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A Need Hierarchy for Teams



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October 2004

ISR Technical Report # UCI-ISR-04-9

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Irvine, CA 92697-3425
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1 Introduction

Typical software development is a multi-team effort requiring coordination among developers. It has in fact been shown that about 70 percent of a software engineer's time is spent on cooperative activities [1]. Collaboration is thus at the heart of software development.

Research in collaboration has resulted in a host of collaborative tools and environments that support collaboration one way or the other. There are a number of classification frameworks that classify collaborative tools based on the capabilities of the tool or the coordination problem that they solve. These classification frameworks either focus on a particular aspect of collaboration (an area) or are frameworks for classifying a set of tools that belong to a particular area. The existing classifications and frameworks fail to provide an

overview of all existing approaches to collaboration and are inadequate in providing conceptual guidance to help users choose the right kind of tool.

In order to be better able to understand the collaboration technologies that exist and the problems that they address, we decided to take a step back and identify the needs that allow a team to function and excel. We adapt Maslow's hierarchy of needs for the individual from the psychology domain to create the collaboration needs of a software development team. The collaboration needs are categorized into five layers and correspond with the needs specified by Maslow. We have tried to stay as true to Maslow as possible.

The rest of the paper is organized as follows. Section 2 briefly describes Maslow's hierarchy of needs. We map the needs of the team in Section 3, and conclude in Section 4 with our observations.

2 Maslow's Need Hierarchy

Abraham Maslow is known for establishing the theory of a hierarchy of needs [2]. Maslow studied human subjects (exemplary people being Albert Einstein, Jane Addams, Eleanor Roosevelt, and Frederick Douglas) rather than mentally ill or neurotic people, which was radically different from the Freudian and Skinner schools of psychology. He claimed that human beings are motivated by unsatisfied needs, and that certain lower needs need to be satisfied before higher needs can be satisfied.

According to Maslow, there are general types of needs (physiological, safety, love, and esteem) that must be satisfied before a person can act unselfishly. He called these needs "deficiency needs." As long as an individual is motivated to satisfy these needs, he is on the path to growth ultimately reaching self-actualization (a growth need) once all the deficiency needs are met.

He further claimed that these needs are prepotent. A prepotent need is one that has the greatest influence over our actions. Every individual has a prepotent need that may vary among individuals. For example a teenager may have a need to feel that he/she is accepted by a group whereas a heroin addict will need to satisfy his/her cravings for heroin to function normally in society, and will not worry about acceptance by other people. According to Maslow, once a deficiency need is met at once other needs (needs at the same level or higher level) emerge, and these, rather than physiological hungers, dominate the organism. When these higher needs are in turn satisfied, again new (and still higher) needs emerge, and so on. In essence as one desire is satisfied, another

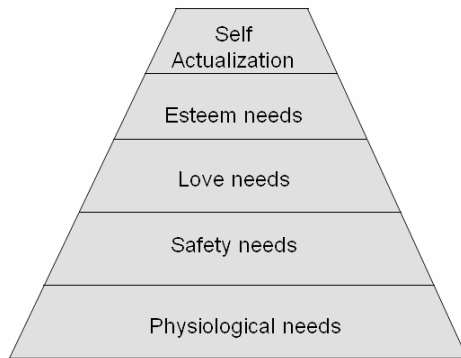


Figure 1. Maslow's Hierarchy of Needs

pops up to take its place.

The need layers in the hierarchy do not have strict transition points and the pyramid is mainly heuristic in nature. The five layers in the hierarchy of needs are explained as follows:

2.1 Physiological Needs

Physiological needs are the fundamental needs that allow an organism to survive. These needs include air, water, food, sleep, etc. If the individual does not satisfy the needs at this level,

they may be sick, in pain or in discomfort. Individual are thus motivated to alleviate them as soon as possible. Only once these needs are reasonably satisfied may one think of other things.

2.2 Safety Needs

Once the physiological needs are relatively well gratified a new set of needs that are mostly psychological in nature emerges.

Safety needs allow an individual to establish stability and consistency in a chaotic world. Needs that can be categorized into this layer are security; stability; dependency; protection; freedom from fear, anxiety, and chaos; need for structure, order, law, and limits; strength in the protector; and so on. For example an individual may need the security of a home and family before concerned about higher needs. However, if a family is dysfunctional (an abusive husband), the members in the family (the wife) cannot move to the next level as she would be constantly concerned for her safety.

2.3 Love Needs

Love and belongingness are next in the hierarchy. "The love needs involve giving and receiving affection. When they are unsatisfied, a person will feel keenly the absence of friends, mate, or children. Such a person will hunger for relations with people in general for a place in the group or family and will strive with great intensity to achieve this goal. Attaining such a place will matter more than anything else in the world and he or she may even forget that once, when hunger was foremost, love seemed unreal, unnecessary, and unimportant. Now the pangs of loneliness, ostracism, rejection, friendlessness, and rootlessness are preminent." ([2], chapter 20).

2.4 Esteem Needs

The esteem needs can be categorized into two types. First is self-esteem which results from competence or mastery of a task. Second, is the attention and recognition that comes from others. "All people in our society (with a few pathological exceptions) have a need or desire for a stable, firmly based, usually high evaluation of themselves, for self-respect or self-esteem, and for the esteem of others. These needs may therefore be classified into two subsidiary sets. These are, first,

the desire for strength, achievement, adequacy, mastery and competence, confidence in the face of the world, and independence and freedom. Second, we have what we may call the desire for reputation or prestige (defining it as respect or esteem from other people), status, fame and glory, dominance, recognition, attention, importance, dignity, or appreciation.” ([2], chapter 21)

This is similar to the belongingness level; however, wanting admiration has to do with the need for power. For example individuals who have all of their lower needs satisfied, would drive very expensive cars to raise their level of esteem.

2.5 Self-Actualization

The need for self-actualization is "the desire to become more and more what one is, to become everything that one is capable of becoming." People who have everything can maximize their potential. This need is a growth need and is attained once all the deficiency needs have been fulfilled. People at this level can now seek knowledge, peace, esthetic experiences, self-fulfillment, etc. Individuals at this level need to realize their potential to be at peace with themselves.

3 Team Needs

In this section we investigate the needs of a software development team. We treat the entire team as a single entity and do not distinguish roles within the team. Using the need hierarchy frame proposed by Maslow we get an insight into what are the fundamental needs for a team to function, what makes the team cohesive and how can the team be made more efficient.

We create a hierarchy comprising of the deficiency needs and the growth needs. The first four layers are namely fundamental needs, safety needs, belonging needs and Esteem needs. Once the needs at a particular level are satisfied the team needs to fulfill the needs at the higher level. Once all the deficiency needs are satisfied the team is free to address its growth needs and reach self-actualization.

As the requirements of an individual in a society are different from the collaboration requirements of a software development team the specific needs in a layer are different than that of the individual. In our mapping we have attempted

to be as true to Maslow as possible. The five layers in our hierarchy of collaboration needs for a team are explained in the following paragraphs. We further identify areas in software engineering that address the needs in each layer.

3.1 Fundamental Needs

The fundamental needs of a software development team would be the ability to create software artifacts and communicate with team members. These needs are sufficient to form the team and sustain communication between members. The team can use basic computing technologies like code editor, compiler and linker to create software programs. At this layer technology only supports implementation and testing in the software development life cycle. The rest of the software artifacts like requirements or design documents are created and maintained by the developers manually. Bare boned coordination facilities are provided by emails.

Research in systems programming provides solution to the needs at this layer. Basic text based email clients that allow attachments can serve the communication purposes at this layer.

3.2 Safety Needs

Safety for a team is different from the personal safety of an individual. We consider safety needs for the team as safety of the software artifacts that the team produces. The team at this point should be safe from hardware or system failures, mistakes from the team members, and malicious activities from outsiders. Server based storage (backups outside of personal machines) ensures safety against hardware failures to an extent. Versioning of artifacts ensures that if a team member makes a mistake the mistake can be rolled back. Access rights allow only authorized members to make changes and prohibit outsiders from breaking the software. Access rights (locking) also enable coordination within the team such that changes are not inadvertently over written. Antivirus programs and email encryption further helps in keeping the software artifacts from malicious hackers.

Configuration management systems [3] provide external storage, versioning and access rights facilities. There is considerable research in cryp-

tography and anti-virus system protection that deal with safety from malicious intent of hackers.

3.3 Belonging Needs

An individual in the society needs to feel accepted and have a sense of belonging to a group. The individual can perform better and strive for esteem needs once they know that they are loved. In the same vein the team needs to be close-knit and cohesive for the team members to feel accepted which enables them to further perform well. Belonging needs of the team can be separated into two tiers.

One is the belonging needs of an individual in the team and the other is the belonging needs of the team in the parent group (the department or the company). When a team is cohesive, it is easier for the members to approach others when they require help. Collaboration in the team is smoother and efficient when the members feel that they belong to the team and place the needs of the team over personal needs. Companies promote team building via company sponsored picnics, retreats etc. Unfortunately these activities are most effective when the team members are collocated. An example of the feeling of belonging to a team when the members are distributed is the strong allegiance that open source developers have for their projects [4].

The team is motivated to perform well and work towards the company's goals when they feel that their team is an important part of the company and belong to it. This sense of belongingness is usually fostered by company sponsored events, cross department meetings and stock and shares. An example of this sense of belonging would be when teams put in the affiliations of their parent company when they publish research papers. A software team would be proud to be associated with a well known parent company say, IBM Research labs.

As discussed earlier the feeling of belonging is currently based on collocation of the team members. There are a few technologies that allow distributed teams to be cohesive by allowing the members to interact with each other. Discussion forums and email lists enhance the feeling of belonging to a group as they foster the sense of a

community and soon the community members recognize each other via their email Ids. CSCW applications such as TeamRooms [5] , Instant messengers [6], Portholes [7], [8], JAZZ band [9], etc. promote cohesiveness in the team by allowing the team members to interact with each other either through their electronic profiles or social proxies.

3.4 Esteem Needs

The esteem needs of a team are similar to that of the individual in society. The team seeks to be competent and efficient so that it can gain the respect and prestige from others. At this stage the team would like to be known for solving hard problems; produce code that is elegant, cost effective and efficient; is known in the research community. To further this goal the team seeks to publish its artifacts (research papers, good documentation, articles in trade journals) to gain recognition from the user and research body.

The chief aim of project management is to allow optimum task assignment and easy task monitoring such that the team is efficient and is able to meet the development targets. There are a number of tools that aid project management. Software methodologies like code reviews, good design creation via UML or architecture strive to create good quality code. Recommendation systems and data-mining help new developers to quickly learn the system and start being productive. Net meeting and shared screen applications allow distributed developers to collaborate. Change management tools that track parallel changes allow developers create code with fewer conflicts. Formal methods and testing techniques like Junit testing, assertions, model based testing, etc., enable developers to create more robust software. Thus there is a multitude of tools and techniques both in software engineering and Computer Supported Cooperative Work that attempt to increase the efficiency of the team. In fact almost all research efforts (configuration management, groupware systems, recommendation systems, software architectures) are focused on needs at this layer.

3.5 Self-Actualization

At this stage the team is well recognized in the community and has the power to negotiate to

work on projects that the team wants to work on. The team has achieved self actualization.

4 Conclusions

Research in collaboration has resulted in a host of tools and environments. Attempts in creating classifying these tools are not comprehensive enough as each classification framework either focuses on a particular aspect of collaboration or the technique that tool employs. We are now at a point in time where we need to incrementally perform research and use the infrastructure already provided by other tools.

We therefore take a step back and investigate the collaboration needs of a software development team and then based on those needs identify the research areas that address those needs. We use Maslow's insight into the needs of an individual to create a hierarchy of needs for the team. We have not conducted any ethnographic studies to validate our need hierarchy for the team, but believe that we can use Maslow's insight into the human psyche to extrapolate the psyche of the team.

The hierarchy of needs for the team is categorized as a) *fundamental needs* that allows the team to function as a team and create software deliverables b) *safety needs* such that the software artifacts created by the team is safe from hardware failures, mistakes by the team or malicious outsiders c) *belonging needs* such that the team is cohesive and functions as a unit d) *esteem needs* allow the team to be recognized by others based on their efficiency e) and finally when the team becomes highly acclaimed, it is free to pursue the kind of work that the team desires and has reached *self actualization*.

While creating the need hierarchy and mapping the research areas that cater to the needs in each layer of the hierarchy we observed that almost all research areas have focused in increasing the efficiency of the team. Addressing the belonging needs have been largely the responsibility of the team members. Collocation has allowed team members to build team cohesiveness via face to face meetings and collocated group activities. But as teams become distributed in nature maintaining cohesiveness via face to face interactions becomes difficult. Teams thus increasingly are getting dependent on technology to help them maintain team cohesiveness.

The software research community should take advantage of Maslow's insight into the needs of an individual to understand the needs of the team while designing collaborative tools.

Acknowledgements

Effort partially funded by the National Science Foundation, grant numbers CCR-0093489 and IIS-0205724, and an Eclipse Innovation Grant, 2004.

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André van der Hoek is an assistant professor at UC Irvine, Anita Sarma is a Ph.D. student under his supervision.

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