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Expert Group Knowledge Triggers:
When Knowledge Surfaces

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ABSTRACT

Specialised knowledge is a key component of success in an organisational context that resides in the expertise of the organisation's personnel. To explore this situation, an ethnographic case study was chosen in which data was collected from a software development project. Extempore verbal exchanges occur through the interplay of project team members in weekly meetings, as the software was tested, analyzed, and altered in accordance with the customer's needs. Utilizing tacit knowledge from the project members as well as the group, new tacit knowledge surfaces and spirals, which allows it to build over time. Five extempore triggers surfaced during the research generated through explicit stimuli, allowing project members to share and create new knowledge. Through the use of ideas developed by Husserl and Heidegger, this study has cast some light on verbal exchanges that, through their interjection, allow significant learning to take place. The theoretical development places these learning triggers in an interpretive framework, which can add value to other software development projects.

KEYWORDS

Ethnographic Case Study, Expert Knowledge, Knowledge Triggers, Project Management, Software Development

INTRODUCTION

Project management assumes a rational approach to decision-making by project managers, but recent empirical studies (Wynn, 2018) support the view that managerial judgment is the preferred mode of decision selection in many projects. Managerial judgment is based on situational assessment, and thus on time-constrained knowledge rather than on more prescriptive rational decision-making (Taylor, 2004). The surfacing of knowledge in projects has been conceptualised as emanating from a combination of improvisation, project management and knowledge management activities (Leybourne & Kennedy, 2015). The issue of improvisation, however, can be seen to be at odds with established best practice. Prescriptive, probabilistic and objective based project management systems are no guarantee of success and in some cases they can create an illusion of control that is not always justified (Hodgson & Drummond, 2009). All projects have a temporal focus and the dominant logic in this

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field is structured planning to achieve workable projects on time. Knowledge sharing is at the core of meetings where different forms of expert knowledge are required.

Tacit knowledge is a difficult form of knowledge to share and acquire during a project due to its intangible nature. Tacit knowledge is at the core of a knowledge based society and its exchange is still of great interest to researchers. How tacit knowledge is exchanged and used within the different project teams plays a vital role in project success. Banacu (2013) stresses the importance of tacit knowledge transfer due to companies needing it to obtain a competitive advantage. This research analyses a project team's tacit knowledge exchange within a software development meeting environment.

White and Perry (2016) argue that there has not been enough focus on the expert knowledge of software developers and their influence on the production of information systems. This is an area where software work is highly socialized but careers were highly individualized (Benner, 2008). Their mutual standing in the work overcomes the set of partial knowledge that they each possess. Being able to manage different knowledge sources through coordination and integration is a significant challenge during such a project (de Souza et al., 2006). The focus of the research lies in exploring knowledge exchange in software development projects and sheds light on how this expert group knowledge actualises and thus contributes to theory. Embedded observation in a particular project provided the empirical material for this research.

This article discusses the findings of a research project (Dreyer, 2018) which aimed to understand how tacit knowledge surfaces within the software development process. It examines how the group knowledge generated through expert interaction can be recognised in a software development project, and used to improve project implementation (Clancy, 2006). The paper consists of five sections. After this introductory section, theories relevant to the area of study are identified and discussed. The following section then outlines the research methodology deployed in the study. There then follows an evaluation of the data and a discussion of findings, and in the concluding section, the main outcomes of the research are summarised and implications are discussed.

THEORETICAL BACKGROUND

Project teams, and in particular those involved in software development, exist to provide workable solutions that incorporate and create new knowledge from the separate expertise held within the team. In discussing the idea of knowledge creation, the theory of tacit knowledge has been influential since the work of Nonaka and Takeuchi (1995). This created a protocol for a knowledge generating company using a Socialisation, Externalisation, Combination and Internalisation (SECI) model. In the same volume, three of the model elements are presented in a recursive pathway, as more available knowledge is created in the transfer from tacit to explicit knowledge. Internalisation is the counter flow in this model and it occurs across and counter to the other three modalities.

The concept of tacit knowledge arises from the observation by Polanyi (1962) that "our personal knowing of a thing is unspecifiable" (p.343) to the extent that it is more than the articulated fact. Importantly, this tacit knowledge is seen as the form of knowledge that is *not* routinely articulated and embodied in human action (Scharmer, 2001; Riain, 2009). This leaves open the question of whether the knowing is not, or cannot be articulated. Personal knowledge communication contains both these elements in ways that are difficult to separate. This will apply to knowledge from an expert who, as such, is considered to have expertise. Importantly, Nonaka and Takeuchi (1995) see the process to convert tacit knowledge to explicit knowledge as essentially context dependent, which entails physical proximity and interaction.

In this view, a shared reality and face-to-face interactions are the root of knowledge creation (Berger & Luckmann, 1967). These interactions are seen as "the key to conversion and transfer of tacit knowledge and, thus, are the triggers for the whole knowledge creation process" (Bartolacci et al., 2016, p.795). This process is holistically contained in the context, but often needs disjunctions to crystallise the knowledge available. Having several groups of experts involved moderates the flow

of knowledge substantially, and hence developing a shared understanding is essential, as it is a group effort to develop software (Fischer & Ostwald, 2001). This shared reality is a form of "putting oneself into work" (Heidegger, 2001, p.160).

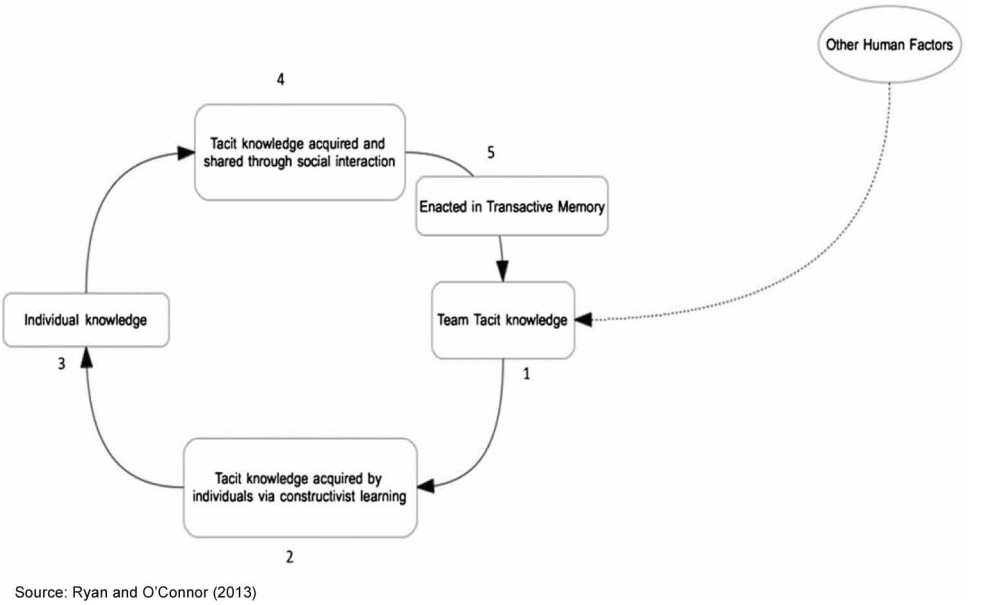
There have been a number of difficulties in implementing such a knowledge creation project in a timely manner, particularly in software projects (Marouf & Khalil, 2015). A Husseralian approach to phenomenology is one that derives the essence of an idea. Husserl (2012, p. 255) considers that a thought can emerge as a vague thought that is, in its initial stages "an inarticulate grasp". Polanyi's (1962) use of the term "strenuous groping" and the view that "any science is grounded in a tacit ontology of its object domain" indicates the "unspoken assumption about the objects in use" (p.301). Knowledge we acquire and own is not entirely specifiable and therefore gives rise to the articulate grasping as we seek to extend our articulation of what we know. Triggers add value in a group context by enabling this process. Triggers can be seen as unique events that start a process, initiating something new. They are an initiation of a phase change in the knowledge development process that enables articulation. Accepting that there are some dynamic effects, the process of knowledge exchange will not be self-generating without interventions. These situations are not always easy to recognize, as they are not routinely articulated, and therefore the opportunity for the identification of a new understanding may be missed. Engeström, Kerosuo, and Kajamaa (2007) see these discontinuities as either mundane or directional. Directional changes can seem an anathema to the idea of continuity but continuity is not the same for all participants. These triggers or "discontinuities" in the existing situation, can be created from outside the group, and can "trigger micro-processes of organizational learning" (Berends & Lammers, 2010, p. 1060). Through the recognition of tacit knowledge triggers and the creation of an analytical framework, the group as well as the individual knowledge sources are assessed. This analysis builds upon existing theories, discussed below, which were used to understand and extract tacit knowledge.

Others have developed the idea of a shared space as the forum for knowledge development. It is possible to share knowledge through different channels; however, a shared space reinforces the relationship between colleagues allowing knowledge creation to take place (Dreyer & Wynn, 2017). These spaces are formed in different ways, such as through informal discussions during a break, emails or meetings. Developing the view of shared reality, the environment where knowledge can be exchanged and is able to build up has been called "Ba". This concept, developed by Nonaka and Teece (2001), gives a basis for knowledge to be shared and created. Nonaka and Konno (1998) see "Ba" as a mental flexibility and an ongoing dynamic process that allows new insights to be constantly generated. The space of "Ba" provides for a continuous flow of knowledge exchange, where the knowledge is able to transform and change. Knowledge is not tangible, but is able to evolve and build up tacitly through its self-transcendence. This view recognizes that this knowledge forum is a shared space where relationships can emerge (Nonaka & Teece, 2009). Knowledge is thus not a set of facts and figures; it is not a set of statistics or applied conceits, but a "space" in which processes are constantly iterative, marked by close communication, by modelling, by mentoring, and by incessant experiential inputs that lead to outputs. Given the creation of a knowledge generating space, they recognize the need for dynamic effects. This space is not tangible, but is a fluid continuum wherein there is constant change and transformation resulting in new levels of knowledge. Knowledge is a process and never becomes finalised, which is paralleled in the software development process, where databases are built and then later updated over time with more information. However, both need knowledge or information, which is captured and put into context. It is a self-transcending and ever-spiraling evolution. Embracing the concept of "Ba" is essentially arguing for a learning culture, which has the advantage of promoting the concept of presence to each other. However, it seems that the proximity entailed in knowledge creation needs further exploration. In Heidegger's terms, this space can be seen as a "clearing" or a "shedding of light". (Heidegger, 2015, p.133).

Further work has been done on the knowledge exchange dynamic. Group tacit knowledge is the focus of Ryan and O'Connor's (2013) Theoretical Model for the acquisition and sharing of Tacit

Knowledge in Teams (TMTKT). They note, "individuals draw from the team tacit knowledge and create their own tacit knowledge. This is a background process which is dynamic and reciprocal relying on constructivist situated learning" (Ryan & O'Connor, 2013, p.1618). Looking at knowledge flow, their approach allows the analysis of knowledge movement within a group. The model (Figure 1) was constructed by using a qualitative approach and the focus is to explore the flow of team tacit

Figure 1. Theoretical model for the acquisition and sharing of tacit knowledge in teams

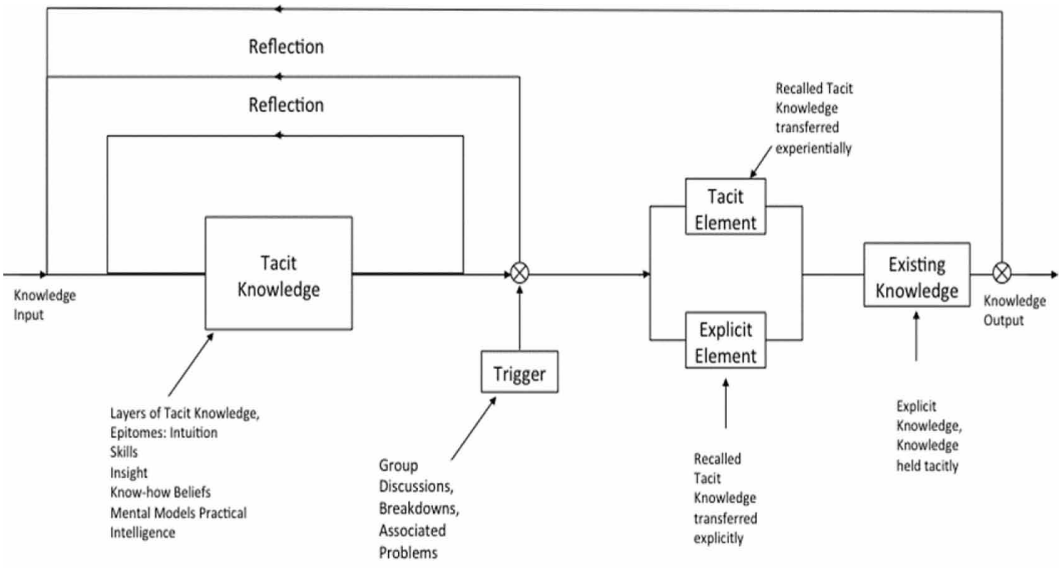


Source: Ryan and O'Connor (2013)

knowledge. The cycle of the model begins with the current state of knowledge within the team; through constructive learning, an essential part of knowledge creation and sharing which greatly develops individual knowledge. Constructive learning is, at its essence, the process of an individual assimilating new facts and experiences into a pre-existing web of knowledge and understanding (Ryan & O'Connor, 2013). The gained individual knowledge - expert knowledge - can then be shared with the team, allowing "transactive memory" to build up. In the context of this model, the "transactive memory" is defined as team tacit knowledge, where the expert knowledge from each individual in the team is stored and a common understanding is developed. Transactive memory is thus the combination of specialization, credibility and coordination of knowledge within the group (Ryan & O'Connor, 2012). Once the team has established common team tacit knowledge, which can be influenced by other human factors such as emotions or outside influences, the spiral begins anew in a continuous cycle. Team tacit knowledge and its flow allows the social analysis of the project group during the meetings. This model proposes that individual constructive learning precedes the development of transactive memory. Given the discussion above, any team tacit knowledge must be present but individualized; the transactive memory becomes focused on the project outcomes and therefore allows a team to progress in the project.

Clarke (2010) proposes a model evaluating tacit knowledge from an individual point of view (Figure 2). Incorporating the idea of triggers, knowledge input begins the process; tacit knowledge is then created through reflection; and triggers, such as group discussions and breakdowns, influence reflection on the newly gained knowledge. There are both tacit and explicit elements of this new

Figure 2. The tacit knowledge spectrum model



Source: Clarke (2010)

knowledge. The tacit knowledge triggers in Clarke's model are used as a form of sensitization during this research, and are then further developed to be utilized in a group setting.

The benefit of this model (Figure 2) is the manner in which it incorporates the idea of triggers and the cycle of reflection by team members. The literature discussed above provides the theoretical basis for the analysis of tacit knowledge within teams as well as the flow of tacit knowledge and its environment. Nonaka and Teece (2009) established the "Ba" environment for tacit knowledge exchange; the SECI model allows the classification and evaluation of knowledge exchange and associated learning; Ryan and O'Connor's (2012) model provides a team view of tacit knowledge exchange, complemented by Clarke's (2010) individual perspective of tacit knowledge. Knowing more about the operation of these triggers will help develop an understanding of expert team knowledge creation.

RESEARCH METHOD

The goal of the research is to show what influenced the surfacing of expert knowledge and the articulated interaction surrounding the occurrence of triggers. The aim is to provide insight into which triggers allow tacit, expert, knowledge to surface to aid teams to achieve project success. Using the theoretical ideas discussed above, a strategy of analytic generalization (Yin, 2009) was adopted to develop theory.

As noted above, an embedded case study was chosen to analyse the interactions in a potential group knowledge space. Therefore, this research used an organization and a specific software project as a single ethnographic case study which "remains firmly grounded in the ethnographer being there" (Riain, 2009, p. 303). A case study approach allows a "detailed investigation of one or more organizations, or groups within organizations, with a view to providing an analysis of the context and processes involved in the phenomenon under study" (Hartley, 1994, p.323). They "provide the opportunity to place research into a certain context due to the selection of specific sectors, institutions, countries, etc." (Cunningham, Menter & Young, 2017, p. 923). This approach can generate a great

deal of detail, and Silverman (2013) has pointed out how case studies can provide a complex and rich understanding of change projects across a period of time.

The chosen case study allowed an inside, participant, view of a software development project, where experts discussed the content needed for the development of the software product. By electing to pursue participant observation and an inductive research approach, the aim was to let the findings emerge over time. The research was conducted over a three-month period, focusing on approximately 30 hours of recorded meetings, with ten team members involved. The software environment was geared to a fast-paced project, there being a clear launch date for the new software. One of the authors was an embedded member of the software team, and an active participant in the work of that team. To develop a software product, multiple groups of experts are needed to achieve a productive knowledge flow (Fischer & Ostwald, 2001). These sessions were project meetings, which took place several times a week. Four of the team members were core, attending most of the meetings and therefore had the most influence on the project. According to Valente and Davies (1999), key actors play a central role in groups through the creation of new ideas and their understanding. The core team consisted of human resource consultants, later referred to as HR A and HR B, as well as software developers, SD A and SD B. In addition, the end user or client - CL A - was often involved in the process. Other experts from the companies joined in when their knowledge was needed, and their input is represented by the prefix HR, CL or SD depending on the company from which they come.

The focus lies within the times the meetings took place, shedding light on the expert knowledge exchanged during face-to-face formal interaction, aiming to highlight the importance of meetings. The extensive researcher involvement created a developed appreciation of the interactions at work in these meetings. The recordings of the meetings were coded through contextualization, and then systematically reviewed. First, the meetings were generally evaluated by date, which then allowed topics discussed during the meetings to surface. These transactional topics were then pulled together to find tacit knowledge, its triggers, expert and team knowledge, knowledge creation as well as the exchange over time, through the previously discussed theories. Different themes started to surface, which were previously found in the literature, such as constructive learning, individual and group tacit knowledge, as well as tacit knowledge triggers. Focusing on tacit knowledge triggers, a more in-depth analysis through a narrative, inductive approach was undertaken using the ideas of individual noemic knowledge and the interactions from being present in the discussion.

The case study and the focus on being with others allows a greater appreciation of the knowledge exchange that can develop. Using the phenomenology of Husserl (2012, pp. 86-7) which emphasizes the indutiablity of internal perception and the tenuousness of outer perceptions. The internal perceptions are noetic but they are influenced by the social environment. This interaction between what is personally known and sharing space with others should become manifest in expert project meetings. Rabanaque (2010) quotes Husserl to note that the living body is "the connecting bridge (verbindende Brucke) between subjectivity in the world and physical thinghood in the world" (p.47). Noting this standpoint has enabled the study to develop the connection between personal knowledge and contextual interaction. Thus, a cumulative picture emerged from the findings and allowed theoretical generalization in order to create new knowledge. Focusing on one project, each team member plays a crucial role in passing on tacit knowledge to his or her colleague. Knowledge elements are then passed on to other project team members through one or multiple triggers, which allows knowledge to surface. Each team member passes on his or her currently articulated knowledge. This then encourages or triggers the creation of new knowledge in the other team members. The knowledge is dragged from the tacit to the articulate in this process. This key assumption was evaluated and examined in the software development context. The triggers are related to extracts in the data where evidence of each trigger was found and established. As the research focuses on one project, knowledge passed on over time can be put into context and evaluated against knowledge that has been previously exchanged.

In the following section, the data is evaluated to highlight knowledge generating episodes. Using the knowledge exchanged in the different companies, the interplay of knowledge exchange helps further

understand how the knowledge spirals within the project. Five main triggers were found, which are discussed in detail below. A combination of theory and data will be demonstrated.

RESULTS AND DISCUSSION

The knowledge within the project was spread between the different participants, and a group effort was needed to achieve success. Within each collected extract, triggers were observed which allowed tacit knowledge to surface. The goal during the analysis was first, to find evidence of tacit knowledge, and then to understand what kind of tacit knowledge was found, and lastly, to determine what made tacit knowledge surface. During this analysis phase, five main triggers were identified which are discussed below with collected extracts from the research. Clarke (2010) identified tacit knowledge triggers, but they were not identified in types. The trigger types emerged through the data as well as their impacts.

Following the transcription and analysis of the meetings, 45 extracts were selected and used to demonstrate evidence of tacit knowledge and its triggers. In this initial phase, the SECI model was used as a sensitizing approach. Within these extracts, Socialization, Internalization and Group tacit knowledge were always found; externalization was found 28 times, and combination nine. These findings were used as the basis to show tacit knowledge exchange. Then, tacit knowledge triggers were analyzed from the data. Visual triggers were found 18 times, conversational triggers 39, constructive learning triggers 19, anticipation triggers two and recall triggers seven times (Figure 3). These triggers and their operation are the focus of the following discussion.

Visual Triggers

Visual triggers allow an individual to utilize previously gained knowledge to surface by reading or seeing information. During the research, this trigger mainly surfaced when the software was looked at and edited by the team. The knowledge is gained tacitly, becomes processed, thus triggering a socialization within the group. In these scenarios, the software development company would present the developed software pages (i.e. screen design and content) to the human resource consultancy. The pages in the software were analyzed by the team and changed according to their needs when possible. This mainly focused on wording, the layout or process in which the pages were to be found and structured within the software. Visual triggers were found on numerous occasions, one example is the following:

SD A: Multiple Pensions. Order of priority. So, when they run out of money, this one comes first, this one comes next... Say you are on 500 GBP a week and you get an attachment of earning because you failed to pay your child support. So, the attachment will have top priority. There is a level at which deductions should stop.

HR A: Sorry can you just go back to the pensions type.

SD A: yea.

HR A: Just wanted to see where I can attach the file.

SD A: I think this needs a real thorough look; I am just skimming through it.

In this extract, SD A explained the pensions pages. Through constructive learning, the HR consultants learned how the pensions pages functioned; during the explanations, HR A stops the discussion to refer back to a previously seen page. SD A had moved on, HR A was still processing the visually gained knowledge in the previous page and asked to go back to see if a feature was

available. In another extract, one specific part of a page - the payroll ID - triggered a conversation within the group. The work reference and the ID were confused by SD A, thinking two references were used by the HR company; this triggered HR A to further explain their system of referencing employees. This visual trigger allowed conversational triggers to surface by starting socialization between the project members.

Visual triggers can also be more simplistic. In another extract, the team looks at the salary screen, and needs to rearrange the display order to fit the requirements of the HR consultants. The visual stimuli of the software triggers work and process knowledge of the HR team, which is to be combined with the software engineering environment. Similar situations were found in other extracts, where the 360 feedback is being assessed. HR A says changes within the structure of the pages will need to be done to fit the requirements of the client. HR A's tacit knowledge base of the customer as well as experience are combined with the knowledge visually gained through the software.

Throughout the data analysis there have been several extracts demonstrating how visual mediums trigger knowledge within an individual. This triggered knowledge enables the project team to further conversations, complete gaps of knowledge within the group' and thus allows group tacit knowledge to prosper. Visual triggers launch an internal process within an individual, where the tacit knowledge base is used to combine the current tacit knowledge of an individual with the new visually gained knowledge.

Conversational Triggers

Conversational triggers occur frequently during meetings. Knowledge surfaces explicitly, which is then processed by a team member. The individual will then use the newly gained knowledge, add it to their existing knowledge and create new tacit knowledge. This interaction continues within the group and allows knowledge gaps to be addressed. Due to conversations being at the center of the research, conversational triggers are one of the most frequent and are found throughout the research. The following extract demonstrates a conversational trigger:

HR A: In an unrelated topic, we talked about sick pay, policies and rules last week. I do not have any up to date paper work from you guys. Could you send me the most recent copy?

CL A: I can send you the policies, because we did update them about 6 weeks ago, when we changed the sickness payroll for the organization…. So I can send that over to you. Could you copy in SD A as well? Thank you.

SD A: So Payroll, while you mention that…

The analyzed extract demonstrated a conversational trigger, where HR A discusses the pay policies, this then triggers SD A's tacit knowledge, where the topic is changed to payroll. SD A listens to HR A and CL A discussing a finance related topic and this enables the recall of an unsolved issue with payroll. Later in the discussion, seen during another extract HR A furthers the topic of payroll by building on the knowledge SD A shared. Through explicit exchange within the group, knowledge spirals and builds individual knowledge within each individual. Topics of discussion are altered and enhanced by using the tacit knowledge gained from the previous group member. Their similarities trigger socialization and externalization such as in another conversation, where the discussion allows knowledge to spiral and prosper within the group. Externalized knowledge is used by several members of the project, processed and complemented by the knowledge of each individual taking part in the discussion.

Conversational triggers are one of the most frequent triggers found in the analysis of the data. Explicit communication within the group allows group tacit knowledge to build and each individual

to utilize the knowledge to work to achieve project success. This trigger is often in combination with visual or constructive learning, where an external verbal medium allows an individual to take in information, process and reflect the knowledge to then externalize the new processed knowledge. This greatly supports group tacit knowledge and the core objective of a meeting - 'to get everyone on the same page'.

Constructive Learning Triggers

A constructive learning trigger occurs when a project member explains to the others a specific topic of the project. The knowledge is passed on from one person explicitly to the group as a whole, which tacitly utilizes and combines the knowledge. During the project, learning was crucial due to the software being tailored to the company. Each project group, the HR consultants, software developers as well as the customer exchanged knowledge through learning and integrating the knowledge in the software as well as its usage. This trigger also results in socialization, where questions are raised to clarify and add to the subject. An example of a constructive learning trigger can be found in the following extract:

SD A: Is it a standard wage? You can have multiple standard wages such as London living wage. You can put pay on hold. So you know when the customer.... just going to get SD B up to speed.

HR A: So that is going to be the annual basic pay, sorry, the FTA (in full) isn't it? Oh no, it's going to be FTM (in full).

SD A: Yea.

HR A: Because over here you have the percentage haven't you. So will it work out?

SD A: I don't know, we need to ask SD B.

HR A: Because otherwise there is a lot of room for error.

SD A: The pro rata bit didn't work, the rest did. The standard hours need to be calculated to see hourly rate by default (on screen).

When SD A explains the pay by period page to the HR consultants, constructive learning takes place. This allowed HR A to process the gained knowledge and externalize what had not yet been understood. Externalization of knowledge can also confirm newly gained knowledge. SD A explains payments, which then triggers HR A to confirm the name of annual basic pay, FTM.

Constructive learning can also be task related; another extract shows the customer as well as the HR team are trying to understand what data can be fed into the system and how it should be structured. This allows an interplay between constructive learning and conversational triggers, which can also be found in the extract above, where knowledge surfaces by teaching as well as learning and ultimately an understanding of an issue of the project is achieved.

Visual, conversational and constructive learning triggers interplay in some of the extracts. While the software pages are being shown, conversations are being triggered and furthered within the group. This also allows constructive learning to take place. Conversational triggers can also often be triggered by visual triggers. During another meeting, the recruitment page in the software triggers a conversation on how the employees are ordered, by usage or alphabetically. Here, the visually, explicitly gained knowledge triggers a thought process within each individual, which is then turned into a conversation where knowledge surfaces through discussion.

Anticipation Triggers

An anticipation trigger allows an individual to raise a topic within the group, which he or she had waited or hesitated to address. The trigger surfaces through a similar topic of discussion and allows a change of topic. In this case, the project member plans to talk about a subject during the meeting, and waits for a moment to bring it up. This is not to be put in direct comparison to a "to-do-list" or minutes, where the subjects of discussion are being listed before a meeting and discussed one after the other, but rather allows another issue to emerge through its similarity. It can surface during externalization or socialization.

During the extract shown in the conversation trigger section, SR A was anticipating discussing payroll during the meeting, but a conversational trigger allowed the finance topic to emerge. Another example of an anticipation trigger is demonstrated in an extract, which builds on a previous meeting where HR A asks to run through the 360 feedback. Here an email was sent to the group about the topic. It was not necessarily planned to discuss the topic; however, HR A specifically asks CL A to explain and run through the process. This built on the previous meeting between SD A and HR A found in the extract below:

SD A: Now we are getting into linked records - we have done the core records. We talked about name changing, to be the item type: appraisal type; standard appraisal; 360 appraisals; and scoring appraisal. So this is something to look at with SD B tomorrow.

HR A: My thoughts on the whole are that we will probably have to change some of that, but I am not quite sure to what yet, until we start building the form, and then work through every stage of the process. I think it will become clearer.

SD A: Is there something from the old software that could make it clearer?

HR A: No, because they currently don't use it. I've got draft one of the questionnaire done now, which I would be happy to send to you but it hasn't even been checked by CL A yet. While we're at it, you know we talked about the summary of the feedback and SD B asked what kind of format you wanted it in? We just got some off the internet that CL A quite likes - do you want them now or should I give them to SD B?

SD A: To SD B -the feedback is in the process engine, so that's his / her part.

Anticipation triggers are the least commonly found triggers within the data. The meetings were usually structured around a specific topic of the software, which was addressed. Unlike recall triggers, where knowledge pops up, anticipation triggers build around the notion of waiting to discuss a topic when the meeting allows the subject to come up.

Recall Triggers

Recall triggers surface when a topic of discussion or a visual trigger allows an individual to remember knowledge related to the subject which seemed forgotten or not shared in its entirety. This trigger can occur during any stage of the tacit knowledge process. New gained knowledge is processed through several steps, when it is initially heard or seen, and combined with existing knowledge; or when it is transformed into explicit knowledge and shared with the group, recall triggers can emerge. This can change previously shared knowledge and alter the conversation. These triggers are of significance due to the knowledge almost being forgotten and often not being able to surface, as well as the knowledge being at risk of not being shared in its entirety or differently; this could change the outcome of parts of the project:

SD A: So they might have a monthly London weighting allowance. What do you pay by period?

HR A: They have a clothing allowance and a first aid allowance.

SD A: So those sort of things. So it has a name, pay by period name, it has a pay type, it has a period it can fall into. It has to be authorized.

HR A: Every period?

SD A: Every payment has to be authorized. Sorry yes, it is authorized on their account and then it's generated into weekly or monthly payroll as it gets signed off.

HR A: Would you only put in payments for that month or put in something for future months?

SD A: ...you put it in as a go ahead, so when you set it up you select if it is set up for just once or if it runs every month.... For example, season tickets run over 10 or 12 months.

During the above extract, SD A explains the monthly allowance page to the HR consultants and during this discussion, HR A asks how allowances are authorized. SD A first replies quickly, but then goes into more detail when recalling that the short answer was not sufficient to understand the authorization process. This internalisation process allowed SD A to clarify and further the discussion. Recall triggers can also be minimal, where an individual mistakes one thing for another. In another extract, validating recall triggers, HR A recalls a conversation from the day before and combines the current topic and processes with the previously gained bureau knowledge to fill in gaps of knowledge.

In addition, more evidence was found in an incident where HR A confuses FTA with FTM, which is a tacit process where, through knowledge recall, the initial thought is corrected. In the extract above HR A recalls previously gained work knowledge and shares it with the project members. The conversation focuses on recruitment, where HR C is the recruitment expert within the group. HR A's knowledge is triggered through HR C's uncertainties and is able to add valuable knowledge, having previously worked in the field.

Recall triggers are quite frequent throughout the meetings and they are often found in combination with conversations, constructive learning and visual stimuli. Recall triggers are an internal tacit process where knowledge 'pops up' at random. This might be related, as well as unrelated, to the discussed topic. This trigger allows an individual to communicate knowledge, which is recalled in order to further the knowledge exchange within the group, and thereby enhance group tacit knowledge. Figure 3 shows the number of triggers (left–hand 'y' axis) by category ('x' axis) found in the analysed conversational data. Conversational triggers were the most frequent, meaning that within a conversation newly gained knowledge allowed new knowledge to surface. This is followed by constructive learning triggers, visual triggers, recall triggers and anticipation triggers.

The triggers found through the research demonstrate the need to allow the creation of a knowledge-sharing place within a company as well as teams. These spaces should help teams find a safe environment which supports knowledge exchange and allows the experts within the team to share and build on each other's knowledge. Using different means throughout the meetings can also help trigger expert knowledge to surface, allowing more knowledge to spiral and build.

In Figure 4, the creation of knowledge and its relationship to trigger points is shown. It is evident that, in absolute terms, conversational triggers allow group tacit knowledge (Group TK) to surface the most. Constructive learning and visual triggers are the second and third respectively. It can also be seen that knowledge combination is the least likely to surface via these triggers, whereas socialization,

Figure 3. Tacit knowledge triggers found in the analysed data

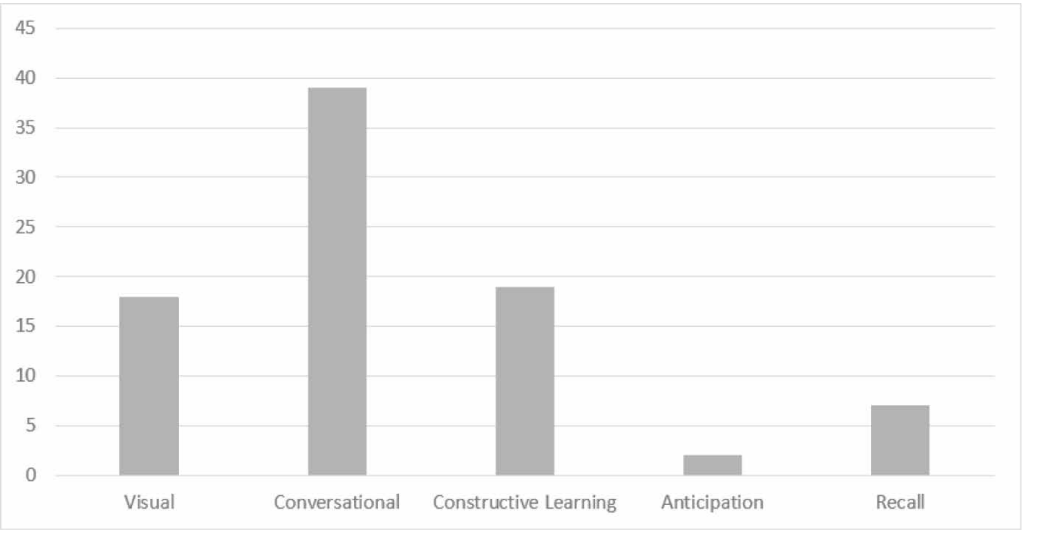
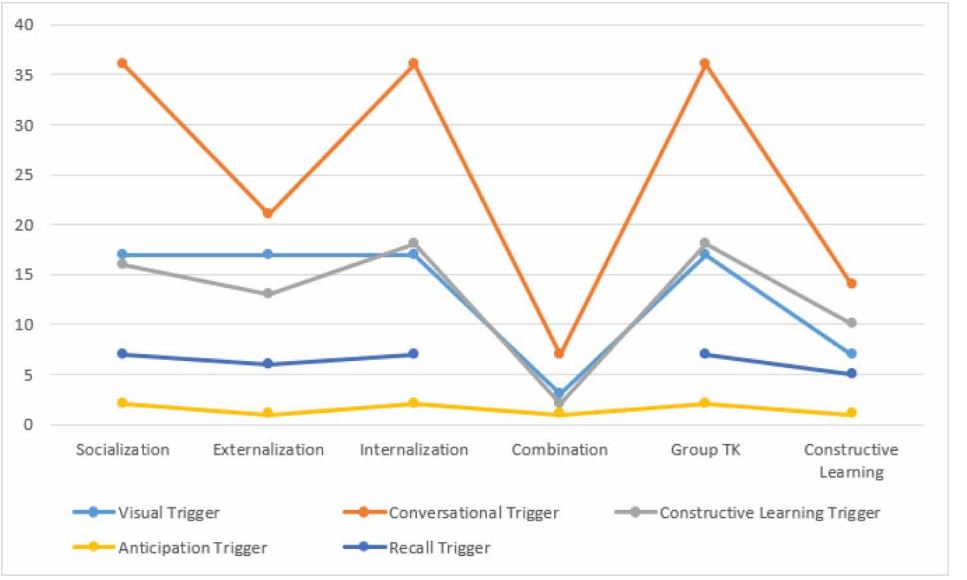


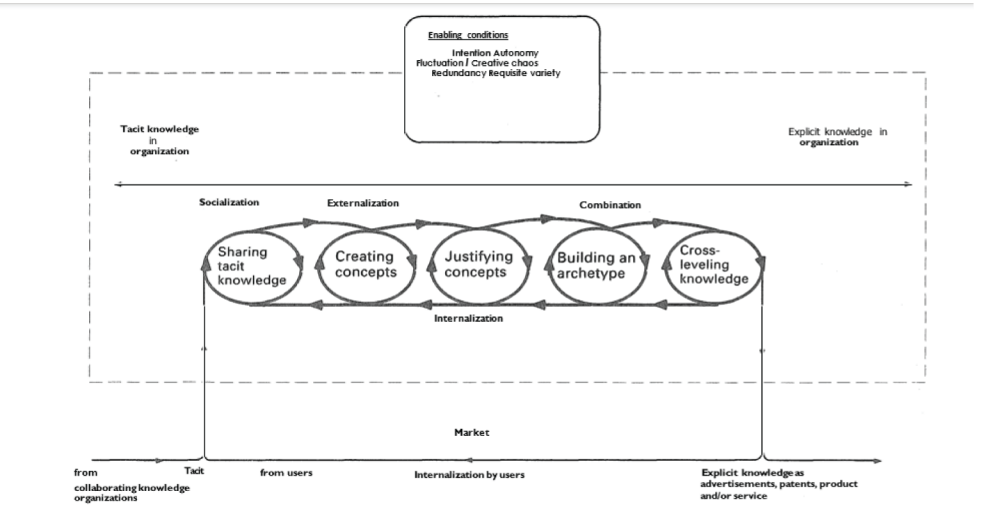
Figure 4. Knowledge creation and its relationship to trigger points



internalization and group tacit knowledge were the strongest tacit knowledge exchange factors. The model helps understand the trigger points and their importance to tacit knowledge exchange.

Tacit knowledge triggers allow the exchange of expert knowledge in an organization. In the five-phase model of Nonaka and Takeuchi (1995), the process of tacit knowledge in relation to the market can be seen (Figure 5). This allows a view of the continuous cycle of sharing tacit knowledge within a company. From sharing tacit knowledge, creating concepts, justifying concepts, building an archetype and cross-levelling knowledge, the internalization process is shown. This process helps the triggers find their place in the knowledge creation process.

Figure 5. Five phase model of the organisation knowledge creation process



Source: Nonaka and Takeuchi (1995, p.84)

In summary, this research project discovered and described the development of five types of triggers that are episodic moments for tacit knowledge conversion. The different triggers that emerged through the research were:

1. **Visual Triggers:** Tacit knowledge surfacing through visual stimuli;
2. **Conversational Triggers:** Tacit knowledge surfaces through a conversation held within the team;
3. **Constructive Learning Triggers:** Tacit knowledge is enabled through a team member explaining and the others learning from them;
4. **Anticipation Triggers:** Tacit knowledge was exchanged by an individual in the group by waiting for the topic to come up or the meeting to take place;
5. **Recall Triggers:** Tacit knowledge resurfaces through discussions or visual aids, which seemed forgotten or not present by an individual.

Appreciating the role of triggers in the situated learning of software teams is a significant contribution to the understanding of how group knowledge emerges. This will also help researchers further understand the impact tacit knowledge has on project success. It is important to interpret and analyse knowledge adequately in software projects to prevent misconceptions (McAfee, 2003). Using an appreciation of a developed theory of triggers can help project teams focus on exchanging and exploring knowledge from different perspectives. Constructive learning within the group, as well as discussions to further understand the software and exploring the knowledge input from each individual are crucial for a project to succeed.

However, these moments can only be created within a dynamic environment in which an exchange of knowledge is supported by the project team. Spending time together as a team and working together is at the core of knowledge creation and transfer. Seeing the project develop over time allows strategies to surface and be applied during the software development process (Vitalari & Dickson, 1983). Bouncing ideas off one another, and subsequent mutual learning, furthers the knowledge creation process. This allows each individual to take in more knowledge and provide a better, more complete view of the subject and enables the prospect of more complete software to emerge.

In relation to categorizing these triggers, Heidegger (1992) notes that Aristotle identifies five modes bringing things into "truthful safekeeping" (p. 377). So anticipation triggers, for example, are self-reflective, in that becoming aware of them allows their incorporation into group discussion. The modes are detailed below (Table 1) and it is possible to map the triggers against these modes. It should be noted that these modes are not mutually exclusive; some modes are combinations of others.

Table 1. Phenomenology of trigger types

routine-directive-productive operating	Conversational triggers are those that become involved with productive operating towards the work
observing-discussing-revealing determination	Constructive learning triggers are those where there is merit in further discussion about the issue.
solicitous circumspecting (circumspection)	Anticipation triggers are those where an issue needs to be brought out in advance from the work.
authentic-seeing understanding	Visual Triggers that stem from the productive observation of the material at hand.
pure beholding	Recall Triggers occur when knowledge is retained and becomes part of intelligent application.

CONCLUSION AND IMPLICATIONS

The aim of the paper was to further understand and progress the field of knowledge transfer and its triggers within a software development environment. This initial objective gave rise to a new theoretical idea. The conversion of tactile skills is not the crucial element in the development of group knowledge. From the empirical data conducted for this study, the process of externalisation can be considered as being with Mitsein and the joint presence of the expert group allows their presence to be a noematic bridge. The basis of expert meetings is not therefore one of discussion but the emergence of new presentations by the participants. This emergent expertise is the refinement of the phenomenological essences of what is needed to deliver the combined knowledge. This framework, based on a phenomenological approach, will aid the implementation of managerial judgement in expert group sessions. Possessing an awareness of these distinctions will facilitate knowledge capture. How they emerge opens the way to further research into what makes tacit knowledge surface within groups. Appreciating them as breaks in the flow of the project that generate knowledge is important; together with this, they are an opportunity to understand in a better way the mind of the other. Heidegger indicates that practical revealing is "a factical relationship of concern with respect to the world which is just encountered" (Heidegger, 1992, p.382). His further work resonates with this theme where the Scientist, Scholar, and Guide continue to discuss the relationship between determination, speculation, and authentic seeing (Heidegger, 2010, pp.5-6). This structure provides for valuing the unexpected, and what Berends and Antonacopoulou (2014) call "surprises", as they are not always in accord with the espoused aims of the project. This allows managers the opportunity to create environments, in which this personal knowledge can surface and be shared within the teams.

This research highlights how interaction (seen as a "noematic bridge" in terms of a shared learning conversation) with the knowledge triggers can be productive. Taylor (2004) sees triggers as risk factors, and whilst they may delay project completion, an appreciation of the operation of triggers will enable the team learning to be incorporated within an appropriate timescale. Varying the context of the project team as well as testing the triggers on day-to-day working groups can shed light on tacit knowledge triggers. This study has found that recognizing phase changes in project temporality allows managers to appreciate the knowledge gained from extempore interjections. The development

of awareness of triggers in a dynamic environment helps the comprehension of expert knowledge exchange in software projects. Understating the knowledge a team has, and aiding its emergence through exchange, can ultimately lead to more productive outcomes for software development teams, and will contribute to successful and well-functioning products. The value of such an approach to the creation of knowledge is to see the concept of truth not as correctness towards the object, because in this situation it remains indeterminate. The alternative view is to see truth as non-concealment - it brings forward that which remains hidden. Using the framework to identify triggers, in the form of modes of knowing, is an approach that reveals the personal knowledge that indicates and reveals the unspoken assumptions about the objects in use discussed above. Further investigation into knowledge sharing and interaction between software project groups will help to validate the triggers.

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