

Sensemaking Handoff: When and How?

Nikhil Sharma

School of Information, University of Michigan, 1075 Beal Ave, Ann Arbor, MI-48109

nsharma@umich.edu

Abstract

Computer support helpdesks often engage in sensemaking while working on atypical problems. Handoffs are common in these sensemaking situations due to shift changes, because a different skill or perspective is needed or simply because the current sensemaker may be exhausted. Though handoff may be needed, it may not always be successful. This could be true because sensemaking involves non-routine activities for which no structural support for handoff may exist, or because sensemakers may not be sure what to handoff if sensemaking is not complete.

This study examined the issues related to sensemaking handoff in computer support helpdesks. Existing theories of sensemaking (Russell et al, 1993 and Weick, 1996) were used as a framework. Semi-structured interviews were conducted with two different computer helpdesk personnel groups at a large mid-western university. Successful handoffs occurred either very early or very late in the sensemaking process. This choice of handoff time as well as other aspects of handoffs are discussed using the principles of least collaborative effort [13] and mindfulness [18].

Author Keywords

Sensemaking, handoff, handover, collaboration, asynchronous, customer support, helpdesks.

Introduction

Sensemaking often involves gathering information and gaining an understanding of the information to accomplish a task. This process is often done collaboratively with others. In the spirit of the theme of ASIS&T 2008 it can be said that people transform information into a structure for current and future use in the process of sensemaking. 'Handoffs' are one type of collaboration which are asynchronous and serial. There can be many reasons and scenarios when handoffs take place. For example, in a shift the whole work environment is handed off, but in referrals only the task at hand is directed towards a new expert.

Though handoffs may often be needed, they may not always be successful. Since sensemaking is situated in a breakdown of routine activities, there may be no special procedures and structures for supporting handoff. The sensemakers may not be sure what to handoff in the earlier stages of sensemaking since sensemaking is not complete. Handoffs are considered a ripe event for errors and adverse events in domains like healthcare even when structures are in place for handoffs [8].

This paper looks at handoffs in a non shift change situation where sensemaking problems are common. Computer support helpdesks at a large Midwestern university engage in sensemaking due to the variety and complexity of problems they receive. In such non shift change situations, it is important to consider why people handoff, when do they decide to handoff and how they handoff sensemaking. Answers to these questions can help expand our understanding of sensemaking handoffs. This can lead to implications for design of sensemaking handoff systems and also help sensemakers decide if, when and how they should handoff in non-shift change situations.

Background and Related Work

The two major components of this inquiry: sensemaking and handoffs have been the focus of many past studies. First we look at two sensemaking theories and then at past work on handoffs.

Theories of Sensemaking

There are many prominent theories of sensemaking. This work attempts to reconcile and use two prominent sensemaking theories, that of Russell et al [13] and Karl Weick [17]. There are other pertinent and established theories like Dervin [5]. Russell et al's model was chosen because of its focus on representations that are a useful concept in handoff and Weick's theory was chosen because of its focus on organizational aspects of sensemaking since handoffs often occur in an organizational setting.

Russell et al's [13] sensemaking is the process of searching for a representation, and encoding data into that representation, to answer task-specific questions. These representations are based on the

requirements of the specific task. The different operations like searching for representations, searching for information and encoding information into representations impose different costs on cognitive and external resources. Representations are chosen and modified to reduce the cost of these operations. Russell et al.'s model is useful for understanding sensemaking in many ways. Firstly, the model lists the various sub processes involved in sensemaking like processing task requirements, searching for representations, encoding data, shifting representations and using the encodons (encoded representations). Secondly, the cost structure principle provides useful behavioral insight into how the various processes listed above are related to each other. Thirdly, the model also foregrounds representations which when externalized become the material that gets transferred during handoff in sensemaking. Finally the simple straight forward nature of the model makes it useful for drawing design implications for various operations in sensemaking.

While the Russell et al.'s model informs how individuals or groups on the whole engage in sensemaking, Weick's sensemaking [17] can help us understand the micro-interactions between an individual and the group during sensemaking. Weick characterizes sensemaking as the placement of stimuli into a framework. These frameworks are similar to Russell et al's usage of representations. Frameworks could be made up of categorizations, anticipations or assumptions.

Weick gives a rich characterization [17] of the process by outlining its seven properties. Sensemaking is:

1. Social: Sensemaking is influenced by the actual, implied, or imagined presence of others.
2. Grounded in identity construction: A person or group's sense of who they are in a setting affects the sense they make and their actions.
3. Retrospective: Sensemaking is influenced by what people notice in elapsed events.
4. Focused on cues: Sensemaking is about the elaboration of traces into full-blown stories, typically in ways that selectively shore up an initial hunch.
5. Ongoing: sensemaking is dynamic and requires continuous updating and reaccomplishment.
6. Driven by plausibility rather than accuracy: Sensemaking is about creating meaning that is sufficient to proceed with current projects
7. Involves constant enactment: In inexplicable times, people have to keep moving.

Drawing from the integration of these complementary theories we can make these following three predictions regarding handoff sensemaking:

1. Russell et al suggest that the representation developed in sensemaking depends on the task & cost structure as perceived by the sensemaker. The representations created by the provider may be too idiosyncratic to be of use to others. The involvement and consultation or at least attention to the needs of the handoff recipient may remedy some of the incompatibility problems.
2. Russell et al also suggest that representations evolve during sensemaking, thus the representations may be inchoate and unstable early on in the sensemaking. Also, parts of this representation may be internal and non-externalizable. Thus even though the sensemaker might have made progress, early progress might be latent and thus useless for handoff to a recipient.
3. Weick points out that because of the plausibility and constant enactment in sensemaking, frameworks are often inert and change slowly. People also lack the ability to notice residue and modify frameworks accordingly. Diversity can help in such situations. Handoffs can sometimes result in the recruitment of a different perspective or expertise which can help improve sensemaking.

Handoff as Collaboration

Olson & Olson found [10] that when collaboration is distributed it requires high common ground [3], collaboration readiness and high technical readiness to be successful. The nature of the work also affects collaboration. Sensemaking requires frequent and complex communication with short feedback loops since it is a closely coupled activity. This puts even more demands on handoffs. If handoff is distributed rather than collocated the problem may be further compounded by the lack of shared physical environment. Suchman found that physical environments are mutually constituted and structured to enable joint work [16]. This means that the physical space is another important contextual factor in the sensemaking handoff picture.

Handoff and Handover

Some past research has looked at handoffs in particular. Often the term used in the literature is 'handover' instead of handoff. Handover research has focused mainly on handoffs due to shift change. Most of these studies have attempted to find variables that help the receiver come up to speed in order to have a smooth shift change.

Efficient communication was found to be an important factor in many of these studies. A literature review of handover [8] in the medical domain found communication to be an important factor in handoff efficiency. Other studies in the health care domain have suggested creating roles [15], formal communication and handover practices [9, 14 & 19] to facilitate handoffs.

Handover research has also stressed the importance of prior knowledge and common ground besides communication. Patterson and Wood's [11] field studies of NASA shuttle missions highlight the influence of prior knowledge and building a common ground between practitioners in having an effective and efficient update. Harper and Hughes [7] observed that flight controllers chose prior agreements over active communication to minimize errors. While this observation by Harper and Hughes sounds contrary to the push for more communication, there are several possible explanations for the limited verbal communication. Firstly, the flight controllers have shared visual data and high common ground and their problem is mainly of allocating attention. Secondly flight control handovers seemed to involve lots of routines and are thus somewhat different from typical sensemaking situations. Prior agreements and procedures might not work in sensemaking situations which are novel and therefore more communication may be needed.

The existing literature on handovers provides insights into the factors affecting handoffs like the need for additional communication and reiterates the need for common ground but the literature is lacking in some aspects. First, while the research on handover has concentrated on shift changes, other handoff situations are somewhat ignored. Second, not all scenarios covered in the literature are sensemaking scenarios; some like flight control involve more procedural work. Sensemaking presents additional problems to handover. During sensemaking procedures are either being developed or severely challenged.

Computer Helpdesks Study

Computer support helpdesks deal with many kinds of requests. While many requests are routine and procedural, others are novel and lead to sensemaking situations. In such non shift change situations, it is important to consider why people handoff, when do they decide to handoff and how they handoff sensemaking. Semi-structured interviews were conducted with two different computer helpdesk groups at a large mid-western university. Ten participants from two computer support helpdesk groups at a large Midwestern university were interviewed for this study.

University wide phone based helpline group (G1)

The first group (G1) works on the phone based helpline for anyone affiliated with the university. The group has around 20 full time employees. Out of the 8 participants interviewed from the group, 3 were female. The group was unlike most industry helpdesk groups in many ways. Firstly the age of the personnel was much higher (30 to 66 years). Secondly the turnover rate of the group was very low. Group members had been around for 6 years or more. Thirdly there was no one in the group with a computer science degree. When asked, the supervisor of the group said that this was a conscious decision. She felt that non-CS employees were more committed to users, had better communication skills and had fewer turnover rates than CS graduates. A conscious decision was also taken in the group a few years ago to not hire students as temporary workers. The supervisor and other employees reported that although students were useful in the group, their turnover was high and they had little common ground with the long term permanent staff. The supervisor reported that she thought the group performed very well. In a survey done by the group about five years ago, 99% of respondents said they were satisfied by the service provided by the helpdesk. The group members interviewed said they were very happy with the institutional support from the university. In one incident, the Director of User Services and the Director of Computing Resources spent a day answering questions with the team

“(The director of user services) came down.... They got phone calls and they got to deal with the front line of these irate customers, customers upset, tried to walk them through this. It was a real eye opener to them. They said you know what....maybe we need to keep (ourselves) more in the loop when we make changes and when we do things because they are going to tell us what the general feel of the customers is going to be like.”

The physical layout of the workspace of G1 involved a large room with workstations for each of the members. Calls to the helpline were channeled to available helpdesk members in the room. Members were not able to select or screen calls; they were expected to answer any calls based on availability in the room. The working hours for the helpline were 8am to 7pm on weekdays.

Engineering College helpdesk (G2)

The second group G2 provides support to engineering school members through phone in, walk in and email. G2 was much smaller, with only 3 full time employees, all male and up to 5 temporary student employees. Two members of the group, including the supervisor of the group were interviewed for the study. G2 members were much younger (20 to 33 years) than G1 members. This group also had a low turnover rate for the fulltime employees, the most recent member had been in the group for 5 years. The student turnover rate was high and the students were hired every semester.

The physical layout of the G1 workspace was a large office area shared with other computing staff groups. The office was divided into three subspaces. Walk-in users encountered the student cubicles, this was the first subsection. The second subsection of the space was a large cubicle for the junior most fulltime employee. The other two senior fulltime members shared an office about 15 feet away. One of these senior members, served as the supervisor for the group.

Incoming calls and walk-ins were first handled by the students and escalated to fulltime employees as per need. All three fulltime employees shared the burden of the escalations as well as requests for help through email. Walk-in and phone in hours were 8am to 10pm on most days.

Findings

Semi-structured interviews were conducted with the participants at their workplace. The interviews ranged from 1 to 2 hours. The questions were focused on learning the work habits and work culture of the participants and the sensemaking situations they faced. The participants were also asked if there were handoffs during the course of their work, if so what were the reasons for the handoffs, what were their handoff strategies, how they decided when to handoff and systems and tools they used for handoffs.

Sensemaking and communication

While some of the reported practices were common to both groups, some were peculiar to one or the other groups. Participants from both groups said that they received a lot of simple routine questions, for example password resets requests. Less than 10% of the problems stumped the employees. These rare problems were the sensemaking problems.

“Ones (cases) that get referred are **the trickier ones** that somebody really does need to work one-on-one with the customer. Somebody who is an expert at whatever that problem is has to work one-on-one with the customers.”

In such situations participants in both groups first tried to ask other employees present if they had any clues. The manner and medium of asking was different in both groups (see below) due to their different spatial layouts. If help was easily available it was sought from others in the group otherwise the participants said they proceeded to conduct internet searches on the topic. If no answer was available the problem was prepared for a ‘referral’, the term for a handoff.

“Sometimes you just need a sounding board. You know okay I am stuck. I am not seeing something here and boom 9 times out of ten it is resolved in the room right there.”

The participants in both groups prided themselves as “problem solvers” and liked dealing with challenging sensemaking problems.

“We’re **problem solvers** and if you can’t solve a problem then you’re kind of like oh darn. When you have to make a referral almost everybody wants to know what the answer was.”

These sensemaking problems were more common when a new technology was rolled out or when new batches of students arrived at the university. The problems were also compounded when help was sought over phone rather than as a walk-in as the employees could not see the users’ computer and were unable to interact with it directly.

“Yeah but sometimes people call and say my email is not working. Well you go to them well let’s open up a web browser well then they can’t load any web pages. And you’re like well this isn’t an email problem.”

Whenever a handoff was done, a 'referral ticket' was prepared and forwarded to a subgroup of experts appropriate for the problem. Members of the groups formed subgroups of expertise like email clients, Mac/apple OS, windows OS, networking and hardware. A member of the expert subgroup would claim the ticket and start working on the problem. G1 members had different ways of communicating than G2 members. Since G1 shared a single space, it was easy to ask around for help. Help was often sought and received in this manner. Most participants in G1 said they liked this culture of open admission of a knowledge gap and asking for help.

"We're all real comfortable with each other. I mean we have our ups and downs as a family would. But we rely heavily on each other. There's no such thing as knowing everything there is to know about everything so we rely very heavily on each other where I might have an expertise in one field.....so we're rely on each other very heavily."

Yet all group members in G1 were not present in the room at all times. The members split their work time in the phone room and working from home on referrals or on other developmental work like testing and training. A conscious decision was taken to limit work hours in the phone room to 20 per week. This was one reason for the low turnover and high job satisfaction in the group. In order to support communication with 'away' members of the group, all group members were provided cellular phones with 2-way radio support. The members not in the room were supposed to be on call during working hours, from 8am to 7pm. If a request for help tossed in the room was not answered in the room the members would request help from the 'away' members through a wireless phone.

"Like if I'm not in the room and somebody has an email question they can two way to me and I can give them suggestions on what to do or I can say to them I don't know let's refer it and we'll work on it later."

G2 members were not able to throw out a question to others as easily because of their space configuration. Students were easily able to escalate to or ask for help from the adjacent fulltime employee, but not from the other two senior fulltime members. The group relied on instant messaging (IM) to help with the space configuration. If the problem needed a significant amount of communication, the members were forced to walkover to the other member's workspace.

The free sharing of knowledge and advice in both G1 & G2 seems to be in accordance with prior research on information sharing attitudes. Constant et al [4] studied information sharing attitudes and found that exchanges situated in social and organizational context are different from pure individual to individual (i2i) interactions. In pure i2i, self interest and reciprocity is prevalent but in social situations negative behavior and self interest is reduced. Sharing was also found to be dependent on the type of information in question. Tangible information like documents was treated more as a commodity than intangible information like tips and advice. Tangible information was shared depending on prosocial attitudes and organizational norms while intangible information was shared anyway. Constant et al attribute sharing of intangible information like advice and tips to the need to be self-expressive and to boost self-worth.

"Everybody wants to know and sometimes if you get a really odd one and you find kind of an odd solution then we'll send a message out to the whole group and say hey I was working on this and I found this answer just so you know in the future."

Reasons for handoffs

Participants from both groups reported that handoffs ('referrals') were rare in their work. There were many reasons to not refer or handoff. Many problems were routine and could be solved right away. The high level of experience of most full-time members meant that as a collective the people in the group knew a lot. Computing support at this and other universities have been striving to lessen the number of referrals, as low number referrals are considered an indicator of better customer services [6]. Employees prided themselves as problem solvers and were loath to refer the problems to the next level. It was also considered poor service to have the customer wait for hours while the referred problem was picked up by another expert.

"I think part of it is a matter of pride. None of us just wants to pass off a problem before we've given it the best shot we can. "

As is the case in many domains, one cause for handoffs in the groups was shift end. Often in these situations the helpdesk employee would write a ticket, but would often go back and claim it back whenever possible. These handoffs to self were also common when the caller was pressed for time and wanted to continue the problem solving at a later time. Handoffs were also made when it was realized that someone

else in the team had the appropriate skill to answer the question or if a senior member was needed because access to a restricted resource was required.

“Once in a while a consultant will be at the **end of their shift**, it will be like 7:00 and we’re closing at 7:00 and this person called at 3 minutes too with an impossible problem and they’ll just say you know I’m out of time, I’m out of patience and I’ve got to refer this. And then sometimes a consultant will refer it and then take it themselves. ”

One of the biggest causes of handoffs was personal conflict with users. Rude and irate callers were a frequent cause for stress for many participants. Many participants remarked that surgeons, law school students and business students were particularly rude. Participants often said that they would ask around for help in dealing with a rude or irate caller just like they did with a tough question and transferred the call if anyone else was willing to take it.

“Some of them can be the most awful people on the face of the earth and there’s really no reason for it. They just kind of have an attitude when they call. So yeah it can be very stressful, very stressful sometimes.”

“I guess it has happened where I just can’t work with that customer, we’re not communicating, someone else just needs to take over the call. That’s happened in the room, not just with me but with others.”

Finally a handoff or referral was the only option when a helpdesk worker had exhausted all of his/her options and was unable to proceed. In many such situations, a different perspective rather than a different skill set was sought when the handoff was made. The employees reported that another team member would take up the case and ask slightly different questions, which helped with troubleshooting in many cases.

“Sometimes you get too focused on the problem and you miss obvious things and then a fresh pair of eyes will figure it out. That always happens.”

Time of handoff

The participants reported two distinct kinds of handoffs.

Transfer: very early handoff

The first was called a ‘transfer’. Here the helpdesk employee would get the initial details of the problem, ask around for help from others in the room if stumped and if another employee would offer to take the call, it would be transferred. This kind of handoff was common when the employees had a user they had personality problems with or when it was clear that another employee had the requisite skill or knowledge to solve the problem.

“It’s quick in the sense that the customer spends very little time with the person who answers the call. When you transfer it to another consultant, generally I would give them as much information as I have. ”

Referral: very late handoff

The other kind of handoff was the referral. If the employee had exhausted all their options, they would write a ticket and refer the problem to appropriate group of experts. There was considerable institutional as well as peer pressure to not ‘refer’ unless absolutely necessary. The employees were rather encouraged to transfer the problem early on if they thought another member was more appropriate and available. Both groups took pride in the low number of referrals. Usually a lot of work had been done on the problem before it was referred.

“I think part of it is a matter of pride. None of us just wants to pass off a problem before we’ve given it the best shot we can.”

External representations handed off

Both groups informed that they used the Footprints ticketing system for tracking problems as well as sharing information amongst members. The footprints system allowed employees to record communications with the user and other employees; at the same time it also allowed them to add notes. The employees could also add information about actions taken; they could also categorize and label a problem. It was typical to start a new ticket as soon as a new call was received, while some employees updated the ticket during a call, others typed up a ticket after the call was over. This allowed the helpdesk

employees to allocate more attention to the user. In case of walk-ins for G2, the tickets were written after the walk-in is over.

Once a ticket had been written and the problem was still unresolved it was categorized by picking a label from a list or adding a new label and assigned to a group. Most participants said that they attempted to be exhaustive when writing a referral ticket. They tried to put in two kinds of information. The first was user related, for example the operating system used and client affiliations. The other information was about questions asked by the helpdesk, actions taken as well as other notes and memos.

There were also individual variations reported in the length and detail of the tickets. While there was peer pressure to be exhaustive yet precise, there were some reports of team members writing incomprehensible tickets. These were either too short and shoddy or too long and rambling.

“He’s the head of the virus busters’ team. He prefers not to talk to people on the phone but he sends a novel to everybody.... It’s like trying to get a drink of water from a fire hose.”

In both these cases, the participants said they would call the writer to clarify details in the ticket and also occasionally complained to the supervisor about poorly written tickets. Often if the ticket was too long, the expert would skim it and then call the person rather than wade through the text.

Most participants said that they read a ticket to get a general idea of the problem so far and would often supplement the information in the ticket with other information they could collect themselves.

“If somebody doesn’t put in the platform or the client or the version or something immediately somebody’s going to zing back and say hey, well what kind of computer were they using because everybody knows that’s a pretty basic question.... so we keep an eye on each other.”

If possible they would call the user again to verify the problem and to gather any other missed information. They would also call or talk in person to the ticket author; this was a low cost operation because the team members were very accessible.

Discussion

There were four main findings in the study. First, not all cases were sensemaking, some were routine problems and others involved some sensemaking. Second, the culture of communication meant that other experts were the first resource whenever sensemaking arose; this precluded the need for most handoffs. Third, handoffs were done only when employees were at the end of their wits regarding a problem. Fourth, the employees put in considerable effort in preparing material when handoffs actually took place. We start the discussion by looking at sensemaking in the context of the helpdesk and then move to factors affecting handoff decisions. These factors can be understood using two frameworks. The first is Clark & Gibbs’ principle of least collaborative effort [3] and the second is the list of principles for mindfulness [18].

Sensemaking in the helpdesk

While characterizing sensemaking, Weick differentiates it from interpretation. Interpretation is akin to putting labels on situations while sensemaking is more about constructing new labels. Classic interpretation is passive and automatic compared to sensemaking which is cognitively demanding. Many calls to the helpdesks were passive interpretation and cannot be considered sensemaking.

“I would say it’s a little half of the amount of calls I take are password resets and those are...pretty routine and straightforward.”

While passive interpretation is far from sensemaking, active and belabored interpretation can also be cognitively demanding and use the same sub processes as sensemaking like using a representation and modifying it when it becomes inadequate. Most calls to the helpdesk were in this category and strict sensemaking cases are rare.

“I have to **interpret** what the caller is telling me. They don’t know the terminology. In a lot of cases you ask a question how do you get to your email. I don’t know. Well what software do you use to read your email? I don’t know. What do you click on? The icon that sends email. What happens when you do that? My email comes up.”

“Sometimes we end up in situations where a system has failed here at the University – a server, the email system is actually a whole farm of servers and maybe one of those servers has failed and we’ll start getting calls and then you’ll start hearing around the room that other people are asking the same

questions you're asking your caller. And then we have to kind of put people on hold and then we have to **start diagnosis** ourselves what we think the issue is"

Even though sensemaking cases and thus their handoff are rare, they still need special attention. Firstly, most of these cases are error-critical and may be too costly to ignore. Secondly, active-interpretation cases which form the bulk of helpdesk activity can benefit equally from support strategies for sensemaking handoff, since they involve most of the sensemaking sub processes.

Individual factors: Principle of least collaborative effort

The factors are discussed here as 'individual' because even though they operate in a group setting, they affect how an individual operates. Even though there were no rules set at the group level some norms simply emerged guided by how individual operated in group settings. The principle of least collaborative effort [3] asserts that participants in communication will try to minimize their collaborative effort. This principle can be seen at play in the helpdesk group members when they engage in handoffs. The choice of time of handoff and the quality of external representation handed off can be explained using this principle.

Time of handoff

Interviewed participants reported that they engaged in handoff at two distinct times. The first, a 'transfer' occurred at the very beginning of the sensemaking and the second, a 'referral' occurred very late into sensemaking when they hit a roadblock. This seems in accordance with the hypothesis that early on sensemaking may be incubated and hard to externalize and convey. Thus in order to minimize collaborative effort, it is best to handoff either before incubation or handoff when sufficient sense has been made so it can be conveyed or handed off easily. If a handoff takes place in the middle of the incubation phase, the provider might not be able to convey the sense made and the recipient might be forced to start afresh. In this situation the effort of the first sensemaker is completely wasted. The collaborative effort of the group is minimized when the recipient can easily make sense of the problem and the progress so far. This happens when the handoff is done at a later stage when at least some rudimentary sense has been made. This rudimentary sense could include problem definition so far, tried but failed hypotheses and untested hypotheses so far. In contrast, handoffs made in the middle were considered rogue behavior by other members.

"We had somebody in the phones room last week who was upset about something so she put a referral in on something when she shouldn't have but I think she was just mad at all of us. She wouldn't ask us any questions."

Quality of tickets

The principle of least collaborative effort also directed the quality and length of the tickets. Team members often prepared high quality tickets, to obviate the need for later clarifications. Tickets that were missing information, or were too verbose to read through required the recipient to call and clarify. Thus the emergent norm was to write a ticket that required minimum clarification from the writer. Even though G1 team members had two way radios and cellular phones, it was disruptive to answer them, thus most writers said they strove to write precise tickets.

Organizational factors: Mindfulness

The factors discussed here are considered 'organizational' because they emerge from decisions made at the organizational level. Weick and Sutcliffe [18] observed high reliability organizations (HROs) like aircraft carriers and nuclear power plant control rooms and extracted principles for efficient sensemaking or mindfulness. Although these principles were observed in HROs, they can be implicitly at play in any organization. The findings in this study suggest that many of the principles of mindfulness were at play in the helpdesks. Next, the five principles of mindfulness from Weick & Sutcliffe are introduced and discussed with the findings from the study.

Preoccupation with failure

This principle says that organizations should pay special attention to errors and failures. The supervisors of both groups reiterated that they took special effort to minimize the number of referrals. For both groups, a referral was considered somewhat equivalent to a failure and both groups strove to keep referral numbers low. The supervisor for G1 remarked that they had been successful in reducing the number of referrals from few-a-day to two-a-month in the last few

years since adoption of new communication channels like two way radios. While they considered the low number of referrals a good thing, they always sought to reduce referrals to a minimum.

“That’s sort of like I’ve been **defeated** here when you have to put in a referral. At least that’s the way I feel. I hardly ever put in a referral.”

“To me (the supervisor) that’s (user feedback) the most important information – who’s unhappy. I’m glad people are happy but in my book I want to hear from people who are unhappy so I can fix it.”

Reluctance to simplify

This principle means that nothing should be taken for granted; simple explanations should be challenged and alternative complex explanations should be sought. The stress on finishing a call without handoff seems to be at odds with well thought and mindful sensemaking and reluctance to simplify. Yet there were other practices that enforced reluctance to simplify interpretations. The first enabler was the culture of admission of missing knowledge and asking the group for help. The low cost of communication, especially in G1 meant people could be exposed to different views rather than proceeding alone based on their own interpretations.

“If you watch us in the room I guarantee you somebody immediately will say did you try this? Did you try that? Or somebody will say oh I had that happen one day so just kind of talking it out in the room. And you’ll think oh I’m kind of heading down the wrong path.”

The second enabler was the established procedure of going back to the user after receiving a handoff referral.

“Now 9 times out of 10 that customer will give you another piece of information they did not give that consultant will then change everything and then you end up going down a different path and redoing the trouble shooting.”

Even when a lot of information about a case was available, the experts did not form a hypothesis before asking the users a fresh set of questions.

Sensitivity to operations

The principle prescribes paying serious attention to minute-to-minute operations and being aware of imperfections in these activities. The supervisors at both groups had separate offices, yet were highly involved in the operations of the groups. In G1 the supervisor would spend most of her time in the phone room with the other employees to be aware of all operations. When asked why she did not sit in her office she informed that her office did not have a direct spatial connection (a door or window) with the phone room and she did not like being cutoff from the group. In G2 the supervisor was in an office that opened into the group space and so would often walkout to be aware of operations. In G1 even senior directors spent a weekend taking calls with the rest of the team. This sensitivity of operations is similar to the case described by Weick & Sutcliffe [18] where an air force aircraft carrier (an example of an HRO) captain takes a walk with all staff on the flight deck looking for debris and loose parts that could be dangerous to landing planes. Such sensitivity not only raised morale, but also resulted in increased belief in upper management.

“Their willingness to get on the phones and sit in the front lines and take the phone calls gave me a lot of respect for them because they truly want to be able to see”

“You have to include someone from the front line when you are doing stuff because if you want to have an idea you have got to talk to them because they don’t how customers generally react. We know from experience. We talked to these people on a daily basis.”

Commitment to resilience

Weick and Sutcliffe say that the best way to build resilience is to have excess capacity and by creating knowledge and skills. This commitment was observed especially in G1. Limiting the phone room time to 20 hours per week, yet providing them two way radios and cellular phones meant that excess capacity was always available when needed. During sudden spikes in call volume, some calls were transferred to ‘away’ members. Secondly even though no team members had a computer science degree, they had been hired for their communication and trouble shooting skills. In their years of experience they had not only built up personal computing skills but also transactive knowledge [1]. They were aware what expertise other people had. Once

the team members had labeled themselves as 'problem solvers', they implicitly embraced the culture of resilience. Most participants said that it did not matter if they did not know an answer; they knew they could rely on other team members and their problem solving skills to find it out

"We have...not me (laughs)...there are some of the smartest people computer wise in that room....we're problem solvers."

Deference to expertise

During troubled times, Weick & Sutcliffe suggest shifting the leadership role to the person or team possessing the greatest expertise and experience. Within both groups, rank and status did not influence problem solving. Most members of the groups had their own areas of expertise and a question outside their scope was handed off to an appropriate expert. In severe outages and during cascading problems, the relevant experts were sought and asked to prepare guides and cheat sheets for other employees.

Design implications

This study attempted to explore other causes for handoff besides shift change. Another goal of the study was to find how people decide when to handoff and what to handoff. Based on the findings, we can also draw implications for systems supporting handoff.

Firstly, non shift-change handoffs offer an exciting support opportunity for systems and such handovers should not be ignored by designers. There exist situations other than shift change where handoff may happen or even be desirable. The biggest reason for such handoffs is the need for a different perspective or skill.

It would help to pay attention to the differences between shift change and non-shift change situations that may pose different design requirements. In non shift change situations, the recipient and the provider may not meet face to face at the time of handoff unlike during shift changes. This might put more communication demands on the system. Non-shift change handoffs also involve more flexibility and may require more customizability. For example the handoff provider picks time of handoff and sometimes also chooses the recipient of the handoff in a non shift change handover. In a large group, expertise finding systems may help as well, since a different skill is often required to proceed. Finally non-shift handoffs put lesser time stress on the handoff provider. They may usually be able to put in more detailed information than possible in shift change handovers as there are no hard handoff times in non shift handoffs. Due to the higher detail of information in non shift change handoffs, better information organizing tools may be needed to make handoff material comprehensible. Classification, clustering and summarizing may help organize the handoff material.

The second implication is that low cost communication channels must be provided during handoff. The implication is not novel but must be reiterated nevertheless. One reason for success in the helpdesk groups was the ease of communication coupled with a high common ground and small group size. Where groups are larger and common ground is low because of turnover, the communication demands may be different. Integration of communication with the handoff support system may be beneficial for large groups. Most participants said asynchronous communication was too slow for trouble shooting. Synchronous communication with people involved in handoff can help clarify details quickly and save time.

The third implication is that systems should allow for markers that show how much work has been done on the problem and how mature the external representation is. Long texts and time stamps are often imprecise indicators of how much work has been done and how much work remains. If a recipient can judge that a problem is fresh and the supporting material is inchoate, she can correctly decide to start on her own after skimming the provided material.

On the other hand if it is clear that the external representation and thus the supporting material is close to the solution, the recipient's time is better spent in making sense of the material handed-off. Some external representations contain markers that quickly show how mature they are. A good example is an architect's sketch on paper. A quick glance can inform another architect whether it is a well prepared idea or a half cooked one. Computer aided representations often don't contain such markers and can be misjudged by recipients. A system that allows for the creation of external representation with markers for maturity can help handoff immensely. These markers can be achieved in text by the usage of various fonts or by enabling scribbling and commenting within the external representation.

It is clear that many of the implications for design also have corollary implications for organizational culture and group practices and norms. Systems cannot perform without appropriate group practices. For example, if people don't feel safe marking their material as inchoate, they might wrongly mark it as ready even when it not.

Conclusion

This paper began by integrating two theories of sensemaking that helped expand our understanding of sensemaking handoff. The results from interviews with computer helpdesk personnel revealed that non-shift handoffs occurred frequently because someone else had the appropriate skill or perspective to solve the problem. The time of the handoff and the quality of handoff material was chosen by team members according to the principle of least collaborative effort. The time of handoff was picked as either very early or very late to reduce problems due to incubation. A host of organizational factors worked along with the principle of least collaborative effort to guide the work practices of helpdesk employees.

The findings have implications for best practices in groups engaging in non shift change handoffs. First, handoff should be avoided unless a new perspective or skill is required. Second, handoff should be done either before sensemaking begins or after considerable sense has been made. Third, the principles of mindfulness can be used to guide handoffs and can be used as best practices.

The findings have some implications for support systems as well. Non-shift change handovers offer different design challenges and opportunities than shift change handoffs. Low cost communication channels must also be incorporated in the system for efficient handoff. Lastly the support system should allow representational flexibility so handoff providers can put markers about the maturity of their representations in their handoff material. These markers may help decide on an appropriate time for handoff and also help the recipient in judging the usefulness of the material.

Acknowledgments

I am grateful to George Furnas for his help and advice. This work was funded by NSF grant IIS-0325347-ITR.

References

1. Argote, L. Organizational Learning: Creating, Retaining and Transferring Knowledge, Kluwer Academic Publishers, (1999)
2. Christopher, A. et al. 1977. A Pattern Language - Towns Buildings Construction. New York: Oxford University Press
3. Clark. H. H., & Wilkes-Gibbs, D. (1986). Referring as a collaborative process. *Cognition*, 22. 1-39.
4. Constant, D., Kiesler, S. and Sproull, L. (1994) What's Mine is Ours, or Is It? A Study of Attitudes about Information Sharing, *Information Systems Research*, 5, 4, pp. 400-421.
5. Dervin, B. Sense-Making Theory and Practice: An overview of user interests in knowledge seeking and use. (1998) *Journal of Knowledge Management*, 2(2), 36-46
6. Gormly, John. "Rapid Help Desk Revitalization." SIGUCCS September 2003: 159-162. ACM Digital Library. Association for Computing Machinery. Winthrop University Libraries, Rock Hill, SC. 30 July 2006
7. Harper, R.H.R. and Hughes, J.A., "What a f-ing system! Send 'em all to the same place and then expect us to stop 'em hitting: Making Technology Work in Air Traffic Control," in *Technology in Working Order*, Routledge, London, 1993, 127--144.
8. <http://www.safetyandquality.org/clinhovrlitrev.pdf> Clinical Handover and Patient Safety Literature Review Report March 2005.
9. Litzinger, A. and R. Rohde Boehler, Patient-oriented pharmacy on a special ward: results of a pilot project in Germany. *Pharmacy World and Science.*, 1997. 19(2): p. 101-4.
10. Olson, G. M. and Olson, J. S. (2001) Distance Matters. *Human-Computer Interaction* 15, 139-179.
11. Patterson , E.S. and Woods, D.D. Shift Changes, Updates, and the On-Call Architecture in Space Shuttle Mission Control, *Computer Supported Cooperative Work*, v.10 n.3-4, p.317-346, December 2001
12. Priest, C.S. and S.K. Holmberg, A new model for the mental health nursing change of shift report. *Journal of Psychosocial Nursing & Mental Health Services.*, 2000. 38(8): p. 36-43.
13. Russell, D. M., Stefik, M. J., Pirolli, P., Card, S. K. (1993) Cost structure of sensemaking. *Proc CHI '93*
14. Schlienger, R.G., et al., Academic detailing improves identification and reporting of adverse drug events. *Pharmacy World & Science.*, 1999. 21(3): p. 110-5.
15. Shrake, K.L., et al., Benefits associated with a respiratory care assessment-treatment program: results of a pilot study. *Respiratory Care.*, 1994. 39(7): p. 715-24.

16. Suchman L., Constituting shared workspaces. In Y. Engestrom & D. Middleton (eds.) *Cognition and Communication at Work*. Cambridge University Press, Cambridge, MA, 1996.
17. Weick, K. E. (1996). *Sensemaking in organizations*. Newbury Park, CA: Sage.
18. Weick, K.E., & Sutcliffe, K.M. 2001. *Managing the Unexpected: Assuring High Performance in an Age of Complexity*. University of Michigan Pressing Problem Series. San Francisco: Jossey-Bass.
19. Zwarenstein, M. and W. Bryant, Interventions to promote collaboration between nurses and doctors (Cochrane Review). In *Cochrane Database of Systematic Reviews*. 2002. p. 16.