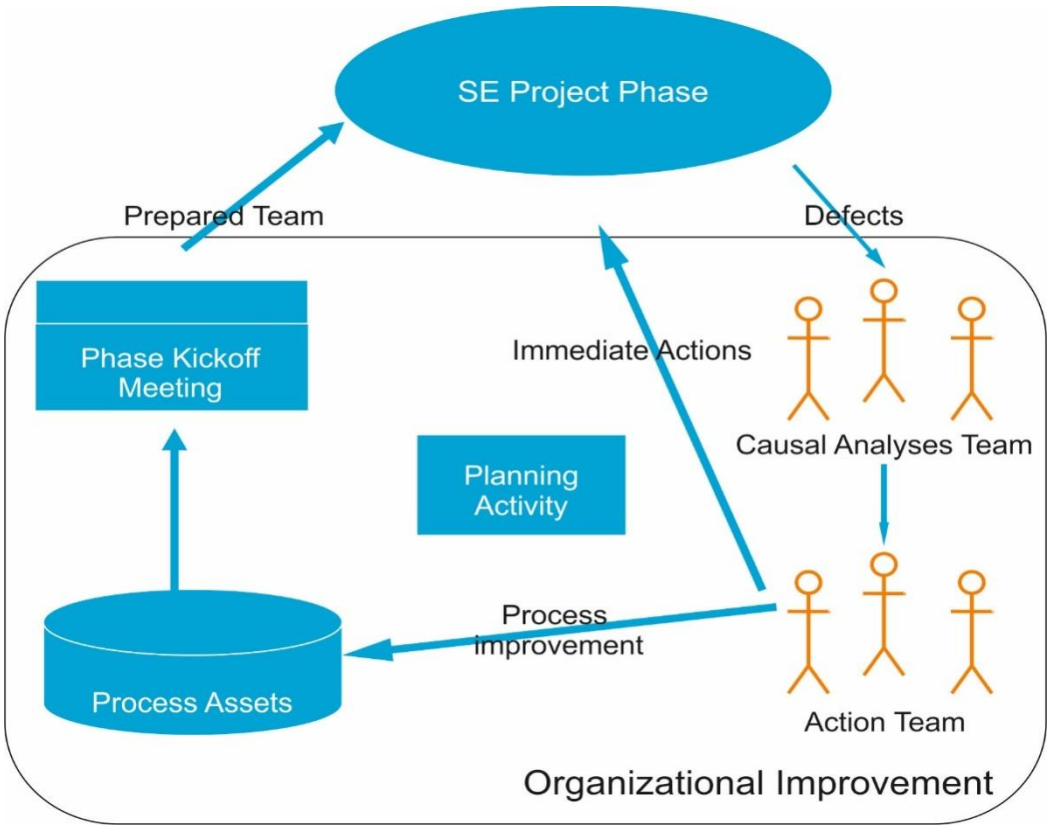

Figure 4. Defect Prevention Process in Software Engineering.
(Note: Is originally developed by authors)

Introduction of new intellectual SE tools could completely change the scheme of communication in IT Project. For example, MIT computer scientists (Conner-Simons, 2015) suggested CSAIL's "Helium" tool for bit-rot problem solving. Bit rot is the slow deterioration in the performance and integrity of data stored on storage media.

This new computer program can automatically fix old code so that engineers can focus on more important tasks. CSAIL's "Helium" system revamps and fine-tunes code without ever needing the original source, in a matter of hours or even minutes.

The second case consider the human being (test engineer, developer) to be outside communication process for decision making and bug fix implementation.So we will have two different schemes of communications (see figure5).

TOGA is the goal-oriented knowledge ordering (conceptual modeling) tool for the specification and system/process identification (s/i) of real-world complex problems.

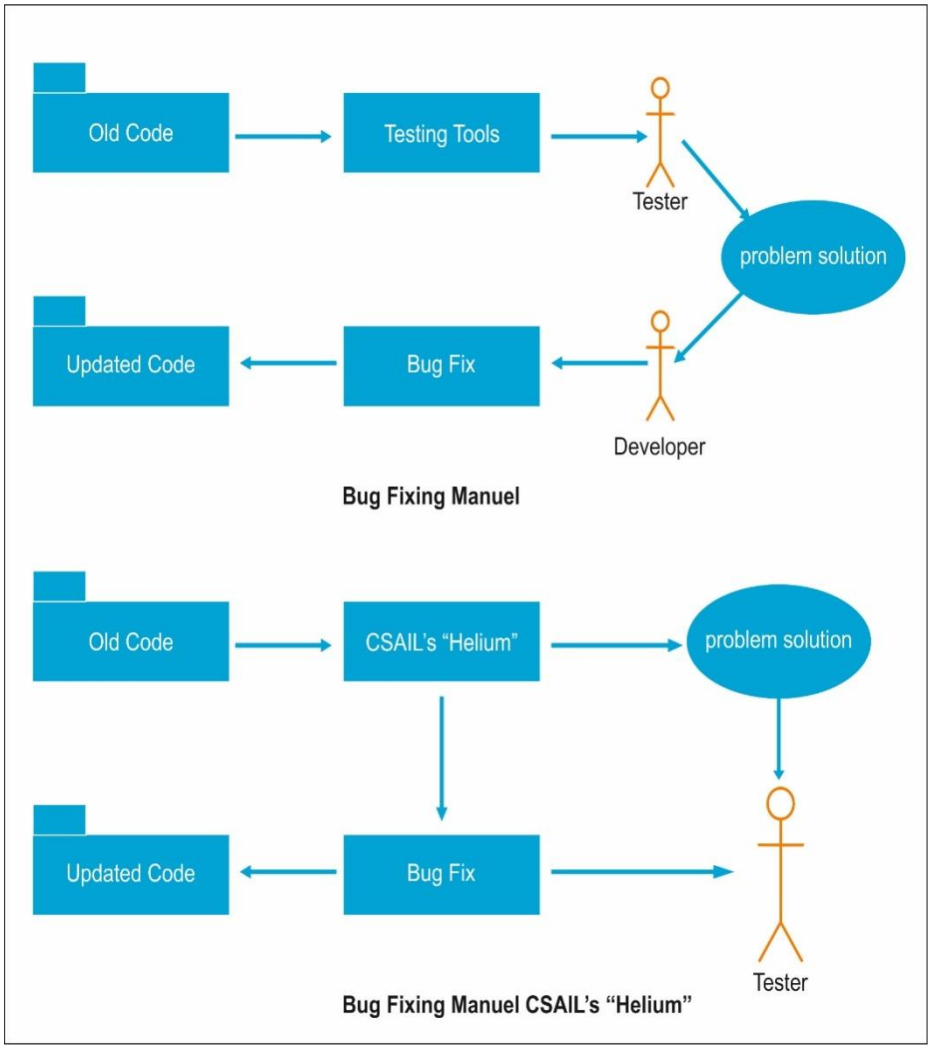

Figure 5. Two communications schemes for manual and automated code fixing.
(Originally it is suggested by authors)

In such sense, it can be seen as an initial top/generic and axioms-based meta-model, and subsequently, the methodology of problem decomposition and specialization using available knowledge.

Top-down means: From most general minimal information on a problem to its detailed specification/identification (s/i).

Such approach enables a control/check of the completeness and congruence of s/i in every problem specialization step.

It requires an initial sufficient amount of information, knowledge and preferences related to the problem, their subsequent acquisition during the problem s/i, and the additional specialization patterns assembled in TOGA as Knowledge Ontology Conceptualization System (KNOCS). KNOCS includes top: meta-modeling axioms, assumptions and model frames.

There are also several key components in project communication management which should be considered. Encoding or translation makes sure everyone understands what is said.

The output of that encoding is the message which is conveyed through a medium. Interference with the message is called noise and finally, the message must be decoded to have meaning for all involved.

4. Conclusion and Recommendations

Communication is an essential process in the world of project management (and for that matter the world in which we all live on a day to day basis). It is difficult to master, but essential to make a good effort in achieving.

The key to getting the best output is communicating with all the members of the team. This is also when you discuss the steps of strategy process and they have a clear understanding of what you are doing. There should be no surprises for them. This communication can be with target audience, stakeholders, management team etc. in various different forms.

In this paper, we have described a Meta-communication model, which extends the spectrum of earlier discussed approaches to Meta-communication modeling for Software Engineering processes.

Communication in global context remains a challenge and the value-consensus formation nearly impossible in the short run. Suggested model provides a way for systematically and meaningfully structuring and organizing meta-level conversations within IT projects.

Thus, it can be used in several Software Engineering processes, in order to enable effective meta-communication. It is argued that meta-communication, i.e. communication about communication rules, is a general integration methodology that is applicable to the integration of architectures, protocols, and systems.

Efforts towards the development of an automated methodology for meta-communication are discussed. The authors view that meta-communication as a design problem.

Meta communicating entities exchange partially specified communication rules. Each entity, or a meta-communication center, applies a standard composition principle on the individual partially specified rules in order to derive the complete protocol architecture.

A report is presented on an existing implementation of the meta-communication mechanism and on translators that transform the resulting specification into C code.

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