On Visual Granularity: Collocated Sales Meeting Interactions in the Machine Industry

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ABSTRACT
Visual representations are being used in typical sales meetings of the machine industry to exchange information and support social interactions. In these meetings, sales representatives design for *granularity* by taking into account verbal and visual details of communication. Our article builds on increasingly occurring collocated interactions in sales meetings investigating the social relevance of mobile devices in face-to-face settings. The article aims to understand the supporting and disturbing role of visual granularity in sales meetings and develops design implications for interaction designers. We conducted an ethnographic study of sales meetings in material handling and paper machine industries, including Conversation Analysis (CA) of video recordings, and involving groups of professional analysts that are seldom used in HCI. Our findings draw evidence from sales meetings and design processes on successful and unsuccessful use of granularity in visual representations. Finally, we propose seven design guidelines for visual granularity striving to understand buyers' perceptions and visual qualities.

Author Keywords
Collocated interaction; conversation analysis; granularity; ethnomethodology; visual representations.

ACM Classification Keywords
H.5.3 Group and Organization Interfaces

INTRODUCTION
Sales representatives (or sales reps) and buyers in the machine industry typically use different visual representations to exchange information and mediate social interactions during sales meetings. To support their persuasive arguments, sales reps use projected slide presentations, videos, product and service pricelists, computed simulators and configurators, maintenance plans and reporting, CRM (customer relationship management) databases, and contracts. Machine industries consist of organisations that produce and sell machinery (e.g., lift trucks, paper machines, cranes, cruiser ship motors, automation systems) for other organisations. Modern work of industrial sales reps and buyers aim at selling mixed product and service bundles, forming larger solutions and value proposals that better fit the buyer organisations' unique needs. Selling single product units and presenting glossy paper brochures including polished images of products, is simply not always enough to achieve organisational goals on either end. While brochures have the advantage that they can be easily left in the hands of a buyer and act as a reminder of the meeting, laptops and tablets can store almost endless amounts of files, especially when connected to cloud services.

Despite being originally intended for single-user activities [36] and seen as problematic during social activities [61], sales reps have increasingly begun using mobile devices (e.g., smartphones, tablets and laptops) in a collocated way [37], in sales meetings and more generally in work-related [50] settings. Sales reps choose their digital equipment based on equipment provided by a workplace, personal desires, number of participants in meetings, and locations in a buyer's operational environment (e.g., meeting rooms).

Our study aims to create a relevant understanding for interaction designers on supporting conversations between participants with visual representations in certain contexts. Context is defined by physical locations and objects, social influences, tasks participants aim to do, and how those are interrupted. Equipment and technology, and temporal time-based influences are also involved [31,34]. Using visual representations only once or leaving them behind for extended periods of time is common in selling contexts of the machine industry. These uses often revolve around information exchange in conversations amongst sales reps and buyers. Earlier studies combining conversational and visual elements have been conducted in contexts such as architects imagining with other architects [45], and urban planning conversations through interactions and materials in use [43].

Designing *granularity* is a typical task for sales reps when planning presentations and social interactions. The term *granularity* [53] originates in sociology where it is used to describe utterances in a conversation expressing certain detail level or form. Below, we elaborate the social relevance of granularity. We make choices on the level of detail and form of a conversation depending on specific

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exchanges of an ongoing conversation. In Schegloff's [53] example of form of granularity, the utterance "someone told me…", by "someone" the messenger is referring to an unknown or hidden identity. Another example represents detail levels of information in different responses to the question "where are you?". Such as, "back in the States", "in California", "in LA", "in Topanga", "at home", "in the study", "at my desk", "at the computer", "on page two", etc. The different resolution of detail either zooms in or out from the target (ibid.)

Sales reps are typically oriented towards creating their verbal granularity so that it matches the buyers' understanding. *Recipient design* also originates in sociology [52] and considerations of context-sensitive elements in conversation that orient to particular others who are co-participants. Recipient design has later been adopted in neuroscience research evidencing that humans in general behold an ability to tune their communication based on who the recipient is [7]. We propose the notion of visualising granularity as a perspective for interaction designers in sales conversations, to better embed designed visual representations into these. Hence, the designers' role is to support a fluent use of granularity for the sales reps in their context-sensitive persuasive arguments, and in this case, a specific buyer's professional knowledge, and aims in tuning accurate enough visual details for their understanding.

This article contributes to the HCI community on mobile collocated interactions and applied Conversation Analysis (CA) methodologies through the following research questions: a) *what can we learn about interaction design from an ethnographic study of sales meetings in the machine industry,* and b) *how to design visual representations that support sales meeting conversations in varying details and forms?* When using the term granularity, we aim to emphasise on visualising details in different styles and levels used in representations. These visualisations mediate conversation in sales meeting contexts that include extensive information exchange. Through these, we strive to open a discussion with the HCI community on the supportive and disturbing role of *visual granularity*.

This paper is structured as follows. First, we cover relevant related work. Second, we present the chosen methodology and data. Third, four samples from two case studies are presented, followed by findings, discussion and conclusions.

RELATED WORK

In this section, we discuss related work on two main areas: the use of Conversation Analysis (CA) both in HCI and collocated interactions, and connecting our study to collocated interactions research.

Conversation Analysis in HCI & Collocated Interactions

CA has influenced the HCI community since the 80's. Lucy Suchman's seminal work on human-machine interaction [56] has been followed by several books of other influential inquiries on HCI system design [40, 59, 64], CMC (Computer Mediated Communication) systems [3, 8, 54], interactive systems using conversational patterns [13, 22], screen-based and speech interfaces and collaborative working environments [9,19,29,47,64]. Norman and Thomas (1990) established the usage of CA in HCI as an analytic tool, which enables designing superior interactive artefacts [47]. Our paper aims to introduce the use of CA into the 'in-between' region of sales reps and software professionals [44] in the machine industry. We also used groups of professional conversation analysts in the domain of design, where typically independently working analysts have participated [63].

Previous studies combining CA and mobile collocated interactions, reveal conversations on videoed mobile phone usage amongst students in pub settings [49]. Based on video analysis of interactions between lift truck drivers, situations where forklift flow runs smoothly, and others where it does not were identified [18]. We follow this line of research to draw evidence of types of *visual granularity* that support and disturb sales meeting interactions.

Collocated Interactions

The use of digital content in sales meeting contexts is growing, opening up space for designers to explore those contexts with the use of technological means. The use of multiple devices to present content among collocated users has been vastly explored in research. This development started in 2007/2008. Interaction designers became interested in mobile collocated interactions with the use of emerging suitable engineering platforms for mobile group applications [16,36,37,38,39,48]. Similarly, our research looks into mobile phones, tablets and projectors and their content as support for the conversation taking place in a sales meeting. Our focus is less on what is taking place on the devices themselves, and we investigate more on using the devices in social interactions during sales meetings [41].

Taylor et al. [59] present collocated individuals using mobile devices as shared platforms, where the authors observe a group of teenagers' social practices through mobile phone use. Their findings report maintaining social practices through exchanges of their phones and content in socially established ceremonies. Similarly, in the machine industry there is a sanctioned procedure where the use of different devices as shared platforms plays an important role in conducting sales meetings. In the following section, we present the methodology of our conducted studies.

METHODOLOGY AND DATA

We used ethnography [24] as a method in studying two organisations' salesforces from the machine industry and developed design implications for visually mediated interactions. The studied producers were from the material handling industry selling lift trucks and added services (Case 1), and from the paper machine industry selling machinery and maintenance for paper factories (Case 2).

Understanding Sales Representatives

In understanding the context of a sales meeting, it is essential to first understand the motivations and characteristics of the main actors' work (i.e., sales reps and buyers). Grasping into mundane activities of sales reps required collecting and studying multiple types of data and domain knowledge [17]. Extensive fieldwork in selling environments allowed us to create thick descriptions [23] of analysed interactions containing conversation and digital equipment. Ethnographic studies have been conducted in such socio-technical environments for decades, including studies in office systems [56], air traffic control systems [30], underground control rooms [26], and service calls for copy machines [28]. Ethnography has been known to benefit in informing design [57] that demands understanding of complex social settings [51].

Face-to-face sales interaction typically included negotiation types of conversational sequences. In these sequences, proposals are firstly presented and later responded by either accepting or rejecting them [2]. These proposals and responses can be mediated through documents in visual, text-based, and paper or digital forms. Design implications inferred from this study provide evidence [17] of how visual representations need to be designed with consideration of levels and forms of details, relevant to the interaction and context.

More than spoken words are used for communication in face-to-face interactions [4]. HCI, semiotics, and multimodal studies have shown the relevance to understand participants' direction of gaze, body gestures, and facial expressions showing if there are difficulties or an emotional transition in the upcoming utterances [32,33]. Similar to earlier research on teleservice work [62], audio-visual recordings of sales meetings became our central, and most frequently used form of data. The extensive, fast-spoken information exchange between participants using digital devices to mediate the conversation, were problematic to observe or report purely with field notes and still photographs. The mediated and context-sensitive [27] information exchange was repeated on video to a variety of researchers [26], and analysed through CA [52].

Ethnographic Research Data and Analysis

First, on data collection the research was conducted in two companies (Case 1 and Case 2). A total of 7 sales meetings were observed (6 for Case 1, and 1 for Case 2). The first author was present during the observations, and remained unobtrusive allowing activities to flow naturally. In addition, 11 individual interviews on the topics of 'sales' and 'equipment' were conducted (eight for Case 1, and three for Case 2). The interviews lasted between 1.5 and 2 hours. The interviewees were sales reps (7), sales managers (2), a marketing manager and an R&D manager. One sales meeting participant from each Case also took part in the interviews. Furthermore, five contextual inquiries [6] lasting 30-60 minutes were carried out in the sales reps' workplace, where they presented 1-4 digital tools, systems, and visual representations. One sales meeting participant (from Case 2) also participated in one contextual inquiry. Finally, five design and development workshops lasting 1-2 hours (two for Case 1, three for Case 2) were also arranged. Videos were recorded for two sales meetings (one for Case 1 lasting 48 minutes from a 1-hour meeting, and one for Case 2 lasting 181 minutes from a 5-hour meeting including lunch), three contextual inquiries, and one development workshop. Otherwise audio recordings, photos and notes were collected during the remaining activities.

Second, data analysis was conducted by 15 researchers (see also [15]). Sales meeting videos were transcribed and sequenced by the first author. Then transcriptions and video excerpts (7 from Case 1, and 16 from Case 2) were presented to two interaction designers. In addition, four CA sessions with 13 researchers were arranged. During CA sessions, the first author introduced a brief description of video excerpts, which were watched three or four times, while analysts asked questions. Then, the excerpts were watched approximately ten times as analysts wrote personal notes, after which there were individual rounds of comments that were discussed and compared. The video analysts were from the fields of interaction design (3), sociology (6), linguistics (1) and organisation management (3). These researchers included doctoral students, post-doc researchers and professors. In both, Case 1 and 2, the analysing researchers included participants from different fields of science, and also included more experienced researchers.

Third, the criteria to choose these four Samples (two from each Case) was to analyse situations during sales meetings where visual representations were either supporting or disturbing the ongoing conversation. Samples 1 and 3 are both connected to Case 1, while Samples 2 and 4 come from Case 2. Lastly, Samples 3 and 4 are discussed differently as they consist of visual representations collected during the design and development workshops (thus there were no video recordings to perform a similar analysis as for Samples 1 and 2).

Based on considerable grammatical differences between Finnish and English languages, also the original *Finnish transcripts are included in italics*. Confidential content is removed from excerpts and video captions. Persons in video captions have been made unrecognisable. The most relevant transcripts are underlined to ease readers to focus.

Varying Visual Representation Roles in Sales Meetings

Below we present Samples 1 and 2. In both examples 2D visualisations are used by sales reps as means of negotiation between different actors. The first example demonstrates how a visual representation was utilised to normalise a conflicting situation. The second example illustrates a moment of uncertainty and misinterpretation of a visual representation.

Case 1: Excerpt: Visually Mediated Response to Warehouse Manager´s Maintenance Worries (Sample 1)
S-REP: sales rep (right), W-MAN: warehouse manager (left-front), PUR: purchaser (left-back).

The participating material handling industry produces lift trucks (Case 1). The sales rep (S-REP) is aiming to sell three high-lift-order-picker trucks and one reach truck to the buyers: the warehouse manager (W-MAN) and the purchaser (PUR). The whole meeting lasted 1 hour. The warehouse manager was suspicious of the maintenance work made for lift trucks that were bought earlier from the same seller. The sales rep tries to convince him that the maintenance follows normal procedures. The sales rep has provided visual representations based on the seller's maintenance records. The sales rep's organisation follows a procedure of including visualised maintenance reports into the machine prices for buyers who have multiple seller's lift trucks in their possession (instead of just a couple). These are so-called 'large customers' (see Figures 1 and 2).

01 PUR: Did Mika have a comment to the
02 maintenance job, apparently you [are closer to
03 that, and,
01-03 PUR: Oliks Mikalla kommenttia siihen huoltohommaan, ilmeisesti sä [oot lähempänä sitä ja,
04 [W-MAN: Yea, just that yes], I have been
05 thinking that, we would need maybe a bit more
06 accurate report on what to fix and what was (.)
07 I feel sometimes that almost like (0.5) They are
08 fixing something that does not exist,
04-08 [W-MAN: Joo siis se vaan että joo], sitä mä oon miettiny että pitäs saada ehkä vähän tarkempaa raporttii mitä korjata ja mikä oli (.) Must tuntuu joskus että (0.5) ihan ku tota korjattas sitä mitä ei oo,
09 S-REP: Okey.
09 S-REP: Okei.
10 W-MAN: That kind of feeling I have had,
11 because let's say it so, my technical knowledge
12 is not enough [.
10-12 W-MAN: Sellanen fiilis tullu, koska sanotaan näin itellä ei riitä se tekninen tieto siihe [.
13 [S-REP: Just the same,]
13 [S-REP: Ihan sama,]
14 W-MAN: °hh. Yesh.°
14 W-MAN: °hh. Jooh.°
15 S-REP: Just the same here, it needs the pro guy
16 (mutual nodding).
15-16 S-REP: Ihan sama et se tarvii sen pro kaverin.
17 W-MAN: Yes.
17 W-MAN: Joo
18 S-REP: Oh (0.4) did you receive these, I might
19 have sent you that fixing report, that had this
20 specification (0.8) Didn't it come, this ours.
18-20 S-REP: Tota (0.4) onks teille tullu nää, eiku mä taisin lähettääkki teille sen korjausraportin silloin mis oli tää erittely (0.8) Eiks tullu, tää meidän.

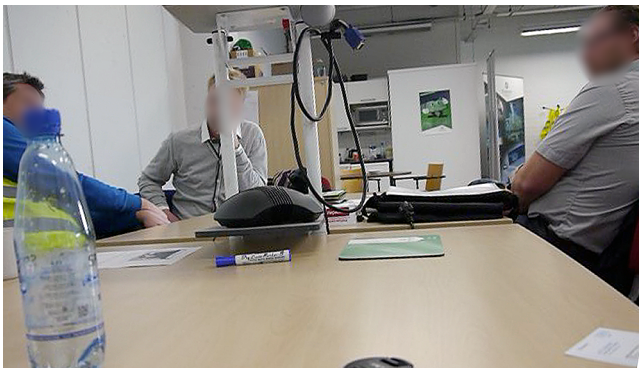

Figure 1. Sample 1, excerpt line 6, W-MAN (left) complains about maintenance to S-REP (right).

Omitted: 66 seconds used to locate the report and marked as significant to the conversations. These utterances reveal the visualised report being directed to W-MAN responding for the buyer's operational environment. S-REP has sent it to W-MAN via e-mail, which W-MAN has received, but only examined it briefly.

The excerpt presents a challenging point in the current conversation. This is opened by PUR on lines 01-03 giving the floor to W-MAN according to maintenance of the existing machines sold by S-REP's company in the past. This is followed on lines 04-08 and 10-12 by W-MAN's claim about possible unwanted maintenance visits made (and charged) by the seller's organisation. In lines 04-08 and 10-12, the pose of W-MAN is leaning back away from S-REP and closes arms around the body. These body gestures indicate a delicate topic to discuss.

On lines 07-08, W-MAN mentions that 'they are fixing something that does not exist', meaning that maintenance people are fabricating non-existent problems. During lines 07-08 W-MAN looks into the eyes of S-REP. These mentioned actions of turn switch by PUR to W-MAN in lines 01-03, and W-MAN's grounding on this issue on lines 04-08 and 10-12, indicate a serious complaint. W-MAN might show some insecurity through body gestures whilst bringing up this issue, as well as criticism towards the seller by the mentioned gaze on lines 07-08. S-REP starts responding on lines 13 and 15-16 by agreeing with W-MAN and does this by mitigating his own technical skills as well. S-REP does this also without agreeing on the maintenance mistakes. Lines 15-16 define that no one in the room has detailed enough knowledge on lift truck maintenance. On lines 15-16 S-REP attempts to halt the discussion on detailed maintenance work, as this cannot take place without the 'pro guy'. On lines 18-20 S-REP's asks about a report sent earlier. During utterances on lines 18-20 S-REP's tone of voice resembles 'grandpa talk' [58] and marks these utterances with this notion of 'let me tell you children what this is about'. S-REP sounds confident upon responding to the complaint.

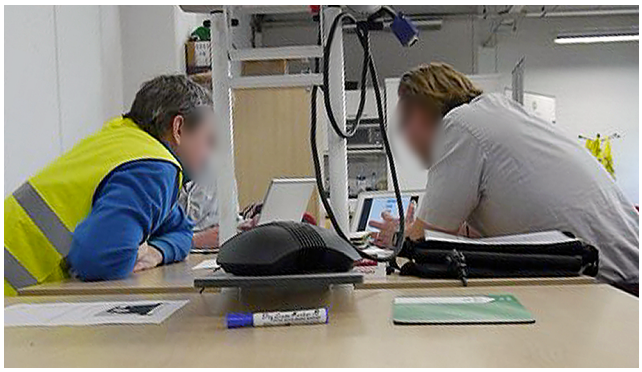

Figure 2. Sample 1, excerpt lines 33-34, W-MAN (left) and S-REP (right) view maintenance report from a tablet.

21 S-REP: Here we can see these, misusage
22 reports and fixing, there are long term rents,
23 (1.0) there is fault fixing, (.) well it is just here
24 (2.0) °let's see what machine this is° (4.0).
21-24 S-REP: Täshän näkyy nää tota väärinkäyttöraportit ja korjaukset, tos on pitkäaikaisvuokrat (1.0), tos on vikakorjaus, (.) no se on juuri nää (2.0) °katotaas mikä kone tää on°(4.0).
25 S-REP: F14, (.) so that's the old one[.
25 S-REP: F14, (.) elikkä se on sitä vanhaa[.
26 [W-MAN: That one might be, is it the 98.]
26 [W-MAN: Se on varmaa, onks se-se 98.]
27 S-REP: Yeah.
27 S-REP: Oh.
28 W-MAN: Yes, It[is the one that is now.
28 WMAN: Joo, Se[on se just mikä nyt oh.
29 [PUR: I also remember [seeing it.]
29 [PUR: Mäki muistan [nähneeni.]
30 [W-MAN: It is the one parked out there (.) that
31 is out of usage.]
30-31 [W-MAN: Se oh just nyt mikä on tossa parkissa (.) mikä on pois käytöstä.]
32 S-REP: Here are the high-pickers then. Here is
33 TTS (.) There is also little bit[.
32-33 S-REP: Jooh, Tääl on sit nää korkkarit, tääl on TTS:sä (.) no siinäkin on jonkin verran[.
34 [W-MAN: Yeah, and [it has sort]of increased
35 now, so it is (nodding).]
34-35 [W-MAN: Joo ja [se on nyt]niinku kasvanu, et se o.]
36 [S-REP And it goes-]
36 [S-REP: Ja se menee-]
37 S-REP: Yes (nodding).
37 S-REP: Kyllä.

On lines 21-24 S-REP begins to provide a response to W-MAN's critical complaint, through a mobile collocated interaction session by describing the content of the report. S-REP turns the tablet computer so that everyone can see as much as possible and shakes his body once when starting to talk. Between lines 25-35 W-MAN and PUR lean towards S-REP's tablet and their gaze is directed at the visualised maintenance report (Figure 2). S-REP and W-MAN agree on separate maintenance costs of the buyer's machines by using positive wordings and nodding as body gestures. On line 29, PUR mentions seeing one of the machines under discussion. By saying that, PUR informs the others he also understands what the discussion is about. At this point, all participants have indicated their interest in the collocated interaction taking place, by saying something in connection to the representation.

Instead of talking to convince W-MAN, S-REP presents the visualised report. The report represents the aging of the buyer's machines through diagrams and figures, which provide statistical information about when repair and maintenance needs grow. By elaborating through the report on each of the separate machines that the buyer has in their possession, S-REP provides an image of the organisational procedure in following repair and maintenance. Grounding the response on visualised data offers something that resembles official information, which is easier for people to believe. By separating the different types of machines in the report, S-REP also emphasises that repair and maintenance work is a complex field to understand. During the mediated interaction with the visual representation in use, visible and audible changes happened in the atmosphere, from a negative starting point, to a point where W-MAN and PUR both indicate being satisfied.

Sample 1 represents successful use of visualised granularity, which supports the interaction. The significance of the visual representation in use comes in that it only displays simple graphics of the increasing maintenance needs for each machine through aging. There is no evidence of what really happened during the maintenance sessions, or who did them, as the visual granularity level does not go to that level. Lines 11-16 also reveal that no one in the room had expertise on lift truck maintenance, and therefore no one can present detailed information on how it is done. Hence, it can be concluded from this mediated interaction that the visual representation had positive influence without actually elaborating an answer to W-MAN's original claim. The claim was related to having detailed information about the maintenance made on lines 05-08, but the granular resolution on the report provided a satisfying level of understanding to W-MAN, without providing that detail.

Case 2: Excerpt: Whose Roll Workshop is it? (Sample 2)
GOM: Global Operations Manager (left-back), PSM: Product Sales Manager (left-front), GSM: Global Sales Manager (right-front), PS: Product Specialist (right-back).

A sales team consisting of five persons (one is away during the excerpt) from the paper machine industry (Case 2) is preparing to meet a specific buyer in the near future. Approximately 5 hours of meeting time was used during the day. The Global Sales Manager (GSM) asks to show a specific slide during a PowerPoint presentation of sales conceptualisation for the buyer. GSM has created this visualisation in the past, and the Global Operations Manager (GOM) has also used it in the past. The sales team falls into an argument on the location of the roll workshop

(i.e., is it in the buyer's factory, or is it a separate one somewhere else owned by the seller?) The location of the roll workshop is a typical discussion when forming maintenance related sales conceptualisations, and relates to the location where rolls of paper machines are serviced.

38 GSM: Here is roll maintenance.
38 GSM: Näissä on telahuoltoo.
39 GOM: SO, we thought that here are sort of
40 (1.0) kupi=work=managers, work=planners,
41 maintenance=groups are here, and there is the
42 roll=workshop from where, where things come
43 (0.8) from (1.9). It may be that we produce that
44 (1.5) expertise group then °to the factory if
45 needed° (2.2). We had, we talked about
46 maintenance=coordinator at that time (.) and
47 him/her as sort of contact=person (2.0) and sort
48 of Saukko's, if needed Saukko's work=leader.
39-48 GOM: NII, se oli tässä ajateltuna et tääl on niinkun (1.0) kupityöjohtajat, työsuunnittelijat, ylläpitoryhmät on täällä, siel on se telaverstas missä, mistä tulee (0.8) tavaroita (1.9). Voi olla et me tota tuotetaan sitä (1.5) asiantuntijaporukkaa sitte sinne °tehtaalle tarvittaessa° (2.2). Meillä oli, me puhuttiin kunnossapitokoordinaattorista silloin (.) mihin mentiin et se on niinku yhteyshenkilönä (2.0) niinku Saukon, ja tarvittaessa, Saukon työjohtajana.
49 GSM: So, what is that roll=workshop unit now
50 then.
49-50 GSM: No, mikäs toi telaverstas nyt sitte on.
51 GOM: Well, this here (0.7), this is the roll=
52 workshop (2.3) (seller's), I recall, if I recall
53 right, now was this here our roll=workshop,
54 because the factory has own one. From factory,
55 there came ordered services (0.8) to be serviced.
51-55 GOM: No, tää on (0.7) tää on se telaverstas (2.3) muistaakseni jos mää oikein muistan ni tää oliko tää nyt meiän telaverstas koska tehtaalla on omansa ni sit tää, tehtaalta tuli tänne määrättyjä huoltoja (0.8) huoltoja tehtäväks.
56 PSM: Or actuall[y.
56 PSM: Tai itseasias[sa.
57 [GSM: That, that is fac[tory's workshop.]
57 [GSM: Tuo, tuo on teht[aan verstas.]
58 [PSM: That is factory[']s workshop.]
58 [PSM: Tuo on tehtaa[n verstas.]
59 [PS: This is.]()
59 [PS: Tää o.]()
60 GOM: This is factory's workshop. I don't
61 remember.
60-61 GOM: Tää on tehtaan verstas. Emmä muista.
62 PSM: Because there goes [from factory.
62 PSM: Koska tuossa menee [tehtaalta.
63 [GOM: Oh, right, this goes this way, this was
64 the factory's roll=workshop.]
63-64 [GOM: Eiku joo ku tää menee näin ku tää oli se tehtaan telaverstas.]
65 PS: It was not put into any bantu at that time
66 either.
65-66 PS: Sitä ei oltu silloinkaan viemässä mihkään bantuun.

GSM has topicalised the conversation around roll maintenance ending on line 38. On lines 39-41 GOM takes the turn and coherently begins to present the sales conceptualisation displayed on visual representation. GOM's act changes soon after mentioning the word 'roll workshop' on line 42. On lines 42-48, there are long breaks during utterances and vague verbal expressions making it visible that GOM may not want to talk about the roll workshop. The core mistake in these interactions starts from lines 42-43 where GOM mentions the roll workshop 'where things come from'. In the visual representation, on the top left corner, there is an orange arrow lightly pointing things going into the workshop, not coming out from it. The rest of the sales team gives no cues on reacting to GOM's utterance at this point.

Being the primary owner of the visual representation in use, GSM can legitimately question GOM's view about the roll workshop on lines 49-50. The letter 's' in the end of the Finnish word 'mikäs', 'what' in English, marks the visualisation as being something familiar. The usage of the Finnish word 'nyt', 'now' in English, in line 49 gives a negative orientation to the sentence by challenging GOM. GSM looks at GOM when making the question and GOM looks back at GSM. GOM is now forced to talk about the workshop.

On line 51 GOM starts responding with the word 'well', with such a prosodic emphasis that may indicate some emotional stress. GOM's wording 'well' also indicates that the following answer may be complicated. GOM's response on line 52, 'I recall, if I recall right' is a strong marker for the following sentence being something significant on lines 53-55. On lines 53-54 GOM claims that the roll workshop would be the seller's workshop, and that the buyer's factory has their own. GOM's gaze is in the visual representation and GOM moves a laser pointer in a circular motion on the left side of it, forming the factory as a separate unit from the roll workshop. On lines 54-55 GOM's gaze moves towards GSM while explaining that services came from the seller's workshop to the buyer's factory.

PSM's utterance on line 56 'Or actually' starts the correction period on GOM's answer, and gets interrupted by GSM's utterance on line 57 'That is factory's workshop'. Then PSM repeats GSM's sentence. On lines 60-61 GOM now realises misinterpreting the location and ownership of the roll workshop on the visual representation. The utterance 'I don't remember' on lines 60-61 is a face saving act by blaming memory, followed after realisation of the personal mistake.

Figure 3. Sample 2, Excerpt line 62, PSM (left front) shows GOM (left back) the way things move on the visualisation.

Figure 4. Sample 3. Failed design of visual representations for salesforce displaying customer needs in warehouse.

PSM's utterance on line 62 clearly indicates that the orange arrow on the top left in the representation has been misunderstood or not recognised by GOM. On line 62, as PSM says 'Because there goes from factory', PSM also points his right hand towards the arrow on the top left, and moves his right hand from left to right (Figure 3). This is the opposite direction that GOM presented on lines 41-42 and 54-55. PSM's hand movement finally seals GOM's understanding on how things are moving: paper machine rolls are moving to the roll workshop, inside the buyer's factory, to be serviced. On lines 63-64 GOM makes a correction based on the information given by others, being the right facts. On line 65 PS mentions the word 'bantu' meaning far away. PS describes the situation from the buyer's perspective, in this case taking the roll workshop away from the buyer to the seller is something they do not want to do. By doing that, PS joins the shared view on the location of the roll workshop inside the buyer's factory.

Sample 2 represents a failed use of visualised granularity in the intended interaction. The visual representation in use is a materialisation of GSM's thought created over six months ago. This makes GSM the primary owner. GOM does not share the same thinking but has also used the same presentations in buyers' locations some time ago. Based on different layers and a lack of details in the visual representation, GOM focuses on it, in ways that side track from the original purpose of presented sales conceptualisation. Time has passed since last using the presentation, making GOM's interpretation vulnerable to mistakes. By missing the meaning of the orange arrow on the top left, GOM sees the roll workshop as an external seller's roll workshop unit, away from the buyer's factory (Figure 3). The arrow lacks explanatory text, which would help by providing more detailed information. In addition, the shadow effect on PowerPoint and the grey colour of the roll workshop (instead of being red as the factory) may influence why GOM makes this misinterpretation.

Designing Visual Representations for Sales Meetings

Below we present Samples 3 (Case 1) and 4 (Case 2). Different from previous samples, the visual representations here are created by designers (including the first author). In Sample 3, the sales reps deny using the visual representation in a real sales context. Whereas Sample 4 demonstrates a debate among different stakeholders on, how the designed representations should be.

Case 1: Failing in Visualising Granularity for Salesforce in Material Handling Industry (Sample 3)

This third sample (Figure 4) reports a failing experienced in visualising granularity for sales reps (in Case 1), by leaving out their interactional viewpoints from the design process.

The visual representation was designed on a shared agreement by the R&D and Marketing departments, only briefly involving the salesforce in the design process. The reason to create this visualisation was to mediate discussions around critical customer needs in the operating environments for material handling. In this case a warehouse with different height shelves, doorways, ramps and loads that lift-trucks carry. These visualisations aimed in providing support for choosing the most appropriate lift-trucks for a specific buyer to buy. An external design agency was used to help in producing a high-quality, computer rendered 3D image that qualified for the standards of the Marketing department. During earlier phases, one sales rep had briefly commented on a rough prototype of the visualisation leaving preferences open ended. As the more polished visualisation was given to sales-reps, their increasingly negative approach came as surprise, which we elaborate below.

Sample 3 represents a failing in *visual granularity*. The sales reps reported the visualisation as being too childish to bring to the intended buyer. They thought professional warehouse managers already know their warehouses, and would only become irritated to see visuals as unwanted notifications [41]. Later, their sales manager also disapproved the representation in sufficient clarity. The experienced warehouse manager is the person that direct sales reps would face in the meetings most often. Marketing manager, concepts manager from R&D, and the first author as researcher all agreed on one thing: we failed in our attempt to create a visual representation for salesforce use. This resulted in questioning a 'taken for granted' design solution [1], which may have been influenced by typical industrial 'specification driven' design processes that avoid subjective implications [11]. The cause was not understanding these people's mundane activities and interactions with buyers in such detail that the design would be useful in intended sales meeting context with warehouse

managers. These experiences guided us to using ethnographic methods. In addition, a dataset of 20 interviews from a fellow researcher, pointed out the willingness of the salesforce to participate in design processes. These studies shed light on the participating material handling organisation's Marketing and R&D departments, and eventually enabled this.

Case 2: Varying Orientations in Design Team for Sales Support in Paper Machine Industry (Sample 4)

The fourth sample (Figure 5) elaborates different roles and views used in the development process of visual representations for the use of the salesforce (in Case 2). We participated in a paper machine producer's design process of modularising service offering. The representations would be for personal use in mobile devices and for sales meetings as presentations. Participants in the design process included a sales rep informing the design as a user, a marketing manager concentrating on brand-related details, and an industrial designer specialising on UI design. Other participants included Global Sales Manager (GSM) as project leader, and the first author as a researcher taking field notes during the process and providing some of the visualised prototypes.

Sample 4 represents a more mature visualisation of granularity for sales meeting interactions. The industrial designer wanted to include more functionality to the visual representation than the sales rep, and considered a picture of the customer's operational ground as a waste of space. The sales rep's view on having a landscape as part of the representation and leaving the smaller number of functional service components, resonated with personal understanding of what is suitable for conversation purposes with buyers. The marketing manager agreed on the sales rep's view and mentioned the importance of following visual brand guidelines such as logos, fonts, and colour themes. Here we had the opposite situation than in Sample 3 where the low resolution and banal details of too obvious content for warehouse managers irritated the sales reps. Now there was too much detail for conversation purposes suggested by the designer.

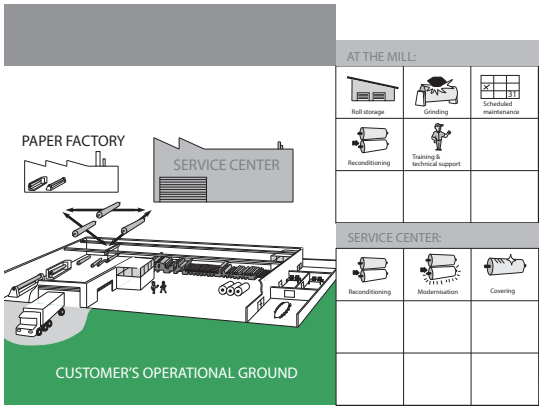

Figure 5. Sample 4, Prototype of visual representation (confidential content removed).

FINDINGS

We present our findings on visualised granularity in representations. We found that the appropriate granularity for a specific recipient supported a positive flow of interaction. However, using an inappropriate granularity for a specific recipient resulted in misinterpreting the original message and developed signs of possible emotional stress. Our findings also demonstrate that designing granularity without thorough understanding of the recipient resulted in a non-working visualisation. Having the actual messengers and (or) recipients participate in the design process enabled a more stable ground for visualising granularity.

Understanding Messengers and Recipients

An appropriate communication with *visual granularity* heavily impacts how the details in the messenger's information match the recipient's levels of understanding. Both underestimating or overestimating the recipient's ability to receive information [35] may result in disturbing interaction and generating a negative response. When the sales reps found our visuals too childish or too simple, it resulted in the recipient's loss of interest towards the visualisations (Sample 3). On the other hand, when the visualisations lacked details or had unclear forms such as in Sample 2, it resulted in the recipient misinterpreting information. We found difficulties when messengers or recipients were not involved in designing the representations (Sample 3). In these, the chosen visualised granularities were only based on assumptions, thus they were not accepted by the sales reps. Purely using customer-related data to inform design, mostly proved to be insufficient, when designing for interactions between sales reps and buyers. Thus, it is essential to first understand the messenger's and recipients' interactions before creating the visuals (Sample 4). There was also more general notion of sales reps being negative towards presenting unfinished prototypes to buyers. Sensitive sales settings created a fear of losing buyers if used as an experimental ground. On the other hand, sales reps were happy to inform designing equipment for meeting purposes. This finding illustrates that messengers can inform about recipients' understandings, as they are closely related to their work.

Allocating Senses on Graphical Details in Conversation

Observing the dynamics taking place, if visualised granularity matches the recipients' information levels it evidently supports the flow of interactions taking place (Sample 1). This may initiate a strong influence in the conversation, where a heavily negative starting point may change into a positive interaction. Differently, if visualised granularity misses the recipient, signs of uncertainty and emotional stress become visible as witnessed in Sample 2. These are results that follow allocating senses on graphical details in wrong ways such as GOM is missing the meaning of the orange arrow being the key detail to locate the workshop. As GOM talks without remembering the meanings of visual details, the chosen interpretation is mistaken.

Visual Representations for Different Contexts

Context-related understandings help in weighting the priority orders and amount of information. In Sample 4, the paper machine industry was in the design process of modularising their roll-service offering. The main driver was zooming the resolution for different buyers between core maintenance work (tokens in Figure 5) and solution contract (the whole picture in Figure 5). From another angle, adding information may help new users prevent misinterpretations and expert users in situations where long time between uses has weakened the ability to interpret low detail. Contrastingly, hiding some visual details would prevent underestimating more experienced users.

Primary Owners of Information

Visual representations can be considered as materialisations of someone's thought, making a person the primary owner of information (e.g., GSM in Sample 2). The meanings of graphics on display in the representation, may only unfold to the primary owners. When secondary owners interact with the representation, misinterpretations of these details are bound to happen. The primary owner may also not be present in the whole interaction taking place. In these situations, the visualised granularity in the information needs to match the recipients that are present at the time. An example of this can be drawn from Sample 1, where no one is an expert in lift truck maintenance. Still, the problem related to maintenance was handled with an appropriate *visual granularity* for the participating recipient, the warehouse manager.

DISCUSSION

Through two years of collaboration in two industry cases, we present insights on *visual granularity* for interaction designers aiming to design fluent sales interactions in the machine industry. The following paragraphs provide answers to our two main research questions: a) *what can we learn about interaction design from an ethnographic study of sales meetings in the machine industry?,* and b) *how to design visual representations that support sales meeting conversations in varying details and forms?*

Collocated Interactions in the Machine Industry

Collocated interactions of sales reps and buyers involved recycling uses of the mobile devices and visual representations through verbal and mediated conversation. The digitalised representations were merely intended for single use or recycled through extensive time periods. In addition, they were targeted for specific recipients, in specific buyer organisations. These excluded standard company presentations being seldom updated and only directed as introductory for new participants to the sales process. Sales reps desired visualisations that support their talk around specific things meaningful to certain buyers. These topics would revolve around products and core needs for those, solution concepts, maintenance, repair, workforce, future business proposals and past collaborations. The topics would also be handled in different detail levels according to recipients and their organisational positions (i.e. operational manager, technical expert or higher management). Sales reps were less interested in highly polished visualisations or photographs, unless they communicated something relevant for some of their buyers. Sales reps also reported many sales-related databases that turn into bin-folders of data due to a lack of understanding users and contexts. Data collected by sensors from machines remained too complex form for conversation. In addition, the user interface created to access data was too iconic allowing multiple interpretations. In some cases, the engineers creating these databases remained the only persons managing to use them. We, the authors, wonder how many working hours went into building these arcades of data. Hence, for designers, the extensive and industry-specific information flow introduces a complex setting.

Similarly, as in a mobile application [50] for designers to collect inspirational photos and share them, sales reps collect relevant documents on their mobile devices for each meeting. The difference comes in that sales reps have a shared proposal with a specific recipient, as in pub talk with mobile phones, where answers are searched from Google in a collaborative activity [49]. Sales reps consider more accurately on who they are presenting and therefore we propose designers to orient towards recipient design [6,52] with sales reps and buyers. In order to do so, sales reps talk-in actions would be supported through a visualising granularity [53] that the recipient(s) understand(s). Visualising granularity for a certain recipient, does not mean 'the exact something'. Instead, we strive for enough clarity just to allow a fluent flow of interaction [12] without disturbing it. This may be mimicked from interactions amongst lift truck drivers driving in a warehouse [18].

Existing HCI studies demonstrate uses of visual representations that partially resemble sales contexts. Visualising granularity resembles research on context-aware applications for travelling people, with having less information, and more accurate information resulting in better design [34]. Adding interactivity enables zooming into more detailed information [66] in demand for less experienced users, without underestimating the experienced ones. Similarly, interactivity would benefit in distributed devices [25] from personal mobile phones to larger screen displays in occasions where multiple users mediate through the same representation [14].

Design Guidelines for Sales Meeting Interactions

We propose the following design implications based on two case studies from the machine industry. The first two guidelines relate to knowledge that designers should gain from the sales reps and buyers: *1) Tools:* designers should inquire on sales reps' favoured tools (i.e., mobile devices). *2) Buyers:* designers should know the buyers by looking into customer databases, talking to sales reps, and ideally by participating in the meetings. The following five guidelines are qualities of the visualisations themselves to

support granularity: *3) Glanceable:* visualisations need to be understood 'at a glance' using simple 2D-graphics and clear labelling. *4) Relevant:* visualisations should connect to the buyer's real environment (e.g., truck number 4), operations (e.g., maintenance plan), and business (e.g., company growth). *5) Quick:* visualisations should not be too fancy or polished in style, as buyers may perceive that sales reps have plenty of time in their hands to create them. *6) Complexity:* visualisations should contain a suitable amount of info for buyers by using a combination of diagrams, tables and tokens. *7) Adaptable:* visualisations should easily support different time allocations given by the buyers to the sales reps (e.g., 1 vs 60 minutes).

Methodological Relevance and Generalisations to HCI

CA applied in HCI research would potentially benefit from this study in terms of detailed connections of devices, visual representations and GUI with rules of certain institutional interaction. We conducted group analysis sessions on two excerpts that included seven professional conversation analysts. This is a typical activity for conversation analysts, and there is a growing interest in design applications of CA [63]. The group allowed rich analyses revealing meaningful details from the fast-spoken interaction. Having multiple researchers in a single session (up to seven) also provided quick iterations and comparisons between taken notes. Taking turns pushed all conversation analysts and interaction designers to seek pointing out 'something extra' to what the persons before had said. The professional conversation analysts also reported learning something new by focusing on how visual details can shape the conversation. Studies combining two camera views of the same interaction, one of a mobile device screen, and one of a person interacting, would enable analysing two videos simultaneously [10]. This article proposes contributions for other CA studies on designing for institutional interactions, such as nurses articulated information exchange [65], especially in settings involving extensive information exchange.

Sensitive Settings with Professional Differences

Sales meetings in the machine industry happen in sensitive settings. Hence, the access to video recordings cannot be taken for granted. Designers should also be involved when choosing the videoed excerpts based on professional differences between conversation analysts. Conversation analysts have been reported of being concerned on problematic interactions, whether they can be influenced by design or not [19]. Design ethnography has debated on the usefulness of detailed descriptions from long-term field work, usually remaining on shorter durations and more robust video analysis [67]. However, design ethnography is still based on a too narrow conception [55]. In our case, we experienced both longer field work time and detailed CA as beneficial in understanding sales reps work and drawing design implications from data. Certainly, the data collections and analysis were also laborious processes.

We also propose that interacting with visual representations in machine and maintenance service selling were slightly different to comparable interactions that we as designers are used to. Earlier research including CA on architects and designers, reports design activities where different knowledge of diverse experts (i.e., designers, engineers) is situated in interactions around visual representations [20,21], how designers work by bridging social worlds through drawings [5] as epistemic and boundary objects, and mediate through imagination [45]. Sales reps and buyers lean more on conversational negotiation sequences of proposals and responses [2] where visual artefacts are intercommunicative tools supporting sales reps' talk. Thoughtful collective actions of interest in understanding different experts' viewpoints on something does not resonate with sales conversation. Sales reps' priors of communications aim to influence another person. Sales reps were also negative towards testing prototypes with buyers in sensitive settings. Hence, clarifying these by separating the design, and use modes is recommended [46].

CONCLUSIONS

Sales representatives of the machine industry increasingly use mobile devices in collocated settings, taking into account how granularity in spoken and visual form and details shape the conversation during meetings. The article focused on visual granularity either supporting or disturbing sales conversation. We conducted two years of collaboration with two machine industries obtaining different types of data from sales settings. These included multiple Conversation Analysis (CA) sessions of videoed excerpts by groups of researchers from the fields of interaction design, sociology, linguistics and organisational management. Findings elaborate insights on granularity in understanding specific messengers and recipients, contexts, allocating senses on visual details and original ownership of information in sales conversation. Seven design implications firstly revolve around seeking information about devices and buyers from sales reps, customer databases and meetings. Secondly, these result as qualities of designing glanceable visualisations, being relevant to buyers with considerations of time used in designing, complexity and adaptability. The study contributes to the HCI community in terms of visualising granularity in contexts involving extensive information flow and using groups of professional conversations analysts. In future research, we concentrate on gaze detection and sound to enrich the understanding on connections of utterances and visual details.

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