

## **Synthesising the Literature on the Benefits and Impact of Group Awareness in Group Work**

**Shukor Sanim Mohd Fauzi\*, Wan Asma Wan Mohammad Sobri and Anjila J. Suali**

*Faculty of Computer and Mathematical Sciences, Universiti Teknologi MARA, 02600 Arau, Perlis, Malaysia*

### **ABSTRACT**

Group awareness among the members has been a concern to researchers studying the group. This paper examines benefits and impact of group awareness to members of the group work based on empirical evidence from literature on the following topics, such as Computer Supported Cooperative Work (CSCW), Computer Supported Cooperative Learning (CSCL), Human Computer Interaction (HCI), Groupware, Information Systems, Psychology, Management and Organizational Science. Systematic Literature Review (SLR) is the method employed for such review. This study contributes knowledge on group awareness and its benefits to the group by synthesising literature on group awareness for the group. Group awareness benefits the group since it enhances group performance – for instance it reduces time wastage, improves quality of output, and increases coordination.

*Keywords:* Collaboration, coordination, group awareness, group work, systematic literature review

### **INTRODUCTION**

There are multiple definitions of ‘group’ or also known as ‘team’ in the literature (Tran, Yang & Raikundalia, 2006; Tajfel,

1982). This research adopts Hackman’s (1987) definition. ‘Group’ is defined as “*a collection of individuals who are interdependent in their tasks, who share responsibility for outcomes, who see themselves and who are seen by others as an intact social entity embedded in one or more larger social systems and which manage their relationships across organizational boundaries*” (Hackman, 1987). Group awareness refers to an “*understanding of activity of others, which provides a context for your own activity*” (Dourish & Bellotti,

#### **ARTICLE INFO**

##### *Article history:*

Received: 15 September 2016

Accepted: 30 January 2017

##### *E-mail addresses:*

shukorsanim@perlis.uitm.edu.my (Shukor Sanim Mohd Fauzi),

wanasmasobri@gmail.com (Wan Asma Wan Mohammad Sobri),

anjilasuali91@gmail.com (Anjila J. Suali)

\* Corresponding author

1992). These definitions reflect that an individual or also known as a group member requires information obtained from other entities (e.g. other group members, task and environment) which can help to develop understanding and increase the knowledge of the task.

In a group, it is easy to be aware of and understand duties of others if it involves a small group and the tasks are simple (Araújo & Bourbousson, 2016). It however becomes complicated as the group expands in terms of its membership (Espinosa, Slaughter, Kraut, & Herbsleb, 2007). Distance makes it more difficult for members to coordinate their work (Chabanloo, Abyaneh, Kamangar, & Razavi, 2011; Herbsleb, Mockus, Finholt & Grinter, 2001). It affects ability of the members to coordinate and communicate especially when team interaction tends to be less spontaneous and frequent (Kraut, 2003). Coordination becomes harder as the number and relatedness of the task increase (Espinosa et al., 2007) and there are mutual dependencies between each task (Malone & Crowston, 1994; Nguyen-Duc, Cruzes, & Conradi, 2015).

Software development is collaborative in nature. Developers need to continuously coordinate and communicate to be aware of each other's work, since each task often impacts the work of the other. Group awareness can help to reduce the coordination and communication complexities more effectively in software development. Thus, group awareness could provide up-to-date knowledge which can help its members synchronise their tasks with other members

(Endsley, 1995; Bourbousson, R'Kiouak, & Eccles, 2015).

Numerous empirical evidences show the benefits and impact of group awareness to group work. However, to the best of the authors' knowledge, little initiative is taken to synthesise the empirical evidences. That has motivated the present authors to perform Systematic Literature Review (SLR) to synthesise the empirical evidences. This study contributes confirms on the benefits of group awareness for group work.

The following section of this paper discusses methodology followed by a discussion of the findings before the paper is concluded.

## METHODS

### Systematic Literature Review (SLR)

We carried out a Systematic Literature Review (SLR) which is an approach of identifying, evaluating, and interpreting all available research relevant to a particular research question (Kitchenham, 2004). The research question:

**RQ1:** *What empirical evidences exist on the benefits and impact of group awareness in group work?*

We performed an extensive search of the following electronic databases by using the keywords identified in Table 1. The keywords were categorised in two: Category A comprises keyword which is related to "Group Awareness", while category B consists of keyword which is interrelated with "Group Work". Both

categories were combined using the Boolean “AND” expression: (*A1 OR A2 OR A3 OR A4*) AND (*B1 OR B2*). The databases searched were:

- IEEE Xplore (<http://ieeexplore.ieee.org>)
- ACM Digital Library (<http://www.portal.acm.org/dl.cfm>)
- Elsevier ScienceDirect (<http://www.sciencedirect.com>)
- Compendex EI (<http://www.engineeringvillage2.org>)
- EBSCOhost (<http://www.ebscohost.com/>)
- ProQuest Research Library (<http://www.proquest.com>)
- INSPEC (<http://www.engineeringvillage2.org>)
- Google Scholar (<http://scholar.google.com>)
- AIS eLibrary (<http://aisel.aisnet.org>).

The papers were examined based on their relevance to the research questions. First, we analysed the title, abstract and keywords. In some cases, we read the entire paper to determine its relevancy. The papers were classified into two categories based on inclusion and exclusion criteria. The following inclusion (I) and exclusion (E) criteria were applied:

- I1.* Papers should directly relate to group awareness and the studies should focus as software development.
- E2.* Posters, panels, abstracts, presentations and article summaries.

After the screening process, the papers were classified according to research method strategy (i.e. experiment, case study, experience report, observational study, systematic review), data collection methods (i.e. interview, observation, questionnaire, multiple data collection methods), type of data analysis (i.e. qualitative, quantitative or both).

Table 1  
*Keywords used in this study*

Category	Keywords
A. Group awareness	A1- Group awareness A2-Workspace awareness A3- Team awareness A4- Team familiarity
B. Group work	B1- Group work B2- Team work

## RESULTS

The study reviewed 10 relevant papers on the topic of group awareness. Table 2 shows the list of the publications such as: ACM Transaction on Human Computer Interaction, European Journal of Information Systems, Organization Science, Management Science, Organizational Behaviour and Human Decision Process, IBM Systems Journal, Personnel Psychology and Journal of Applied Psychology.

Table 2  
*Keywords used in this study*

Type of Publication	Percentage	Paper ID
Journal	80	[P1][P2][P4][P5][P7][P8][P9][P10]
Proceeding	20	[P3][P6]

Three broad dimensions were used to measure group effectiveness (Cohen & Bailey, 1997): 1) performance effectiveness 2) member attitudes and 3) behavioural outcome. Examples of performance effectiveness include improved communication, coordination, productivity, response times, quality, customer satisfaction and innovation. Examples of member attitudes include employee satisfaction, commitment and trust. Examples of behavioural outcome include absenteeism, turnover and safety and group knowledge.

Performance effectiveness was the focus of eight studies (Studies 1, 2, 4, 5, 6, 7, 9 and 10). Two studies (Studies 1 and 9) used completion time to measure group awareness performance. Study 1 found completion time is lower when there is an awareness of support in the group, whereas findings of Study 9 suggest the overall effect of group awareness on speed is significant and it supports the hypotheses for the study. Study 1 also indicates communication is more effective and helps to minimise error in the group work.

Two studies (Studies 4 and 6) used structural complexity to measure group performance. Structural complexity refers to coordination and team size in a group. Studies found team size and geographic dispersion had a negative effect on group

performance. However, group awareness helps to reduce these negative effects by narrowing the performance difference between collocated and geographic dispersion and also between small and large teams. Both studies support the hypotheses that group awareness has a positive effect on structural complexity.

Study 5 measures product defects to examine the impact of group awareness on group performance. Findings show the group is able to reduce product defects to 18.6% and able to deliver the product on time and without exceeding the budget.

Study 7 examines group composition on decision making. Results show group members who are familiar with each tend to solve more cases.

Other studies, such as Study 2, used the variable decision to measure group performance while Study 10 used data from coal miners to measure productivity. Both studies showed a positive link.

Only two studies (Studies 3 and 8) explored the behavioural outcome of the group members to measure group performance. Study 10 suggests group awareness can help to contribute to the group members' knowledge. This is possible if group members have been exposed to different modes social learning in their group. It includes Personal Interaction, Task

Observation and Interaction Observation. However, this study suggest group awareness can help shape its members' learning behaviour which can enhance group performance.

Study 8 applies a collective mind theory to understand how the group members learn what they need to know to determine requirement and manage their dependencies.

Table 3  
*Summary of literature review*

Paper ID	Methods Used	Objectives	Type of Outcome Measured	Summary of Result
P1 (Gutwin & Greenberg, 1999)	Experiment	To evaluate the hypotheses: group awareness can improve the outcome of the shared task	Performance effectiveness - Task completion, communication effectiveness	Task completion times – Completion time is reduced when there is group awareness systems. Communication effectiveness – Communication is more effective and helps to minimise errors.
P2 (Cooper & Haines, 2008)	Experiment	To evaluate the hypotheses: Group awareness will improve decision making	Performance effectiveness - Decision quality	Decision quality - Study found group awareness aided decision making and consensus-seeking. Group awareness has helped members to discuss, instruct, consult, coordinate and assist other group members.
P3 (Singh, Dong & Gero, 2009)	Experiment	To investigate the relationship between modes of social learning and level of group familiarity to enhance group performance	Behavioural outcome - Group knowledge	Group knowledge- As group familiarity increases, group performance also increases. Social interaction has an effect on group awareness which in turn elevates group performance.
P4 (Espinosa et al., 2007)	Case study	To evaluate hypotheses : 1. Group familiarity and geographic dispersion interact positively and has an effect on group performance; there is a positive effect of team familiarity on group performance especially when teams are geographically dispersed	Performance effectiveness – structural complexity	Distance – Results showed that geographic dispersion and team size had a negative effect on performance. However, group familiarity helps to mitigate these negative effects by narrowing the differences between co-located and geographically dispersed teams.

Table 3 (continue)

		2. Group familiarity and team size have positive effect on group performance, such that the effect of team familiarity on group performance is stronger when teams are larger		Team size – Group familiarity also helps to narrow the difference in performance between small and large teams. More members mean extra resources to boost performance of the group.
P5 (Huckman, Taats & Upton, 2009)	Case study	To examine the impact of experience on group performance	Performance effectiveness - Product defects	Product defects - The study found the level of awareness (e.g. the average number of times each member worked with every other member of the team) has a significant effect on performance. The team member – for instance Project Manager (PM) - is better able to allocate responsibilities among team members and manage interdependencies. The project team members such as the engineers also have the ability to identify and manage interdependencies. This benefits the team where the team is able to reduce the product defects to a rate of 18.6% and able to deliver the product on time and without exceeding
P6 (Espinosa et al., 2002)	Case study	To test hypotheses : shared mental model and work familiarity have a positive effect on coordination in large-scale software development	Performance effectiveness – structural complexity	Distance – Study 1 (interview) - Results suggest that 78% of the participants recognised the importance of coordination and understanding the strengths of each member (e.g knowing who knows what, familiarity with colleagues) Study 2 (survey) – Shared mental model had a positive effect on team coordination

Table 3 (continue)

				<p>Study 3 (archival study)          – shared mental model          reduced time take to          develop software          Work familiarity –          Study 1 (interview) -          Results also showed that          participants recognised          the importance of          coordination and shared          mental models of the task          (e.g. shared knowledge          of the concepts, common          vision of goals)          Study 2 (survey) – no          significant results          Study 3 (archival study)          – familiarity with the          same modules or files          reduced time for software          development</p>
P7 (Gruenfeld, Mannix, Williams & Neale, 1996)	Experiment	To examine the role of group composition on group decision making	Performance effectiveness – number of cases solved	<p>Cases solved - Three          different group          compositions were set          up – a) three individuals          know each other b) two          familiar individuals and a          stranger c) three strangers.          Results from this study          indicates all familiar          and 2 familiar/1 stranger          groups were most likely          to identify the correct          suspect when critical clues          remained unshared. This          improves group’s decision          making which enhances          group performance (in the          number of cases solved)</p>
P8 (Crowston & Kammerer, 1998)	Case study	To understand how the group members learn what they need to know to determine requirement and manage their dependencies	Behavioural outcome - Members learning behavior	<p>Member learning          behaviour - This study          applies a collective mind          theory to understand          how the analysts learned          what they need to know          to determine requirement          and manage their          dependencies. The major          claim of that theory is that          individuals develop</p>

Table 3 (continue)

				shared understanding of one another which can enhance group performance. Two companies were examined. The results showed companies who employ three individual behaviour such as contribution (an individual member of a group contributes to the group outcome) 2) representation (an individual builds internal models of the group) and subordination (an individual puts the group's goals ahead of individual goals) tend to have a positive effect on group performance. The group with the stated behaviours can perform task conscientiously, make decisions intelligently, able to coordinate the contributions to other group members effectively, had little difficulty correctly identifying persons who would be affected by changes.
P9 (Harrison, Mohammed, Mcgrath, Florey & Vanderstoep, 2003)	Experiment	To examine the hypotheses varying levels of group members familiarity and its effects on group performance	Performance effectiveness - Completion time	Completion time – Results show that the overall effects of familiarity on speed and quality of group performance is significant and it supported the hypotheses.
P10 (Goodman & Leyden, 1991)	Case study	To examine the effects of familiarity on group productivity	Performance effectiveness - Productivity	Data from 26 coal miners indicate that the awareness or familiarity among the workers increase group productivity. The study also found, absenteeism leading to staff being replaced and thus affecting the level of familiarity in the work group.



## DISCUSSION AND CONCLUSION

This study contributes to research on group awareness and group work by synthesising the literature on the impact and benefits of the former on the latter. This study is important as it provides empirical evidence on the explanation on benefits of group awareness for the members of the group.

An in-depth and systematic review of relevant literature showed group awareness has a significant impact on members of the group in terms of reducing time taken to complete a job, make communication more effective, improve decision making, reduce coordination problem, increase productivity, and improve the group member's learning behaviour. Social interaction, experience working together and shared beliefs support group awareness and this in turn, enhance group performance.

### Future Research

Based on empirical studies, it is believed that group awareness can also provide a positive impact to software development – for instance, improve the quality of decision making, improve coordination and communication and others. Thus, software development demands heavy involvement of members of the group which requires coordination and communication among group members to accomplish the task. Our future research will focus on the impact of group awareness in software development.

## ACKNOWLEDGEMENT

The authors gratefully acknowledge funding from Ministry of Higher Education, through the Research Acculturation Grant Scheme (RAGS) grant (600-RMI/RAGS 5/3 (4/2014).

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