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Where does information on incidents come from?

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Abstract

Objectives/Scope: Ensuring people in an organisation are well connected has been shown in previous research to be vital for exchanging information, influencing attitudes, and improving safety. After an incident, information is often distributed within a company so that others can learn from that incident. While processes to share incident information often exist, there is a need to understand whether and how information reaches those who need it in their roles, as effective information exchange is a first step to building the knowledge of those not directly involved in an incident.

Methods, procedure, process: To investigate this topic, the Open University, in collaboration with the Energy Institute, sent a survey to employees working in operational and maintenance teams at a European site of a multinational energy company, asking how they receive safety related information. Survey respondents included both front-line workers and managerial members of the teams. The surveys enquired how people receive information about incidents, focusing both on formal and informal channels. Here a formal channel refered to an email, document, or meeting where information on an incident is purposefully shared. Informal channels include, for example, discussing a safety concern with a colleague.

Results, observations, conclusions: The data evidenced that plant operators and managers received information in different ways. Front-line workers appeared to have many connections within a team with whom they would discuss safety concerns, but mainly received information from outside their team only through official notifications distributed by the health and safety team. The managerial level members of the unit, on the other hand, often had a wide network of colleagues external to their immediate team, from whom they heard information about industry incidents in addition to the reports distributed by the health and safety team. How teams responded to an incident alert, and what additional knowledge was gathered by management was, nevertheless, not captured by a formal system. It is likely to be useful to formally record information on the actions taken in response to an incident by teams, as others could then learn not only from original incident information, but also from the responses of other teams within the organisation.

[1] The views and opinions expressed in this document are those of the individual authors and do not necessarily reflect the policies or positions of their employer.

Novel/ additive information: Consideration of the flow of information is vital if companies are to enable workers to learn from incidents which they weren’t directly involved in. While health and safety are usually the source of information, all workers at a site have the opportunity to hear about industry incidents that could help to keep front-line workers safe. However, unless a procedure exists to record the actions taken by teams and additional useful information gathered by management, learning will be kept to a local level. A formal database or system could aid teams in understanding how others have learnt from an incident.

Introduction

Information exchange is a vital part of improving safety in energy companies (Lingard, Pirzadeh, Blismas, Wakefield, & Kleiner, 2014). This includes companies' efforts to learn following incidents. Information distilled from an incident investigation must be spread across a company for widespread learning and organisational change. Otherwise insights garnered affect only the individuals involved in the incident (Jacobsson, Ek, & Akselsson, 2011, 2012; Littlejohn, Margaryan, Vojt, & Lukic, 2017).

Information exchange can occur in multiple-ways in a company. Previous research has demonstrated that knowledge can be exchanged tacitly (Zhang, He, & Zhou, 2012) and informally (Rienties & Kinchin, 2014), for example by working with more experienced colleagues (Billett, 2014). Another example of informal exchange would be the sharing of best practices as contractors move around a company and work with different groups (Gressgård & Hansen, 2015). Information can also be spread through formal and purposeful methods, such as databases or meetings (Anderson, Ramanujam, Hensel, & Sirio, 2009; Jacobsson, Sales, & Mushtaq, 2009, 2010; Reiter-Palmon, Kennel, Allen, Jones, & Skinner, 2014).

Two literature reviews on learning from incidents have highlighted both the importance of information exchange on incidents, and that the topic still lacks concrete research to explore communication strategies (Drupsteen & Guldenmund, 2014; Lindberg, Hansson, & Rollenhagen, 2010). While receiving information about incidents does not necessarily lead to learning (Lukic, Littlejohn, & Margaryan, 2012), it is an essential step as workers need information in order to learn.

This paper describes the research undertaken with a European site of a multinational energy company to understand how information about incidents is distributed. The study applied social network analysis techniques to investigate how information is dispersed both through formal and informal means. The study aims to conceptualise how information on incidents moved around this particular site, and identify potential gaps and key roles.

Workplace learning through networks

Prior research on the role that networks can play in workplace learning has focused on two types of connections: weak and strong links. A strong link would, for example, be with someone who you work with every day. As teams members often see each other almost every day there are usually many strong links within a team. A weak link, on the other hand, would represent a connection to someone who is closer to an acquaintance, such as a fellow member of a professional group that you rarely see. Both weak and strong links appear to play a role in information exchange, as well as in problem solving. Rather than one being better than the other, a balance is needed in a team.

In prior research on social networks it had been proposed that tight-knit groups, i.e., ones that have a lot of strong links between members, have advantages when exchanging technical or complicated information (Hakkarainen, Palonen, Paavola, & Lehtinen, 2004). By having close bonds it is likely that members of the group share common understandings and language, enabling them to communicate effectively about complicated concepts (Nahapiet & Ghoshal, 1998). In Nonaka and Takeuchi's (1995) model of knowledge building this is called socialising ideas (i.e., exchanging knowledge tacitly within a group). These unspoken shared understandings allow tacit knowledge to be drawn upon when faced with problems. However, there is a lot of redundancy in the information exchange that occurs, as most members of the group will have similar experiences. This similarity between members can make it difficult for innovative ideas to arise since problem solving requires new knowledge or a fresh perspective.

Weak links are less suitable for communicating complex information, as two people not actively involved in each other's work are unlikely to both have the same baseline knowledge. For example, an engineer and a lawyer both deal with complicated situations, but are unlikely to be able to communicate effectively about the intricacies of each other's work. However, weak links are vital in problem solving, as a way of gaining a completely different perspective on an issue. In network-oriented theories of professional learning links to external groups, i.e., people who an employee sees less frequently and are therefore more likely to be weak links, are considered important for this reason. Weak connections allow the inflow of novel ideas and perspectives that can shed new light on issues (Burt, 2004). While strong links within a team allows the flow of information, especially technical information that requires participants to understand similar concepts (Hakkarainen et al., 2004), the number of external connections to a team are equally important for solving problems (Palonen & Hakkarainen, 2014), such as how to avoid incidents.

When considering how information on incidents is distributed around a company it is therefore important to consider both how well-connected teams are within themselves, and where external links may bring fresh ideas on ways to address problems.

Method

Data was collected from a European site of a multinational energy company. The site employed around 200 employees. Two production operations teams, their management team, supporting maintenance engineers, and the maintenance management team were invited to take part in the study. Overall 35 of the 63 workers invited to take part in the study responded (55.6% response rate). A breakdown of the response rate per team is provided in Table 1.

Table 1: Response rate per team

Team	Team size	Responses received	Response rate
Operations team 1	18	13	72.2%
Operations team 2	10	8	80.0%
Operations management	10	4	40.0%
Maintenance engineers	18	7	38.9%
Maintenance management	7	3	42.9%

The site workers were asked to fill in a survey to identify who within their network they turn to for advice on safety, as well as from who they receive official information on safety. The survey was designed based on previous research that has been conducted in workplace environments focusing on information exchange (e.g., Palonen, Hakkarainen, Talvitie, & Lehtinen, 2004). A name generator survey, i.e., a survey that asks participants to list people who they have a certain type of relationship with, was created as a way to identify who was connected to whom (Wasserman & Faust, 1994). This survey was divided into two parts. The first listed all members of the person’s immediate team. For each person on the team the respondent was asked to indicate:

1. Would you discuss a safety related concern with this person?
2. In the past six months have you received safety related information from this person through a formal channel, such as an email or meeting?

The question further clarified that communication could take any form, e.g., written or verbal. The second question asked the same two sub-questions, but enquired about people outside of the person’s immediate team. No list of names was provided for this question, but respondents were provided with a space to list a name and their relationship to the respondent.

The survey was originally written in English and then professionally translated into the local language. A native of the local language who was an expert on social network surveys then checked the accuracy and nuance of the translation.

The survey was distributed via an online platform to participants. A link to the survey was sent by the researcher to each participant by email. An explanation of the purpose of the research was included in this initial email. Participants then received up to three reminder emails at approximately two week intervals.

After this time the response rate of the two operations teams was deemed sufficient for network-level analysis, i.e., there were enough data to construct the structure of each team. A high response rate is essential for network-level social network analysis, as a low response rate could lead to a section of the network to be completely missing (Hanneman & Riddle, 2005).

Analysis of the data was undertaken using the UCINET software. The analysis consisted of both network-level, i.e., whole team, and ego-level, i.e., individual, analysis. Only the results of the two operations teams were analysed at the network-level as the response rate of the three other groups was too low (Hanneman & Riddle, 2005). Two networks for each team were created and analysed. The first was an advice-seeking network. The advice-seeking network was created using the answers to the 'would you discuss a safety related concern with this person' question for each team member. The second was an information-receiving network. This network was constructed using the answers to the 'in the past six months have you received safety related information from this person through a formal channel such as an email or' question for each team member.

All responses were included in the ego-level analysis. The respondents were grouped into those with management roles and front-line workers for the ego-level analysis. The software package R was used to compare the two groups.

Results

Network-level analysis of operations teams

Figures 1, 2, 3, and 4 show the network diagrams that were produced for each of the two teams. Figures 1 and 2 are the advice-seeking networks of teams 1 and 2 respectively. Figures 3 and 4 are the information-receiving networks of the teams.

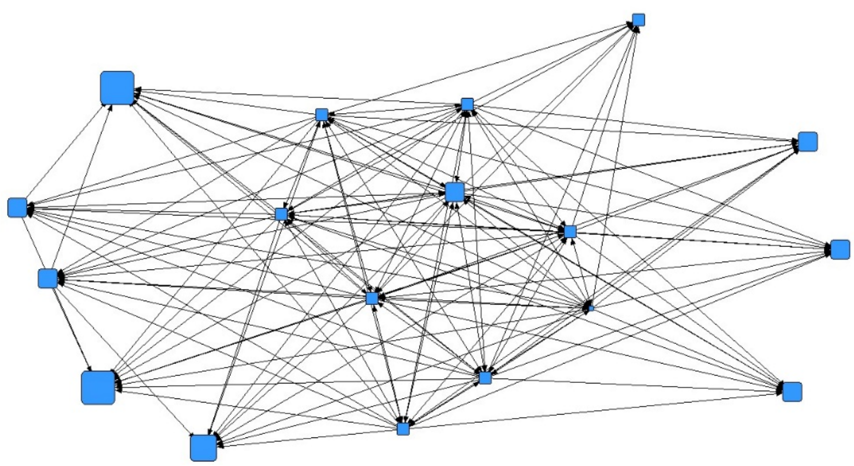

Figure 1: Advice-seeking network of team 1

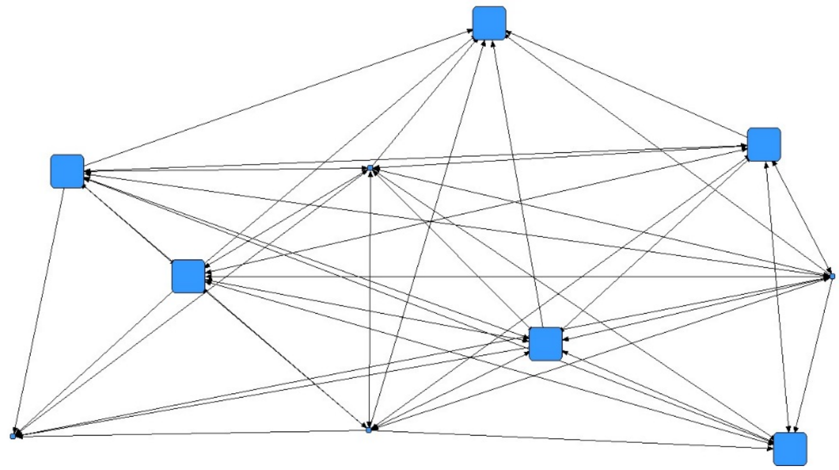

Figure 2: Advice-seeking network of team 2

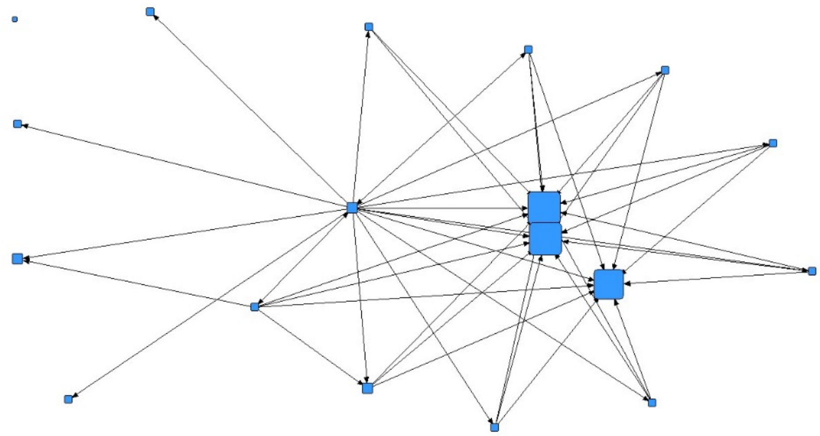

Figure 3: Information-receiving network of team 1

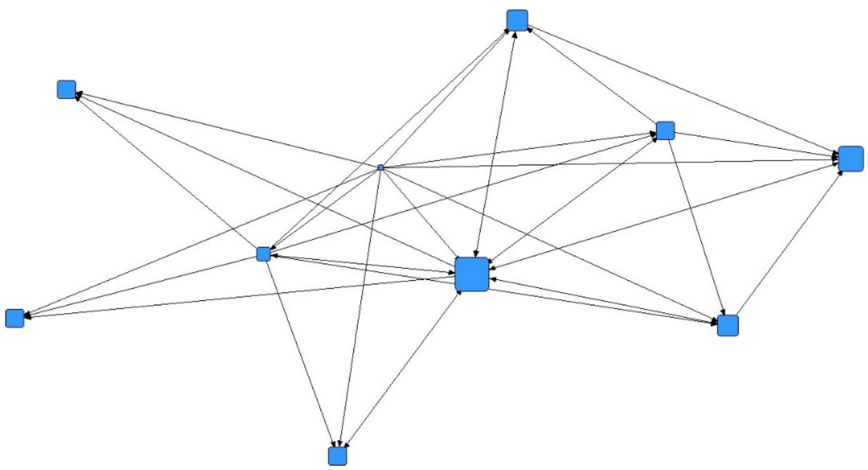

Figure 4: Information-receiving network of team 2

In each of the diagrams a square represents a member of the team. The edges, i.e, the arrows between the squares, represent relationships that were present in the surveys. If person A said that they would discuss an issue with person B, then an arrow would be present in the diagram starting from A and pointing at B. The size of the square is proportional to the number of respondents who chose that person, i.e., the large squares represent the people with whom most respondents would discuss issues, or from whom they received information through a formal channel.

The density of a network is a measure of the proportion of edges that are present compared to the theoretical maximum. If everyone indicated that they would discuss issues with everyone else in the team, then the density would be 1.00. If everybody chose half of the team members as people they would feel comfortable discussing issues with, then the density would be around 0.50. Table 2 shows the densities of the four networks. The advice-seeking networks are dense in relation to other teams who have taken part in research on workplace learning (e.g., Palonen et al., 2004; Zhang et al., 2012). In particular, the density of team 1 is likely to be more similar to team 2's in reality than it appears in Table 1, but was reduced due to five team members (17.8%) not responding to the survey. The densities of the information-receiving networks are substantially lower than the advice-seeking networks. This is to be expected as information on safety through formal channels is mainly received through supervisors, or others in formal positions of responsibility in the team.

Table 2: Network densities of operations teams

Network type	Team 1	Team 2
Advice-seeking	0.56	0.83
Information-receiving	0.17	0.40

Another set of metrics that can be used to give insight into the structure of a network is the in-degree and out-degree. The in-degree is the number of people who chose a certain team member. The out-degree if the number of team members chosen by a particular respondent. The in-degree and out-degree for both types of network are shown in Table 3 for team 1 and Table 4 for team 2. Each team member was randomly assigned a number to maintain anonymity.

Table 3: In-degree and out-degree for team 1

Team Member	Out-degree advice-seeking	In-degree advice-seeking	Out-degree information-receiving	In-degree information-receiving
1	0	11	0	10
2	17	8	3	1
3	0	11	0	10
4	3	9	0	1
5	15	8	3	1
6	17	8	3	1
7	0	10	0	9
8	0	9	0	2
9	3	9	3	2
10	17	8	6	1
11	0	9	0	1
12	0	9	0	0
13	17	9	16	2
14	17	8	3	1
15	17	7	3	1
16	17	8	2	1
17	17	8	4	1
18	0	8	0	1

Table 4: In-degree and out-degree for team 2 networks

Team Member	Out-degree advice-seeking	In-degree advice-seeking	Out-degree information-receiving	In-degree information-receiving
1	9	6	1	3
2	8	7	2	4

3	9	7	2	4
4	9	7	8	7
5	4	7	1	5
6	9	6	9	0
7	9	7	4	3
8	9	6	7	2
9	0	7	0	3
10	0	6	0	3

Ego-level analysis

For the ego-level analysis respondents were designated as either a front-line worker, i.e., part of an operations team or a maintenance engineer (n = 28), or management (n = 7). Ego-level analysis of social network data usually examines the types and number of connections that people in different positions have. In this case analysis focused on the external connections between front-line workers and management. Table 5 displays the descriptive statistics of the two groups. An external connection was considered any named person who was either someone the respondent would approach to discuss a safety concern, or someone from whom they had received information through a formal channel.

Table 5: Descriptive statistics of external connections

Group	Mean number connections	Standard deviation
Front-line workers	1.3	2.81
Management	5.9	6.4

A Mann-Whitney U test was conducted to ascertain if the difference between the two groups was statistically significant. A non-parametric test was chosen due to the small sample size and the Shapio-Wilk test demonstrating that the distribution of both groups was significantly different to a normal distribution. The Mann-Whitney U test revealed that the number of external connections listed by front-line workers and management differed significantly with a p value of less than 0.01. The most common external connection for both front-line workers and managers was a member of the health and safety Team. Managers were also likely to list colleagues from across the organisation or from outside the company.

Discussion

Information sharing within the operations team

The network diagrams of the two operations team showed that within this company the teams are closely connected. The advice-seeking network densities of 0.56 and 0.83 of team 1 and team 2 respectively suggest that information flows informally with little hindrance, when a problem is identified. When examining the out-degree of respondents it can also be observed that the majority of team members who completed the survey indicated that they would contact anybody in their team to discuss an issue.

Interview data collected concurrently with the network data (Murphy, Littlejohn, Rienties, King, Bryden, forthcoming) validated that information on issues discovered was likely to be shared with the whole team quickly. The participants from the operations team detailed their teams' process for raising concerns, which involved either asking the person physically closest to you for a second opinion, or announcing the problem to the whole team via their walkie-talkies.

In terms of receiving information through formal channels the network diagrams showed that there were key people in each team responsible for spreading information. It should be noted that in the smaller team a larger proportion of workers appeared to be viewed as playing a role in sharing information through formal channels such as meetings. There are various potential explanations for this, but based on prior research it is likely that the smaller team size contributed to the denser connections, both formally and informally (Burt, 2004).

External connections of teams

Front-line workers appeared to have a limited number of connections outside their team in comparison those in managerial roles. As the most common external connection was to the health and safety team, the same team distributing information on incidents, it suggests that there are perhaps limited new perspectives being brought to discussions around incidents within front-line teams. Nonetheless, two team members mentioned that they would approach external contractors with whom they work for advice on safety related issues. As contractors have experience in a variety of environments they can offer novel insights to issues that teams face (Gressgård & Hansen, 2015).

Managers, on the other hand, appeared to have multiple connections to people outside of their immediate work colleagues. The types of connections also varied greatly, from colleagues within the same organisation to connections in other companies. These perspectives can offer unique insights into incident information. The disparity between the number of external connections of the managers and front-line operators highlights the importance of the role that the operations supervisor plays within a team. Management play an important role in expanding their own knowledge related to incident alerts, which they can then convey to their team. The team supervisor becomes a key player in this process of expanding on the information contained in an incident alert, as they link the members of the management team, who have an expanded understanding, to the front-line workers who carry out the actual operations.

The flow of information between groups is visualised in Figure 5. A missing feature of this information flow is feedback to the health and safety team. While further research would be needed to understand if there are concrete benefits to informing the health and safety team of how and why a team took action following an incident alert, it could be useful for at least two reasons: 1. The health and safety team can better understand the types of incidents that are most relevant to fromt-line teams, 2. The health and safety team can share actions that different teams took following an incident alert. In particular this second reason could be beneficial in allowing teams to learn not only from the original incident alert, but from the responses of different teams within the organisation.

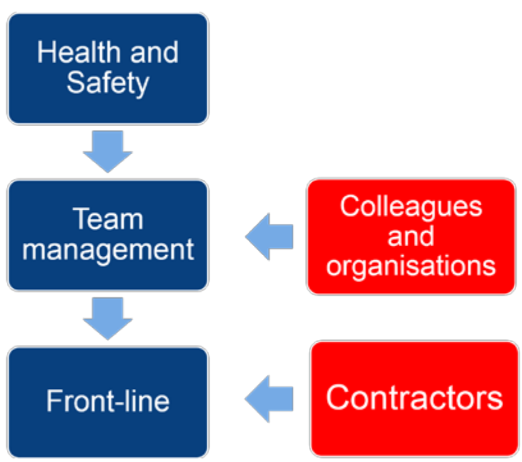

Figure 5: Flow of information within company

Conclusion

This research highlights several considerations on how information flows around a company and whether it is used effectively to learn from incidents. The research confirms previous findings that trust within a team is an important factor to support discussion of safety issues, enabling each team member to utilise the knowledge of others and combine it with their own. Connections to other people outside one's

immediate team bring new knowledge and insights to discussions about incidents. Management are the ones who typically have these external connections, but team supervisors play an important role in ensuring that management's expanded knowledge reaches front-line workers.
Lastly, it would potentially be useful if a record existed of what teams did following an incident alert. Unless this record of how teams learnt is created then the health and safety team have little insight into how teams use the information they distribute. Additionally teams would have the opportunity to learn from what others do following an incident alert.

From a practical perspective there is a need to focus on three aspects of information exchange:

1. Ensure that team members feel comfortable discussing incident information and safety concerns with the rest of the team. This includes being provided with specific opportunities for discussion.
2. Enable managerial level staff to cultivate a large network through membership of professional bodies, attendance of conferences, and training, etc. The team supervisors of front-line workers must be well connected to these managerial level employees, as the supervisors provide the bridge between those with the largest bodies of knowledge and those doing the work.
3. Incident recording systems should allow teams to record what they found useful and the actions they took after receiving an incident alert. This is important for sharing between similar sites, but also for the health and safety team to understand how the information they disseminate was used.

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