

EXPECTATIONS IN A PARTICIPATORY DESIGN TEAM

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ABSTRACT

A human factors specialist gathered ethnographical data for a deeper understanding of diverse team expectations, high-level team behavior and work culture throughout a participatory design process. Expectation levels were high for individual team members and the overall team itself, although expectations from the team for upper management were uncertain and were rated low to very low. Additionally, the participatory design team showed successful multicultural team factors to include honesty, competence, commitment, communication, creativity, and clear expectations.

INTRODUCTION

Participatory design does not just ask Participatory design is often used within a mini-project to generate prototypes that feed into an overall project's design process (Fidgeon 2009).

Participatory design does not just ask users' opinions on design issues, but actively involves them in the design and decision-making processes (Schuler and Namioka 1993; Muller and Kuhn 1993).

Steen, Kuijt-Evers, and Klok (2007) state that "in participatory design end-users articulate a problem in their current situation and researchers/designers try to solve that problem together with them. In ethnographic fieldwork the researcher/designer shifts towards the end-users by interviewing and observing them in their current work situation. Both aim to get insight in a current situation of end-users or to solve a current problem for them."

Therefore, in this paper we present a journey through the participatory design process of control-room-layout design by a professionally and culturally diverse team. The researcher used in-situ ethnography and traditional case study methods to include personal interviews, a questionnaire and survey, and detailed observations and records of design meetings and outings to examine expectation levels and high-level team behavior.

Prior to the formation of this unique team, the Human Factors Engineering Group (a team of two) were to complete reviews for the control rooms in the new facility and created a guideline to provide a simplified design process for those reviews.

The design of a new facility, based on an already existing process, and layouts, including control room design, were to replicate the reference facilities located in a foreign country.

However, the preliminary layout designs and equipment lists were incomplete for all the new control rooms due to differences in standards and regulations from the reference facilities to the new facility, therefore requiring revised layout drawings and additional equipment and revisions to the reviewing guideline (Figure 1). The HFE group was tasked with the redesign of all control rooms as well as the final review. The control rooms involve the operations of the entire facilities. Therefore the inclusion of other departments and facility groups i.e., nuclear safety, chemical engineering, manufacturing and laboratory system engineers, procurement...etc. was necessary to gather needed information about equipment and other control room needs. HFE held several large meetings with many representatives from other departments to discuss the new layout designs. After a few of these large meetings, it was apparent that a smaller layout participatory design team was necessary to



Figure 1: The revised control room review guideline.

complete the control room layouts and intermittent large group informational meetings were more productive.

One of the authors, a human factors specialist, spearheaded a unique small design team to include professionals from multi-disciplines and cross-cultures, including former operators. Additional individuals from multi-disciplines and cross-cultures joined the initial small team when necessary as the layout process continued.

To work effectively in a culturally diversified team requires listening, open mindedness, to different perspectives of critical thinking and problem solving techniques and accepting that the parties at the table come with a unique frame of reference, lessons learned, and preconceived expectations (Janssens and Brett, 2006).

We discuss the way the participatory design team was staging its activities, how that worked and what the members' expectations were.

We start by explaining team expectations, the elements that form effective teamwork as identified in literature, followed by the dynamics in teamwork that we have analyzed in our study.

EXPECTATIONS: DEFINITIONS

According to the Collins English Dictionary (1991), expectation can be defined as a belief about (or mental picture of) the future, anticipating with confidence of fulfillment, the feeling something is about to happen, outlook, or the sum of values of a random variable divided by the number of values.

Osvath and Osvath (2008) conclude expectations, in humans, as "planning for future needs that relies heavily on two capacities, both of which lie at the heart of our cognition: self-control, often defined as the suppression of immediate drives in favor of delayed rewards, and mental time travel, which could be described as a detached mental experience of a past or future event. Future planning is linked to additional high complexity cognition such as metacognition and a consciousness."

EXPECTATIONS IN TEAMS

Forming multicultural teams is becoming more common as companies become more global. Janssens and Brett (2006) wrote, "Collaborations are generally organized in the integration and/or the identity model or the coalition model. Dominant coalition sets

the scene, overrides differences that are not in line with its logic, revise and suppresses other perspectives. This, in turn, creates a less culturally intelligent team model because it discourages meaningful participation in information extraction and decision making"

The most common alternative approach, the integration and/or identity model, requires all team members to sublimate their cultural identities to that of the entire team by adopting "super ordinate goals" based on their common interests. The approach has the advantage of encouraging every team member to participate. However, it carries two risks. In the interest of unity, team members might submerge their cultural identities, and hence their ability to think differently. In addition, the effort to include everyone in decision-making might cause the team to function at the level of its least-creative member (Janssens and Brett 2006). The fusion concept aims to overcome that type of problem by ensuring that every member contributes his or her expertise to the team's discussions. This takes careful organization and team management. Every member contributes.

Successful teams have five things in place and a set of common characteristics (1) a clear sense of purpose, (2) well-understood norms of behavior (3) measurable success indicators, (4) clear roles and responsibilities and (5) operating rules (Douglas 2009).

Additionally, successful high-level performance teams adopt a set of positive behaviors that include dynamism, flexibility, action focus, new challenge acceptance. Their attention is directed towards capitalization based on competencies, high mutual trust, unconditioned team attachment, innovation, continuous learning and development. High performance teams have not only to respond to change, but also initiate it (Abrudan and Brancu 2009).

Horwitz and Horwitz (2007) suggest teams with denser expressive and instrumental social networks tend to (1) perform better and (2) remain more viable. These effects are especially potent when the network structures precede initial bouts of performance, but they diminish as time elapses and the familiarity of team members with one another grows.

To counter act diminished effectiveness,

this case study suggested introducing new players to the team intermittently, especially when expertise is required from lead engineers or those individuals familiar with the reference plant operations and processes.

The high-level team discussed in this paper adopted the fusion concept. Additionally, the team did not have a leader hence the fusion team style ensured an equal input of expertise from all members. The human factors specialist organized and facilitated all meetings and the gatherings, but each member contributed equally.

ETHNOGRAPHY AND HUMAN FACTORS

Human factors specialists and ethnographers found in the workplace have similarities. Both use a form of observation of the work culture, the process of work, the behavior of human beings interaction with each other, the environment, time and space and are often times translators between engineers, designers and upper management. Additionally both are likely to be a part of a work team or participant of the group or team in a study (Jordan and Dalal 2006). However, traditionally the fields have very different roots.

Ethnography has a long history with its roots in anthropology, workplaces and more recently used in systems design. Ethnography understands the world from the point of view of those who inhabit it and is behavioral, i.e., interested in the detail of the behavior to a greater or lesser extent but only as part of the social system. In contrast, the human factors engineering field generally does consider the behavior itself as the appropriate level of analysis (Hughes, King, Rodden, and Andersen 1994).

According to Chapanis (1991) "human factors is a body of knowledge about human abilities, human limitations, and other human characteristics that are relevant to design. Human factors engineering is the application of human factors information to the design of tools, machines, systems, tasks, jobs, and environments for safe, comfortable, and effective human use".

The process presented here is a narrative of the journey undertaken by the team and reported by the human factor specialist who was also a team member. Our research inquiries included; what discussions occurred? What required



Figure 2: Huge quantities of rebar support the concrete to form massive walls for the six story complex facility.

innovation or caused frustration? How did the Team come to a consensus for decisions? What was the driving force behind any compromises made? What were the expectations from each team member and the team itself? What expectations did upper management have for Team performance? These were the questions asked to each team member during personal interviews and are represented as quotes throughout this paper.

METHODS

A human factors specialist, the first author, observed and recorded a participatory design process of a design team during layout meetings and outings with engineers, designers and users for over a year. Furthermore, because the specialist was also a team member and present during all the participatory design process, the study had an ethnographic element in it, in that it followed the process and the teamwork closely. For this study, a questionnaire and personal interviews were used to collect data and expectation levels were rated from 1-extremely dissatisfied to 5 being extremely satisfied.

THE DESIGN TEAM

A human factors specialist and applied psychologist, from the western USA, organized, facilitated and participated with the small design team.

Team members:

- (1) a senior instrument and control and software engineer, many years of corporate, government, and military working experience, wise, worldly with a wicked sense of humor from Britain;
- (2) a software engineer from French facilities operations, who is highly intelligent, calming, cool and collected while wearing two hats, one



Figure 3: A conceptual drawing of the completed facility.

for operations and the other for software design, an uncanny ability to see details that others tend to miss from France;

- (3) a chemical engineer from operations with years of operations experience is feisty, forceful and driven, a firecracker and dynamite in a small package, willing to put up a good fight and stand up for what is “the right thing to do for the operators”, intense and dramatic from the south-eastern USA; and
- (4) an electrical designer, eager, talented, excellent technical skills, common sense and smooth sense of the ironic, pays particular attention to what goes on “outside the box”, also from the south-eastern USA.

The small design team met once a week. The team sent new layout information for review and comment to the larger groups via email. Meetings were held with the larger groups intermittently for final layout design.

THE PARTICIPATORY PROCESS

The design process for the control rooms discussed in this paper was long and similar to a journey or quest. The study was conducted for a year while the team continues to meet and will do so until all the control room layouts are complete. Team members preferred to visit the structure while under construction in addition to working on model layouts. The experience of being in an actual room helped with special determinations and the future physical control room environment.

During outings and meeting times the team often referred to the overall project as the “French Castle” or “French Fortress” due to the massive scale and extreme thickness of the double walls filled with debris surrounding the inner core structure (Figure 2).

The building will be windowless, concrete, gray, cold, and mammoth. Figure

3 is a conceptual drawing of the finished facility and outlying buildings. The missing effects: the drawbridge, a moat (filled with the local alligators) and the roofline adorned with security guard gargoyles spurring fire, hot oil or gushing water after a momentous rainstorm. Our research inquiries included; what discussions occurred? What required innovation or caused frustration? How did the Team come to a consensus for decisions? What was the driving force behind any compromises made? What were the expectations from each team member and the team itself? What expectations did upper management have for Team performance? These were the questions asked to each team member during personal interviews and are represented as quotes throughout this paper.

RESULTS

Due to the 20%, reduction in the building footprint from the original design and added extra amount of equipment and piping needed to comply with the new standards and regulations the team speculated on what type of control room operators might fit and work in the cramped, low-ceiling, labyrinth environment (Figure 4).

Finding adequate space for equipment and workstations were and continue to be the biggest challenges to this project from the standpoint of design. The realization and response to space



Figure 4: This is a stark interior look of one of the low ceiling, windowless control rooms. 10 ft floor to ceiling height (red arrow) slated to be 8 ft. with raised floor and dropped ceiling for lighting.



Figure 5: A control room layout exercise using (to scale) colored paper for workstations.

constraints was expressed by team member (1) during a personal interview said, “Initially, there was all this moaning about how little space we had and I just felt it was overdone, however as we started shoving stuff in the first control room and the way that more and more stuff kept appearing. Then seeing the actual space that is allocated for the first control room (obviously which I had seen on drawings) but the reality of just how low the ceiling is etc. made me into a true “believer” to keep stuff out of the control rooms. So that is where I am now: revising the layouts to allow the minimum of equipment in there and (just) keep the minimum separation.” Additionally, providing adequate, comfortable workstations for a large number of operators was exasperated by space constraints.

An example was the Team did not have a designated designer assigned specifically to the control rooms and the need to work on a preliminary layout continued without a designer. Team member (1) and the human factors specialist came up with the idea to cut out colored pieces of paper for workstations. They brought the to-scale cut out pieces of papers to represent workstations to a team meeting. The team members worked together and fitted the cut outs on the preliminary drawing in the correct process order. During the creation time each member filled in the gaps, discussed workstation placement and work flow and what needed to be near each other and why. The meeting time was calm, easy, and fun. There were no arguments, just a lot of laughter. Team member (4) finally said, “This is a billion dollar project and we are using tape, colored paper, a ruler, and markers to design a control room for operators to work in for twenty years. This is not normal, is it? “The team, although

proud of the new layout itself but slightly embarrassed by the elementary look of the layout, Figure 5, presented it at a meeting later on that day to the large group of department heads and met with surprising support.

During the layout process, the team realized the importance of including the ‘human factor’ into the layout designs. Team member (1), “This process has really put in perspective, for me, the importance of the ‘human factor’ aspects.” Team member (2), “I learnt a lot about the ‘human factors’ issues.”

Team member (3), “We were pushed for space so ‘human factors’ became a big player in this part of the project.”

Team member (4), “How we can maximize space in the control room including incorporating ‘human factors’ elements into the design?”

EXPECTATIONS

The team was asked to rate the outcome of their expectation levels (a) for themselves as a team member, (b) their own expectation for the small team as a whole, and (c) the expectations the small team had for upper management. The rating scale was from 1-5, 1 being extremely dissatisfied and 5 being extremely satisfied.

During the participatory process experience, the team began to share their expectations for the assignment. Team member (2), “I tried to share my knowledge of the French control rooms processes” or team member (3), “The expectations of the TEAM are the SAME as my own” and team member (1), “team member 3 is forceful and knows (usually) what she wants but can be told differently. Myself and team member 2 both know what we’re talking about and don’t appear to be too stuck on any position. Team member 4 does a fantastic job interpreting what we decide. And the human factors specialist is a good organizer / coordinator that get the meetings to happen and drag us back on track etc.

The ratings for themselves as team members were all 5’s, and for the small team they were 5. Despite challenges and compromises, the team rated their expectations as extremely satisfied for themselves and for the small team. Team member (4) said, “Each step was exciting - Eager, to make this design and project one to be proud of and able to

use as a presentation if necessary to the client. This was a virgin control room for this project and so therefore there were no roots to follow as far as numbering, sizing, baseline furniture, steps or procedures to follow or milestones to track.”

Expectation ratings for upper management were very low (1- very dissatisfied). Upper management did not appear to be interested in control room layouts and did not express satisfaction or dissatisfaction with the team. The team viewed this as disinterest and lack of communication that existed in previous lower level design efforts in this overall project.

Team member (3) said, “I don’t know if upper management expectations for the team were met. I know upper management did not meet team expectations, not good communication with the Team.” Team member (1) said, “I think the overall project and upper management had this expectation for some sexy, futuristic wall mounted large screen monitors that telepathically display whatever the operator desires. So if that is what they expected, I don’t think their expectations were met; on the other hand, if they expected a complete design, then yes, expectations were met. Upper Management were missing in action. If they cared they would have pushed some of the other groups (cough, cough) into actually doing some work.” Team member (3) said, “Upper management’s main interest was to finalize the design. Some (upper management) didn’t care if it was right or not, but just to finalize it. The good news is that the (small design layout) team made sure it was correct.” Team member (4) responded, “Pushing out the project in unreasonable time, the time constraints were not measured in dates, but measured in the dates given with the time allowed to spend on project per day or week.”

Along with the expectations of upper management additional expectations were apparent from other project groups (those involved in the larger review meeting). Issues and frustrations with other groups and expectations from the small group for the larger group and vice versa were expressed although not rated but voiced during the interviews:

Team member (1) said, “Dealing with

the ‘human factor’ aspects, OK a console uses up so much space and you have to decide where to put it. Explaining this to an annoying human in a large groups meeting though will just keep on wasting time blah, blah, blah. You know what I’m talking about, everybody has met these folks! Two frustrating things really: firstly getting the stuff to fit in the space allocated and secondly the human problems: getting the individual disciplines to come up with their requirements. Luckily the second one got solved by drastically cutting down the number of individuals who really worked on the layouts (and this cut out those who liked to ramble on, distract the meeting, just complained etc. etc.)” Team member (3), “It was definitely a negotiation with other larger groups.” Team member (4), “Groups who don’t know what they want or need in the control room, as if we can wait until later on when they make their minds up to get their stuff in there and we are expected to integrate changes with incomplete or inaccurate inputs (from other groups). The team made the best decisions at the time for the problems that were at hand. The team did not foresee the objections later in the project by others, and the team made all efforts and changes to abide by their new policies (for lack of a better term).” In summary: For this study, the expectations from the team members included the explicit sharing of the quality and project completion values: goal, visions and objectives from the part of all team members. Strong focus on results, the sense of priorities, and clarity in decision were also fundamental for the team to meet high performance standards. However, expectations towards upper management and other groups in terms of communication were rated worst on the scale.

DISCUSSION

Expectations are subject to interpretation, not unlike comfort levels. The English language complicates it even more by using the word in different contexts (Collins 2010). That said the study did ask that each team member rate his or her own expectation level, the level of the team as a whole, and the expectations upper management had for the team as a whole. In this case study, it apparent that up-

per management was not present in the process and was only interested in a construction schedule deadline. This was distressing to the team because they expected to produce a high quality product. The other groups tended to work in isolation from each other on this project. This was the preferred upper management style and caused communication issues for the team because the control room layout involved the “big picture” to include all the groups together in the layout designs.

The team experienced changes and communication problems from upper management and other groups within the organization. These types of problems typically stemmed from the top.

Ideally, in order to help teams deal with change, leaders present a positive attitude themselves and help teams see the opportunities. They may ensure the necessary safety for teams willing to take risk, as well as the necessary instruments to have teams innovating necessary change (Abrudan & Brancu 2009).

Janssens and Brett (2006) found that managers often set up their teams to fail because they themselves fail to help the team anticipate changes or communicate the changes in a timely fashion. Two of the basic elements of fusion are meaningful participation and coexistence.

The team was expected to provide innovative solutions to problems. Figure 6 shows an example of the original conceptual design before the team began the new layout designs. Figure 7 shows the final design after numerous design meetings, outings and discussions.

The discussions would occasionally veer off track and the team got outrageous with their imaginations. Hence, images of vampire penguins (hybrid) who were short and small, able to fit at the undersized workstations, withstand the cold, able to see in the dark, have wings, can fly, able squeeze in and out of tight spaces and walk through walls. Sleeping accommodations and ways to feed the hybrids were also discussed. Flying monkeys were also considered because they have tails and could hang off the pipes to perform maintenance duties in hard to reach spaces. Most of these “off the wall” conversations about types of operators and building additions occurred whilst the team conducted actual on-site visits to the structure itself and were not included in meetings with



Figure 6: Control Room layout in conceptual design phase.

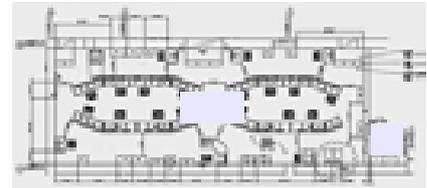


Figure 7: Control Room layout in final design phase.

other groups or upper management.

In all seriousness, the team was very professional and made “perfection” in the layout designs a priority. The humor was a redeeming quality in an often times depressing and oppressive environment of conceptual design mishaps and constant design changes. Upper management was obsessed with the concrete and construction schedule and was not amenable to necessary design changes, although those changes are inevitable.

Although the team was multicultural, cultural differences did not interfere with the expectations or participatory process. Multicultural differences were not a hindrance but beneficial due to the international nature of the project design. The team appreciated the differences and thereby enhanced the process by the sharing of diverse perspectives on problems and creative solutions. The team enjoyed the humor of team member (1) and looked forward to the meetings and outings because they expected to have a good time together, albeit frustrating at times. Creative solutions to the problems often came out of a heated discussion or funny comment and the team would regroup and be ready to move forward and not bog down with drama or useless drivel.

The team exhibited the qualities of a successful team by (a) being honest with themselves and others involved in the design process, (b) providing professionalism, expertise and competence in presenting those aspects in a well-thought out design, (c) an overall commitment to the project through collaboration, innovation and creativity, (d) clear expectations from themselves,

expectations for other team members and those for upper management, and (e) communicating clearly and concisely the needs of the team and results throughout the layout design process. One major difference between workplace ethnography and traditional ethnographic research is that workplace ethnographers routinely work as part of interdisciplinary teams. It is through those team members who are most capable to become the most effective advocates of the benefits of ethnographic approaches in the company as a whole. Managers are attuned to hear findings directly from technical experts, the systems developers, customer account managers, market analysts, and computer scientists we work with may contribute substantially to a change of attitude in the company (Jordan and Dalal (2006). This is also true with human factor specialists who are included in multicultural teams with professionals from different disciplines. Individuals can demonstrate the importance and benefits of human factors to the success of the project. Participatory design team opportunities provide for the inclusion of both human factors and ethnography in present and future design and system development work.

In reflecting upon the ethnographic methods of inquiry in this case study: Hughes et al, (1994) state that “even though design may be concerned with developing a completely new system, understanding the context, the people, the skills they possess, what kind of work redesign may be involved, and more, are all important matters for designers to reflect upon. It is also more capable than most methods of requirements elicitation, as it ought to be, in highlighting those ‘human factors’ which most closely pertain to system factors which are not always just about good interface design but include training, ease of use in work contexts full of contingencies which are not the remit of system design, and more. It is in respect of these considerations that ethnography is especially useful in design.”

CONCLUSION

The participatory design process resulted in a successful high level, multicultural design team. Team factors included honesty, competence, commitment, communication creativity, clear expecta-

tations and moderately happy consensus with layouts considering project challenges. The team was collaborative, determined, strived for perfection and worked diligently to create control room layouts for the health and safety of future facility operators.

A number of high performance key aspects were demonstrated in the high-level team during the design process. The team exhibited a clear understanding of what each individual expects from themselves and the team as a whole and a commitment to being part of a team but still reflecting their own characteristics. It showed competence and the strength of the team as directly proportional to its members' abilities and initiative, clear and honest communication with each other, cooperation and efficiently working together, and creativity and innovative spirit and open to new ideas and initiating change. Challenges prompted responses from team members and required innovation honesty and collaboration to formulate viable solutions.

Expectation levels were high for individual team members and the overall team itself, although expectations from the team for upper management were less certain and rated low to very low. The low ratings were largely attributed to management agendas, priorities, styles and actual management personnel changes that occurred throughout this design process. Communication deficiencies with upper management and others in the larger groups were and continue to be the most challenging to the team expectation levels and the layout design process overall.

Additionally the inclusion of ethnography in the usability methods for this study proved beneficial as a complementary evaluation technique for a deeper understanding of diverse team expectations, team behavior and work culture throughout a participatory design process.

ACKNOWLEDGMENTS

This project would not have been possible without the insights, input, innovations, humor and support of the Control Room Design Layout Team. Thank you.

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