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Outcome of collaborative emergency exercises: Differences between full-scale and tabletop exercises

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# **Trust and Learning from Emergency Collaboration Exercises: Differences Between Full-Scale and Tabletop Exercises**

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## **Abstract**

The degree to which exercises improve the collaboration among different organisations during an emergency is under debate. This study aims to contribute to the scarce research on this topic by giving insight into the perceived effects of exercises on collaboration, learning, usefulness, and interorganisational trust. In particular, this quantitative study looked into the differences between the effects of tabletop and full-scale exercises. A questionnaire assessing collaboration, learning, usefulness, and trust—the CLUT instrument—was developed. Data were collected from 173 full-time emergency management personnel in Norway and Canada. Usefulness, learning, and collaboration outcomes were perceived to be high for both types of exercises, but full-scale exercises were perceived to have greater learning and usefulness outcomes than tabletop exercises. Stronger relationships were identified between the perceived effects on learning and usefulness, collaboration, and trust in tabletop compared to full-scale exercise, whereas the relationship between the perceived effects upon collaboration and trust was stronger in full-scale exercises. Multiple regression analysis showed that the variables used to measure exercise usefulness can better predict tabletop exercise outcomes.

**Keywords:** Emergency exercises; collaboration exercises; tabletop; full-scale; collaboration; trust; learning; usefulness

## Introduction

Evaluations of successful and failed emergency responses highlight the importance of effective collaboration and detailed plans (Metallinou, 2018; Wilkinson et al., 2019; Curnin & O'Hara, 2019). In particular, interorganisational collaboration has been emphasised as a critically important task that organisations should train on (Skr., 2009/2010; Andreassen et al., 2020). In collaboration exercises, multiple organisations participate and aim to integrate and improve their collaboration to handle emergency situations together (Berlin & Carlström, 2015). Such exercises are assumed to include not only command and control, technology, and emergency plans and procedures but also enhanced collaboration between organisations at all levels (Sørensen et al., 2019). They are, moreover, expected to increase the ability of organisations to help each other, to test cross-organisational collaboration, and to prepare participating organisations to react to emergencies in a coordinated manner (Kim, 2013). The outcome of such exercises is, however, under debate. Some researchers claim that emergency collaboration exercises on land (Berlin & Carlström, 2008, 2009, 2015) and at sea (Kim, 2013, 2014; Kristiansen et al., 2017; Magnussen et al., 2018; Sørensen, 2017; Sørensen et al., 2018, 2019) tend to produce results with limited collaboration-related outcomes and usefulness in real emergency responses (Borell & Eriksson, 2013; Kristiansen et al., 2017). Some reasons for these outcomes include unsatisfactory attention to variation (Borell & Eriksson, 2013), dominance of mechanistic behaviour (Berlin & Carlström, 2013), insufficient focus on learning aspects (Berlin & Carlström, 2015), and overdependence on standardisation (Kim, 2013).

Research into the outcomes of collaboration exercises at different levels is scarce, though there are some notable contributions (e.g. Berlin & Carlström, 2013, 2014, 2015; Carlström et al., 2019; Carlström et al., 2020; Helsloot, 2005; Kim, 2013; Perry, 2004; Skryabina et al., 2020). Most of these have focused on the implementation, significance, and effects of the exercises on

participants (Coombs, 2007; Drennan, McConnell, & Stark, 2014; Fink, 1986; Mitroff & Anagnos, 2001). While these contributions are important, they commonly concentrate on national, land-based, full-scale single exercises (FSEs). FSEs are demanding and costly, and participants rarely meet face-to-face. In tabletop exercises (TTEs), participants meet and discuss emergency scenarios. One matter that has yet to be understood is whether the findings for FSEs apply to TTEs.

Interorganisational trust is identified as an important factor in collaborative emergency operations (Roud & Gausdal, 2019). Even if some studies of trust in emergency management (e.g. in Roud & Gausdal, 2019; Seppänen et al., 2013) exist, studies of the trust outcomes of emergency exercises are very rare. The aims of this study are therefore as follows: 1) to develop an instrument to measure collaboration, learning, trust, and usefulness in collaboration exercises and 2) to investigate the outcomes of emergency collaboration exercises in general, and the possible outcome differences between TTEs and FSEs in particular.

## **Theoretical Framework**

The possible outcomes of emergency exercises include enhanced collaboration, learning, trust and usefulness.

**Learning and usefulness.** Learning, “the process whereby knowledge is created through the transformation of experience” (Kolb, 1984, p. 38), is one of the key potential exercise outcomes (Smith & Elliott, 2007). The goal of learning is not only to gain knowledge, it also represents development and change (Sommer et al., 2013). Learning from collaboration exercises may lead to changes and development and reveal gaps in interorganisational collaboration. These gaps can be filled by redefining existing procedures, routines, rules, etc., which is denoted as experiential learning (Stein, 1997). Learning as such is not sufficient; it needs to be relevant. It is therefore argued that collaboration exercises are ineffective when they do not contribute to

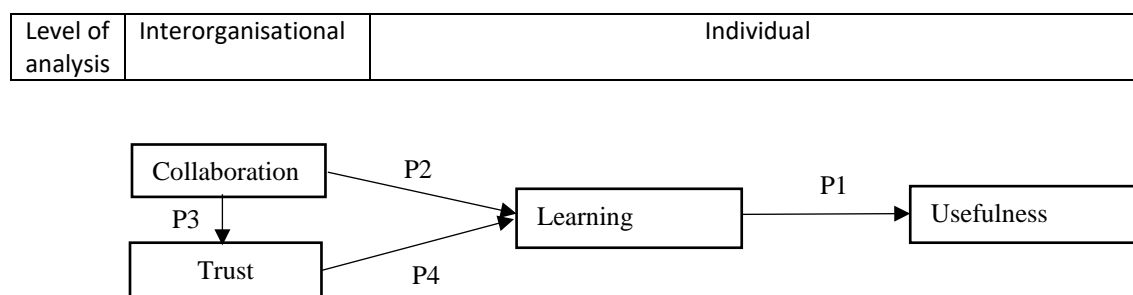
learning that may be useful in an actual event (Berlin & Carlström, 2014; Carlström et al., 2020). The overall goal of exercises is to improve the capacity to handle critical incidents or emergencies, which is denoted as usefulness (Andersson et al., 2014). Our first proposition (P1) is therefore that *learning positively influences the perceived usefulness of emergency collaboration exercises*.

**Collaboration and learning.** In exercises, individuals develop their core competencies and use their capacities interactively and complementarily (Magnussen et al., 2018). To inspire and facilitate collaboration among participating organisations, “participants have to develop a clear understanding of participating organizations’ priorities, ways of communicating, and use of sector-specific terms and abbreviations” (Sørensen et al., 2018, p. 2). Discussions are intended to facilitate collaborators generating productive conflict resolutions and eventually achieving effective interorganisational collaboration (Carlström et al., 2019). This can be achieved through collaboration exercises where participants are involved in work-related activities and discussion through active participation, which contributes to learning (Sommer, Njå, & Lussand, 2017). Our second proposition (P2) is therefore that *in emergency collaboration exercises, interorganisational collaboration positively influences individual perceived learning*.

**Collaboration and trust.** Interorganisational collaboration is identified as a key factor to develop interorganisational trust in the context of networks (Gausdal, 2012) and might have the same effect in collaboration exercises. To build trust across sectors, exercise designers can focus on joint problem solving that allows for improvisation and implementation of new strategies that enhance learning (Christensen et al., 2016). Having the ability to improvise and generate alternative solutions also helps emergency organisations better respond to and manage incidents with a low probability that occur relatively unexpectedly (Torgersen, Steiro, & Saeverot, 2013).

Our third proposition (P3) is therefore that *interorganisational collaboration in emergency collaboration exercises positively influences interorganisational trust*.

**Trust and learning.** In the emergency context, interorganisational trust is recognised to offer more opportunities for learning during collaboration exercises (Lane & Bachmann, 1998). Moreover, interorganisational trust positively influences the sharing of evaluation reports among emergency organisations, which may also improve the learning effects of exercises (Roud & Gausdal, 2019). Our fourth proposition (P4) is therefore that *in emergency collaboration exercises, interorganisational trust positively influences individual learning*. According to the literature and propositions, a conceptual model has been developed (Figure 1).



**Figure 1.** Conceptual model for the outcomes of emergency collaboration exercises.

### Types of Exercises

Five types of emergency management exercise have been defined: orientation, drill, TTEs, functional, and FSEs (Ministry of Civil Defence and Emergency Management, 2008). The types of exercises evaluated in this study are TTEs and FSEs.

A *tabletop exercise* (TTE) may be referred to as a ‘discussion exercise’ (Daines, 1991). A TTE allows emergency management officials to practice the full activation of emergency response plans within confined, controlled, and low-stress discussion scenarios (Coppola, 2006), where they often meet face-to-face. Participants sit together and have a dialogue on how they

would intend to act in a given scenario (van Laere & Lindblom, 2019). This type of exercise is used to practise problem solving and the coordination of services generally reserved for the management level. The effectiveness of a TTE is derived from the energetic involvement of participants and their assessment of the recommended revisions to current policies, procedures, and plans (Drabek & Hoetmer, 1990).

A *full-scale exercise* (FSE), the most complex type, tests all or a major portion of the functions specified in an emergency response plan (Daines, 1991). Such exercises are extremely demanding and face several constraints due to funding and time limitations (Daines, 1991). FSEs are usually conducted in a real-time, stressful environment that is intended to mirror a real incident (Haddow, Bullock, & Coppola, 2013). They often involve long waiting times and limited opportunities to examine different strategies (Berlin & Carlström, 2013). Moreover, different organisations have different roles, work at different locations, and communicate mostly by radio and phone, rarely interacting face-to-face. FSEs mostly aim to identify resource gaps in an operational environment rather than to develop relationships (Roud & Gausdal, 2019).

A variety of TTEs and FSEs exist; however, this study refers to TTEs or FSEs in general and not to specific exercises. Because participants in TTEs from different organisations meet face-to-face and take more leadership of the session, they can try alternative solutions and have more ability to assess options. Thus, we expect some differences between TTEs and FSEs in the level of interorganisational collaboration that they foster. Moreover, less pressure and fear of failure may also result in a more creative discussion that enables more learning in TTEs. In FSEs, there are short decision times and comprehensive simulated life-and-death situations (Waller, Lei, & Pratten, 2014), and the level of face-to-face contact is lower. In addition, the collaboration is remote and not as interactive. It is therefore expected that the conceptual model (Figure 1) works differently in the two types of collaboration exercises.

## **Methods**

A survey instrument was developed to measure collaboration, perceived learning, usefulness, and trust (CLUT). The CLUT survey was distributed to emergency personnel involved in collaboration exercises in Norway and Canada during the spring of 2018. All full-time emergency personnel who participated in this study were from the Coast Guard, police, municipalities, private rescue companies, shipping companies, fire brigades, ambulance personnel, and joint rescue centres. The intention of this study is not to compare the two nations but to compare the two types of exercise: TTE and FSE. The participants' responses are based on their experiences with all previous collaboration TTEs and FSEs.

### **Instrument**

The survey instrument is an extended version of the CLU instrument (Berlin & Carlström, 2015) with a specified scale from Sørensen et al. (2018) that measures perceived collaboration learning and usefulness based on a Likert scale ranging from 1 to 5, where 1 is 'strongly disagree' and 5 is 'strongly agree'. The extension consists of adding trust. To select items to measure trust, the emergency management literature was reviewed, with very sparse results. Two exceptions were identified. The first, Longstaff, Yang, and Society (2008) used three items to measure trust derived from Gillespie and Mann (2004), which are included as items 24 to 26 in the CLUT instrument. These items are used to measure trust that participants display towards the collaborating organizations through words and behaviour (Longstaff, Yang, & Society, 2008). The second, Paton (2007), was not used because it studies community trust, which is somewhat different from trust in collaborating organisations.

Because of the sparse trust measures in the emergency management literature, the general trust literature was approached. A recent critical review of trust measures (McEvily & Tortoriello, 2011) concluded by ranking the work by Gillespie (2003) as one of five noteworthy



measures of trust. As one of two measures of trusting behaviour, Gillespie (2003) found that behavioural expressions of trust are largely captured by a model of trust that emphasises two dimensions: reliance and disclosure (Zand, 1972). *Reliance* represents one domain of trusting behaviour, wherein an individual depends on “another’s skills, knowledge, judgements or actions, including delegating and giving autonomy” (Gillespie, 2003, p. 10). *Disclosure* involves “sharing work-related or personal information of a sensitive nature” (Gillespie, 2003, p. 10). Since disclosure is not identified as important for the response phase in emergencies, we used the reliance items only. These items are numbers 18 to 22 in the CLUT instrument. Item 23, is taken from Scheer, Kumar, and Steenkamp (2003).

The authors adjusted all items to fit the emergency management context. The final CLUT instrument, which consists of four variables and 26 items, was used twice in the questionnaire, once for TTEs and once for FSEs. The questionnaire (Appendix A) also contains questions regarding the respondents’ experiences, backgrounds and demography.

### **Data Collection and Analysis**

A combination of two nonprobability sampling techniques, convenience and purposive sampling, was used. The survey included 173 full-time, publicly hired emergency personnel having different positions, for example, operational staff in the field, staff officers, and officers at command posts. The majority of data (120) were collected via an online version of the survey, while the remaining data (53) were collected using hard copies. The questionnaires were distributed on multiple occasions, and we ensured that individuals did not answer the questionnaire multiple times.

To describe the data distributions, the means and standard deviations were calculated (Bennett, Briggs, & Triola, 2003). Four bivariate regression analyses tested the effects of the exercises on collaboration, trust, learning, and usefulness (propositions). To measure the validity

of the CLUT instrument and the homogeneity of the variables, subscales were analysed by calculating Cronbach’s alpha value, and the result was 0.88, which is considered satisfactory (Brace, Snelgar, & Kemp, 2016).

## **Results**

### **Respondent Demographics**

Altogether, 173 professional emergency personnel from Norway and Canada agreed to participate in the survey. Their ages ranged from 25 to 74 years ( $M = 49.46$ ,  $SD = 10.96$ ). The majority of the respondents were male and had university degrees. Within the last 10 years, 79% of the respondents had been involved in an emergency response. Their professional experience was from 1 to 45 years ( $M = 15.98$ ,  $SD = 10.28$ ). There were 66 (40%) from the tactical level, 36 (21.8%) from the operational level, and 63 (38%) from the strategic level. All respondents had been involved in TTEs and FSEs. Table 1 summarises the demographics of the respondents.

Table 1  
*Respondent demographics.*

<b>Country</b>	<b>Gender</b>	<b>Age</b>	<b>Experience</b>	<b>Education</b>
Norway: 35.3%	Male: 62.3%	Up to 30: 4.5%	1-5: 16.6%	High school: 7.9%
Canada: 64.7%	Female: 28.6%	31-40: 17.2%	6-10: 22.1%	Undergraduate: 51.5%
	Unknown: 9.1%	41-50: 32.5%	11-20: 32.5%	Graduate: 40.6%
		More than 51: 45.9%	More than 21: 28.8%	

### **Usefulness**

The percentages reported in this section refer to the percentage of participants who indicated values greater than 3 on the measure. Most of the survey respondents answered that the exercises were useful for their real-life roles and responsibilities as well as during actual emergency operations. However, the percentage was significantly higher for FSEs 87,5% than for TTEs (77,5%). More than half of the emergency professionals believed that the FSEs were more useful to the ordinary operative staff than to the commanding officer at the strategic level, while TTEs were seen as similarly useful at both levels. Furthermore, they regarded the FSEs to have a

greater influence on their daily work than the TTEs. The mean of all items within the usefulness variable was 3.88 for FSEs and 3.79 for TTEs.

### **Learning**

Respondents felt that they learned more new things from the FSEs than from the TTEs. Most of the respondents felt that they learned a lot about the organisational structure and culture of the participating organisations in both types of exercises. Moreover, they considered themselves to have learned more about communication patterns among the participating organisations during the FSEs than the TTEs. More than half of the respondents stated they learned more about the concepts and abbreviations used by the collaborating organisations during the TTEs than the FSEs. Of all respondents, 64.2% considered themselves to have learned something from FSEs and 58.2% from TTEs about how the participating organisations prioritise their activities ( $\rho=0.01$ ). The mean of all items within the learning variable was 3.82 for FSEs and 3.74 for TTEs.

### **Collaboration**

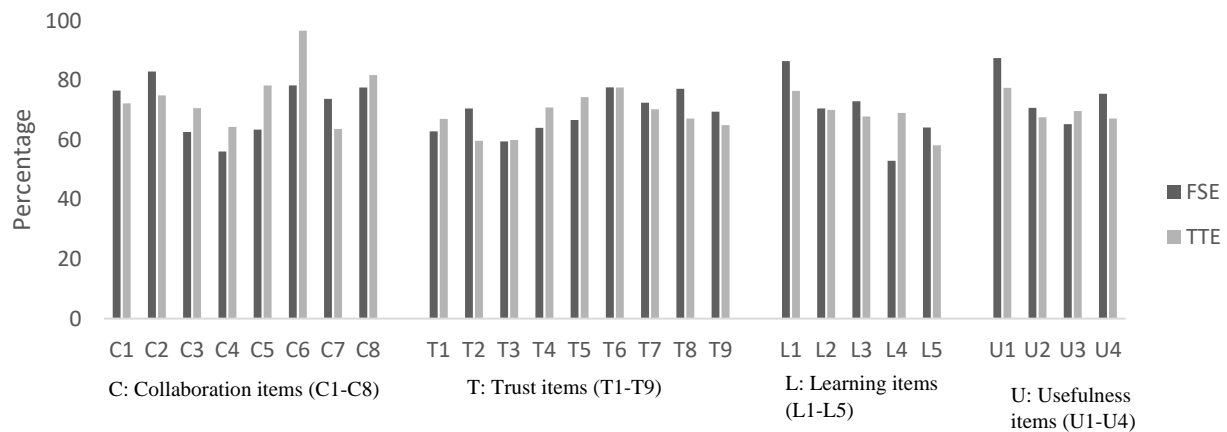
Most of the respondents believed that exercises did focus on collaboration; however, in their opinion the FSEs seemed to focus more on collaboration than the TTEs. Most respondents believed that they performed specific known roles and were active during the exercises. This believe was stronger for the FSEs than the TTEs. More than half of the respondents believed that sufficient feedback was provided immediately after the exercises; however, the waiting time was shorter for the TTEs than the FSEs. Moreover, 56.1% considered that the FSEs provided opportunities to improve and try alternative strategies with the participating organisations during the exercise, compared to 64.4% for the TTEs ( $\rho=0.09$ ). Most of the respondents felt that the collaboration was initiated without unnecessary waiting time; nevertheless, TTEs started faster

than FSEs. Most of the respondents considered that the personnel who needed to practice collaboration were engaged in the exercises. This percentage was higher for the FSEs than the TTEs. About 73.8% and 63.7% of respondents agreed that clear instructions for collaboration practice were presented in the FSEs and TTEs, respectively ( $p=0.00$ ). A vast majority of respondents considered that their points of view were considered by other participants and training staff during the exercises, indicating that a collaboration-developing element was present (Kim, 2014) ; however, TTEs were assigned a higher percentage than the FSEs. The mean of all items within the collaboration variable for FSEs was 3.28 and that for TTEs was 3.82.

### **Trust**

Over half of the respondents felt that after the exercises, they were more willing to rely on the participating organisations based on their work-related judgement. However, the TTEs were assigned a higher percentage than the FSEs. More respondents believed that after participating in an FSE, they were more willing to rely on participating organisations' task-related skills and abilities in comparison with after a TTE. Slightly more than half of the survey respondents answered that, based on the exercises, they were now more willing to rely on the participating organisations to handle an important issue on their behalf. There was no significant difference between the FSEs and TTEs in this question. More emergency personnel agreed that based on what they learned in the TTEs, they were more willing to rely on participating organisations to represent their work accurately to others in comparison to after the FSEs. Many respondents also considered that, based on what they had learned from the TTEs, they were now more willing to depend on the collaborating organisations to back them up in difficult situations than after the FSEs. For both types of exercises, most of the respondents considered that they learned through the exercises that participating organisations are willing to offer them assistance and support if requested. Overall, most of the respondents agreed that their trust in participating organisations

increased because of the exercises (FSE: 72.5%; TTE: 70.3%); however, the percentage was slightly higher for the FSEs than for the TTEs. The majority of emergency personnel considered that the development of trust towards the collaborating organisations within FSEs is exhibited more in their behaviour than that developed within TTEs. This was also true for the development of trust towards the collaborating organisations that is exhibited in their statements. The mean of all items within the trust variable was 3.76 for FSEs and 3.72 for TTEs. Figure 2 summarises the results from the questionnaire according to the four variables (see Appendix A).



**Figure 2.** Summary of scores for each item.

### **T-Test**

To test the hypothesis that there was a statistically significant mean difference between the TTE and FSE, a paired sample t-test was performed. The visual diagram of collaboration, learning, usefulness, and trust histograms and the normal Q–Q plots (not shown) indicated that the output of each group was approximately normally distributed with a skewness value less than 2.0 and kurtosis less than 9.0 (Schmidler et al., 2010). The paired sample *t*-test was associated with a nonstatistical effect for collaboration ( $t = -0.97, \rho = 0.33$ ), which indicates that the mean score between the groups was not significantly different. When it came to trust, the paired sample *t*-test was also found to be not statistically significant ( $t = -0.43, \rho = 0.66$ ), which means that the mean

trust scores between the two groups were not significantly different. Unlike collaboration and trust, the *t*-test for learning found a statistical significance of  $\rho = 0.03$  ( $t = 2.13$ ), meaning that the means of the two groups were significantly different. The paired sample *t*-test for usefulness was also found to be statistically significant ( $t = 2.01$ ,  $\rho = 0.04$ ).

### **Bivariate Analyses of Correlation Between items**

The four propositions were tested using a series of bivariate regressions to explain the causal effects of the four variables (collaboration, trust, learning, and usefulness). All of the learning items were significantly correlated with the mean score across the items connected to usefulness. These correlations explain P1. The findings indicate that stronger correlations exist between item L4 and usefulness and between L5 and usefulness for TTEs than for FSEs. A somewhat weaker but still significant correlation was also found for item L1. In contrast, for item L2, a stronger correlation was found for the FSEs than the TTEs.

Collaboration was correlated to the mean learning score across the learning items for FSEs and TTEs, which refers to P2. Slightly stronger correlations were found between most collaboration items and the mean learning score for TTEs than for FSEs, explaining a significant proportion of the variance in the mean learning score. Items C8, C6, and C7 represented a significant proportion of the variance in the mean learning in general and particularly within TTEs. However, a stronger correlation was found for FSEs than for TTEs for item C3.

Most items in the collaboration variables were significantly correlated to the mean trust score across the items associated with the trust measurements. These correlations test P3. Significant correlations were found between item C3 and the mean trust score in general, particularly for FSEs. The same was found for C4 and C5. For the following items, the results represented a significant proportion of the variance in the mean trust score but were rather stronger for TTEs than FSEs: C7 and C8.

Most of the items in the trust variable were significantly correlated to the mean perceived learning score across the items associated with the learning measurements, which relates to P4. Moreover, the data showed a slightly stronger correlation between the trust variable items and the mean learning score for TTEs than for FSEs. Significant correlations were found between item T1 and the mean learning score for TTEs. The same was found for the following items: T2 and T3.

Table 2

*Bivariate regression of items in learning variable correlated with the mean score across all usefulness measures P1 (sig. =  $\rho < 0.05$ ).*

Code	Learning characteristics of exercises		R	R <sup>2</sup>	F-Value	T-Value	Sig.
	Dependent variable: Usefulness						
	Independent variable:						
L1	I learned new things from the exercises that I participated in.	FSE	0.27	0.08	13.98	3.74	0.00
		TTE	0.38	0.15	28.16	5.30	0.00
L2	I learned a lot about the organisational structure and culture of the organisations participating in the exercises.	FSE	0.31	0.10	18.81	4.33	0.00
		TTE	0.25	0.06	11.77	3.42	0.00
L3	I learned a lot about the communication patterns among the participating organisations.	FSE	0.32	0.10	19.26	4.38	0.00
		TTE	0.31	0.10	18.19	4.26	0.00
L4	I learned a lot about the way that participating organisations prioritise their activities.	FSE	0.30	0.09	17.29	4.15	0.00
		TTE	0.41	0.18	34.76	5.98	0.00
L5	I learned new concepts and abbreviations used by the collaborating organisations.	FSE	0.33	0.11	20.33	4.51	0.00
		TTE	0.51	0.27	59.01	7.68	0.00
	Mean of learning variables for both types	FSE & TTE	0.52	0.27	64.14	8.01	0.00
	Mean of learning variables for FSE	FSE	0.40	0.16	32.18	5.67	0.00
	Mean of learning variables for TTE	TTE	0.50	0.25	55.31	7.43	0.00

Table 3

*Bivariate regression of items in the collaboration variable correlated with the mean score across all learning measures P2 (sig. =  $\rho < 0.05$ ).*

Code	Collaboration characteristics of exercises		R	R <sup>2</sup>	F-Value	T-Value	Sig.
	Dependent variable: Learning						
	Independent variable:						
C1	The exercise focuses on collaboration.	FSE	0.22	0.05	8.38	2.90	0.00
		TTE	0.35	0.13	23.53	4.85	0.00
C2	Sufficient forms of exercise feedback mechanisms (discussions, seminars, after action reports, hot wash, etc.) were provided immediately after the exercises.	FSE	0.18	0.04	5.96	2.44	0.01
		TTE	0.25	0.07	11.33	3.36	0.00
C3	During the exercises, there were opportunities to improve and try alternative collaboration strategies with participating organisations.	FSE	0.41	0.17	35.31	5.94	0.00
		TTE	0.31	0.09	17.38	4.17	0.00
C4	During the exercises, collaboration between the participating agencies was initiated immediately without unnecessary waiting time.	FSE	0.30	0.09	16.51	4.06	0.00
		TTE	0.38	0.15	28.33	5.32	0.00
C5	I performed well-known roles and activities during the exercises.	FSE	0.19	0.04	6.16	8.99	0.01
		TTE	0.32	0.11	20.27	4.50	0.00
C6	Personnel in need of collaboration exercise participated in the exercises.	FSE	0.36	0.13	25.55	5.05	0.00
		TTE	0.45	0.21	42.38	6.51	0.00

Code	Collaboration characteristics of exercises		R	R <sup>2</sup>	F-Value	T-Value	Sig.
	Dependent variable: Learning						
	Independent variable:						
C7	Clear instructions of collaboration practice were presented in the exercises.	FSE	0.34	0.12	22.66	4.76	0.00
		TTE	0.50	0.25	54.60	7.39	0.00
C8	My points of view were taken into consideration during the exercises.	FSE	0.34	0.12	21.92	4.68	0.00
		TTE	0.48	0.23	47.10	6.86	0.00
	All collaboration variables for both types	FSE & TTE	0.61	0.37	102.97	10.14	0.00
	All collaboration variables for FSE	FSE	0.52	0.27	61.81	7.86	0.00
	All collaboration variables for TTE	TTE	0.61	0.37	99.90	9.99	0.00

Table 4

*Bivariate regression of items in the collaboration variable correlated with the mean score across all trust measures P3 (sig. =  $\rho < 0.05$ ).*

Code	Trust characteristics of exercises		R	R <sup>2</sup>	F-Value	T-Value	Sig.
	Dependent variable: Trust						
	Independent variable:						
C1	The exercise focuses on collaboration.	FSE	0.16	0.03	3.98	2.01	0.04
		TTE	0.13	0.01	2.87	1.69	0.09
C2	Sufficient forms of exercise feedback mechanisms (discussions, seminars, after action reports, hot wash, etc.) were provided immediately after the exercises.	FSE	0.17	0.03	4.67	2.17	0.03
		TTE	0.16	0.03	4.45	2.11	0.03
C3	During the exercises, there were opportunities to improve and try alternative collaboration strategies with participating organisations.	FSE	0.31	0.10	17.66	4.20	0.00
		TTE	0.22	0.05	8.29	3.01	0.01
C4	During the exercises, collaboration between the participating agencies was initiated immediately without unnecessary waiting time.	FSE	0.32	0.11	19.93	4.46	0.00
		TTE	0.22	0.05	8.49	2.91	0.00
C5	I performed well-known roles and activities during the exercises.	FSE	0.21	0.04	7.56	2.75	0.01
		TTE	0.17	0.03	5.20	2.28	0.02
C6	Personnel in need of collaboration exercise participated in the exercises.	FSE	0.31	0.10	17.06	4.13	0.00
		TTE	0.30	0.10	16.06	4.00	0.00
C7	Clear instructions of collaboration practice were presented in the exercises.	FSE	0.21	0.04	7.45	2.73	0.01
		TTE	0.32	0.11	19.67	4.43	0.00
C8	My point of view was taken into consideration during the exercises.	FSE	0.21	0.04	7.51	2.74	0.01
		TTE	0.29	0.10	15.47	3.93	0.00
	Mean of collaboration variables for both types	FSE & TTE	0.43	0.18	37.31	6.11	0.00
	Mean of collaboration variables for FSE	FSE	0.42	0.18	35.66	5.97	0.00
	Mean of collaboration variables for TTE	TTE	0.40	0.16	28.71	5.37	0.00

Table 5

*Bivariate regression of items in the trust variable correlated with the mean score across all learning measures P4 (sig. =  $\rho < 0.05$ ).*

Code	Trust characteristics of exercises		R	R <sup>2</sup>	F-Value	T-Value	Sig.
	Dependent variable: Learning						
	Independent variable:						
T1	I am now more willing to rely on the participating organisations' work-related judgements.	FSE	0.43	0.19	38.88	6.23	0.00
		TTE	0.49	0.25	53.79	7.33	0.00
T2	After participating in the exercises, I am more willing to rely on participating organisations' task-related skills and abilities.	FSE	0.36	0.13	25.83	5.08	0.00
		TTE	0.44	0.20	41.33	6.43	0.00
T3	Based on these exercises, I am now more willing to rely on the participating organisations to handle an important issue on our behalf.	FSE	0.29	0.08	15.94	3.99	0.00
		TTE	0.41	0.17	33.66	5.80	0.00
T4	Based on what I learned, I am more willing to rely on participating organisations to represent our work accurately to others.	FSE	0.23	0.05	9.41	3.06	0.00
		TTE	0.32	0.11	19.86	4.45	0.00
T5	Based on what I learned, I am now more willing to depend on the collaborating organisations to back us up in difficult situations.	FSE	0.29	0.09	15.66	3.95	0.00
		TTE	0.39	0.15	29.35	5.41	0.00



Code	Trust characteristics of exercises		R	R <sup>2</sup>	F-Value	T-Value	Sig.
	Dependent variable: Learning						
	Independent variable:						
T6	Through these exercises, I learned that the participating organisations are ready and willing to offer us assistance and support.	FSE	0.35	0.12	24.37	4.93	0.00
		TTE	0.39	0.15	29.43	5.42	0.00
T7	Overall, my trust in the exercise participating organisations increased during the exercises.	FSE	0.34	0.11	22.24	4.71	0.00
		TTE	0.47	0.23	48.18	6.94	0.00
T8	The development of trust towards the collaborating organisations is exhibited in their behaviour.	FSE	0.22	0.05	8.60	2.93	0.00
		TTE	0.36	0.13	25.21	5.02	0.00
T9	The development of trust towards the collaborating organisations is exhibited in their statements.	FSE	0.06	0.00	0.57	0.75	0.05
		TTE	0.19	0.04	5.50	2.34	0.02
	Mean of trust variables for both types	FSE & TTE	0.61	0.37	60.26	7.76	0.00
	Mean of trust variables for FSE	FSE	0.44	0.19	40.11	6.33	0.00
	Mean of trust variables for TTE	TTE	0.50	0.25	56.60	7.52	0.00

## Multivariate Regression Analyses

Multiple regression analyses were used to find factors determining various variables for the two types of exercises. The multiple regression results for usefulness (dependent variable) and learning (independent variables) are presented in Table 6 (P1). The results show that the items of perceived learning together predicted 16% ( $R^2_{FSE} = 0.16$ ) of variation for the FSEs and 37% ( $R^2_{TTE} = 0.37$ ) for the TTEs. For the TTEs, ‘learned new things’, ‘learned about organisational structures’, ‘learned how activities are prioritised’, and ‘learned new concepts’ were found to be significant. Only two variables, ‘learned new things’ and ‘learned new concepts’, were found to be significant for the FSEs.

Table 6

*Multiple regression between usefulness and learning variables.*

Code	Usefulness variables		Stand. Beta	T-Value	Sig.
L1	I learned new things from the exercises that I participated in.	FSE	0.19	1.96	0.03
		TTE	0.30	4.17	0.00
L2	I learned a lot about the organisational structure and culture of participating organisations in the exercises.	FSE	0.06	0.57	0.56
		TTE	-1.69	-1.83	0.07
L4	I learned a lot about the way that participating organisations prioritise their activities.	FSE	0.12	1.46	0.14
		TTE	0.22	2.69	0.00
L5	I learned new concepts and abbreviations used by the collaborating organisations.	FSE	0.18	1.88	0.04
		TTE	0.40	5.43	0.00

FSE:  $R^2 = 0.17$ , TTE  $R^2 = 0.37$

Table 7 presents the results of the multiple regression analysis between learning (dependent variable) and collaboration (dependent variable) (P2). While the models for the two

exercise types have very similar  $R^2$  values, significant differences exist between them in terms of the significant values of the explanatory variables. Except for C6 and C8, which are significant for both TTEs and FSEs, all other variables are either not significant or significant in only one of the models. The findings revealed some differences between the FSE and TTE models. It was found that ‘exercise feedback’, ‘immediate collaboration started’, and ‘performed well’ were not significant contributors to perceived learning for either of the exercise types. The items ‘focused on collaboration’ and ‘clear instructions’ were found to be significant variables only for TTEs, while ‘improve and try alternative collaboration strategies’ was only significant for the FSE model.

Table 7  
*Multiple regression between learning and collaboration variables.*

	<b>Collaboration variables</b>		<b>Stand. Beta</b>	<b>T-Value</b>	<b>Sig.</b>
C3	During the exercises, there were opportunities to improve and try alternative collaboration strategies with participating organisations.	FSE	0.28	3.49	0.00
		TTE	0.04	0.62	0.53
C6	Personnel in need of collaboration exercise participated in the exercises.	FSE	0.19	2.56	0.01
		TTE	0.20	2.59	0.01
C7	Clear instructions of collaboration practice were presented in the exercises.	FSE	0.05	0.64	0.51
		TTE	0.25	3.41	0.00
C8	My point of view was taken into consideration during the exercises.	FSE	0.13	1.76	0.08
		TTE	0.34	5.29	0.00

FSE:  $R^2 = 0.50$ , TTE:  $R^2 = 0.47$

The multiple regression results between trust (dependent variable) and collaboration (independent variables) are presented in Table 8 (P3). The multiple regression shows relatively low  $R^2$  values for both types of exercises ( $R^2_{FSE} = 0.21$ ;  $R^2_{TTE} = 0.20$ ). It was found that two explanatory variables were only significant for the FSEs: C3 and C4. The variables C7 and C8 were only significant for the TTEs. Only one variable was significant for both: C6. Other variables had lower  $t$ -values and were not significant.

Table 8

*Multiple regression between trust and collaboration variables.*

Code	Collaboration variables		Stan. Beta	T-Value	Sig.
C3	During the exercises, there were opportunities to improve and try alternative collaboration strategies with participating organisations.	FSE	0.28	2.68	<b>0.00</b>
		TTE	0.06	0.74	0.45
C4	During the exercises, collaboration between the participating agencies was initiated immediately without unnecessary waiting time.	FSE	0.18	2.33	<b>0.02</b>
		TTE	0.02	0.27	0.78
C6	Personnel in need of collaboration exercise participated in the exercises.	FSE	0.17	2.15	<b>0.03</b>
		TTE	0.20	2.11	<b>0.03</b>
C7	Clear instructions of collaboration practice were presented in the exercises.	FSE	-0.02	-0.29	0.76
		TTE	0.22	1.90	<b>0.04</b>
C8	My point of view was taken into consideration during the exercises.	FSE	0.03	0.43	0.66
		TTE	0.23	2.88	<b>0.00</b>

FSE:  $R^2 = 0.21$ , TTE:  $R^2 = 0.20$

Table 9 presents the multiple regression results between learning (dependent variable) and trust (independent variables) (P2). Both models show relatively low  $R^2$  values ( $R^2_{FSE} = 0.24$ ;  $R^2_{TTE} = 0.30$ ). It is found that T1 was more significant for the FSEs than the TTEs, while item T6 was only significant for the FSEs. Other variables had lower  $t$ -values and were not significant.

Table 9

*Multiple regression between learning and trust.*

Code	Trust variables		Stand. Beta	T-Value	Sig.
T1	I am now more willing to rely on the participating organisations' work-related judgements.	FSE	0.308	2.73	<b>0.00</b>
		TTE	0.26	2.31	<b>0.02</b>
T6	Through these exercises, I learned that the participating organisations are ready and willing to offer us assistance and support.	FSE	0.22	2.49	<b>0.01</b>
		TTE	0.06	0.51	0.60
T7	Overall, my trust in the exercise participating organisations increased during the exercises.	FSE	0.04	0.46	0.64
		TTE	0.21	1.83	<b>0.06</b>

FSE:  $R^2 = 0.24$ , TTE:  $R^2 = 0.30$

## Discussion

The results indicate that the focus on collaboration, trust, and learning in FSEs and TTEs leads to increased perceived usefulness in real emergencies. From the learning point of view, most respondents considered the exercises to be educative. The mean scores of all learning items on the five-point Likert scale were high for both the FSEs (3.82) and TTEs (3.74). The overall learning about collaborating organisations was fairly acceptable since it was above the average

score of 2.5, but a deeper knowledge of how collaborating organisations prioritise their activities was weaker for FSEs, and the use of new concepts was, to a certain extent, weaker for TTEs. Moreover, the bivariate regression shows stronger correlations between the two items ‘how collaboration organisations prioritize their activities’ and ‘learning new concepts and abbreviation’ and usefulness. The reason for this needs to be tested and explored in another study, but a potential reason might be the deeper communication and face-to-face interactions in TTEs, where respondents can reflect on and ask questions more freely than in FSEs. Moreover, a low priority placed on the evaluation phase and cold debriefing could also hinder a useful discussion that contributes to learning new things in both types of exercises (Paton et al., 1998; Roud & Gausdal, 2019; van Laere & Lindblom, 2019).

Correlation analyses showed stronger correlations between learning items and usefulness in TTEs than in FSEs. Similarly, multiple regression results explained the stronger relationship between learning and usefulness in TTEs compared to FSEs. This is an important finding because it identifies a better connection between learning and perceived usefulness in TTEs than in FSEs. Overall, the discussion supports our first proposition (P1), that learning positively influences the usefulness of collaboration emergency exercises.

These results indicate that a more open and collaborative environment during TTEs, in particular, may provide room for reflection and improvisation (Gredler, 1992). A success factor for emergency management is the ability to combine organisational stability and preparedness with flexibility and rapid response in a time of emergency (Christensen et al., 2016). In this study, 64% of respondents agreed that there was room for improvisation in TTEs, whereas it was slightly lower for FSEs (56.9%). However, correlation analyses show a stronger correlation between room for improvisation and learning in FSEs than in TTEs. In contrast with Kim’s (2013) findings, the collaboration exercises in this study did not seem to only focus on sector-

specific exercise-script controlled elements; there were also collaboration elements included, but the results indicate that there is still room for improvement. Tentatively, the results indicate that slightly more standardised behaviour might be exhibited rather than testing new strategies in FSEs in comparison to TTEs. A reason for this could be that around 30% of respondents did not consider the instructions about collaboration during the FSE to be very clear and mostly found themselves repeating well-known activities, which is more similar to a drill type of exercise (Berlin & Carlström, 2015). Yet, the results for FSEs and TTEs are very close; therefore, further testing is required in another study.

The mean values of the collaboration variable were higher for TTEs than for FSEs. The bivariate correlation results from Table 3 demonstrate that TTEs ( $R^2 = .37$ ) show a strong significance at the 95% confidence level and a stronger correlation with learning for all collaboration variables than FSEs ( $R^2 = .27$ ). This may suggest that the discussions and design of hot wash in TTEs provide a better arena for increased learning in terms of shared experience and joint problem-solving than in FSEs (Sommer & Njå, 2012). Overall, the results of this study and the above discussions support our second proposition (P2), that interorganisational collaboration in emergency collaboration exercises positively influences individual learning about collaboration, in general and particularly in TTEs.

The comparison of the bivariate correlations from Table 4 illustrates that  $R^2$  for the FSEs ( $R^2 = 0.18$ ) is significant at the 95% confidence level. Moreover, it shows a slightly stronger correlation with trust for FSEs than for TTEs for all collaboration variables ( $R^2 = 0.16$ ). One reason for this could be the intensive and more realistic nature of FSEs, which highlights the limitations to the competence of the other parties and could lead to developing competency-based trust. Relatively stronger correlations of 'providing clear instruction for collaboration during exercises' and 'considering the points of view of the participants' with the mean trust score were

identified for TTEs. This might be due to the physical presence of the actors in the same room at the same time and the lack of time pressure, which facilitate trust development, enable joint problem solving, and allow further improvisation (Christensen et al., 2016).

Overall, the analysis of the results identified trust as a factor that has some influence on the collaboration exercises and found that it may be developed during exercises, which is in line with the findings of Gausdal (2012) in the context of networks and those of Roud and Gausdal (2019) in the context of interorganisational emergency response. In line with the literature, the findings support our third proposition (P3), that collaboration in emergency exercises positively influences interorganisational trust. This study also found that FSEs and TTEs contribute almost equally to interorganisational trust development.

The results are in line with the findings of Mishra's (1996) study and indicated that both types of exercises contribute to competence development, openness, and reliability during collaborative responses. When it comes to trust, the results indicate that exercises contribute to trust-building among the organisations. As Perry (2004) found earlier, the majority of respondents agreed that their overall trust in the organisations participating in the exercise increased during TTEs, and that through the exercises, they got convinced that the participating organisations are willing to offer them support and assistance. However, they expressed that they relied on participating organisations to handle an important issue on their behalf more after TTEs than after FSEs. This suggests that the TTEs seem to function as trust-building arenas, and most emergency personnel believe that the exercises can be very helpful in terms of face-to-face collaboration without intensive stress. Such exercises also provide the opportunity to give comments and obtain feedback. Moreover, having in-depth conversations on challenges that emerge during TTEs can contribute to establishing a shared view among the organisations and their collaboration exercises and training programmes (Roud & Gausdal, 2019). More than half

of the respondents agreed that after participating in FSEs, they were more willing to rely on respondents' task-related skills and abilities and that they believed that trust towards the collaborating organisation was exhibited in their behaviour more during the FSEs. The bivariate correlations showed stronger correlations between trust and learning items for TTEs in comparison with FSEs.

The multiple regression results show, though, that the trust and collaboration items cannot fully explain the learning outcomes of the FSEs and TTEs. A reason for the lower explanatory power of these regression models for trust could be that during interorganisational collaboration, some form of language problems or differing values, internal cultures, and competences could exist (Möllering, 1997). These 'cultural differences' might create misunderstandings in joint operations, which may prevent trust-building and its contribution to learning (Möllering, 1997). Therefore, collaboration in emergency collaboration exercises positively influences interorganisational trust, which in turn positively influences individual learning. Thus, the fourth proposition (P4) is somewhat supported by the results.

Overall, both types of exercises got a decent score. Learning and usefulness correlate better for TTE, perhaps because participants lead the session more themselves and can try alternative solutions and have more ability to assess options. Less pressure and fear of failure may also result in a more creative discussion that enables more learning. Since TTE (normally reserved for the management level) and FSE (for the management and practical levels) were studied, it is possible that there are some differences in the answers between those who worked 'in the contingency management room' and those who worked in the field. However, this has not been measured in this study. Across all respondents, though, the four propositions P1, P2, P3, and P4 are supported.

The study has some limitations. The greatest limitation concerns perceived usefulness, which does not necessarily correlate with actual usefulness in real life. Moreover, the study could benefit from a larger sample size. Nevertheless, due to the relatively few organisations involved in emergency response, the data collected from Norway and Canada may give a good indication of the perceived level of learning and usefulness of the exercises. The sample also consists mostly of full-time emergency personnel, and the results might be different in contexts dominated by volunteer personnel. It is important to note that the situational awareness of each other's needs, communications, and responsibilities (and people's mental models of these) could have significant effects on how participants assess and perceive the outcomes of an emergency exercise. Thus, the participants may have interpreted the meaning of exercises differently, which may have influenced their answers and resulted in somewhat lower term validity. Although it was beyond the scope of this study, future research can consider these factors in the study design. The levels of analysis also created some limitations, particularly because learning and usefulness are measured only at the individual level. Although a quantitative survey design provides valuable information and good indicators, it cannot cover each item in depth or consider possible linguistic or cultural nuances. Cooperation and trust are prevalent features in Scandinavian culture (Metallinou, 2018), whereas Canada has a slightly more competitive culture, which may have played a role in the results.

## **Conclusion**

The descriptive findings revealed that the usefulness, learning, and collaboration outcomes of both types of exercises are perceived to be high. However, it was found that FSEs are perceived to have higher learning and usefulness outcomes than the TTEs. Bivariate regression analyses between the outcome variables for both types of exercises revealed that learning had stronger relationships with usefulness, collaboration, and trust for TTEs compared to FSEs, while a



stronger relationship existed between collaboration and trust for FSEs. Multiple regression analyses showed that TTE outcomes can be better predicted by the variables used to measure exercise usefulness.

The study has theoretical and practical implications. *Theoretically*, it contributes to emergency management and collaboration literature in several ways. It identified and confirmed the existence of significant relationships between collaboration, trust, learning, and usefulness in TTEs and FSEs. If exercises are followed up with in-depth debriefings, respondent seminars, and opportunities to improvise, they can be more educational and useful in real-life emergency situations. On the other hand, exercises that lack collaboration and trust-building elements can have a weak influence on learning and usefulness. The study highlighted and confirmed the role of trust in emergency preparedness. *Practically*, the study implications underline the importance of these variables for those who plan and fund exercises. It also suggests that reflection seminars that focus on unsolved problems and that let the respondents identify the problems that may lead to changes in structures, behaviours, working methods, and confirmation of existing knowledge and procedures might contribute in this respect.

For further research, the CLUT instrument needs to be developed further to more closely reflect the real outcomes of exercises and to measure learning and usefulness also at the organisational level. The impact of exercises on real world emergency response is often based on perceived data from questionnaires. In order to validate the effect of exercises outcome, variables of emergency response who are dependent on exercises have to be identified and measured. The low number of participants in this study limited the transferability of the results when separating managerial-level and on-site respondents. Thus, we decided to present the data for a nondifferentiated study population. We suggest that further studies include this in their research design and analysis to investigate the differences in the answers at each level. In this study, we

also had to choose a number of parameters to limit the task, but other parameters within the dataset may also correlate. For example, learning may create trust, and trust may create collaboration. This would provide two new assumptions for further research. The survey should be confirmed and tested in other contexts that are dominated by volunteer personnel (e.g. in the United States) to verify the causality and generalisability of the results. Moreover, studying specific TTEs and FSEs with similar scenarios would provide additional insight and important information. Finally, to identify the deeper meaning and connections underlying the study and findings, an exploratory study should be performed.

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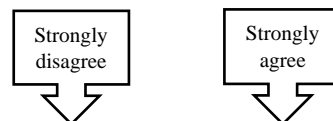
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## Appendix A

### Collaboration, Learning, Usefulness, and Trust (CLUT) Instrument



1	C1	The exercises focus on collaboration.	1	2	3	4	5
2	C2	Sufficient forms of exercise feedback mechanisms (discussions, seminars, after action reports, hot wash, etc.) were provided immediately after the exercises.	1	2	3	4	5
3	C3	During the exercises, there were opportunities to improve and try alternative collaboration strategies with participating organisations.	1	2	3	4	5
4	C4	During the exercises collaboration between the participating agencies was initiated immediately without unnecessary waiting time.	1	2	3	4	5
5	C5	I performed well my roles and activities during the exercises.	1	2	3	4	5
6	C6	Personnel in need of collaboration exercise participated in the exercises.	1	2	3	4	5
7	C7	Clear instructions of collaboration practice were presented in the exercises.	1	2	3	4	5
8	C8	My points of view were taken into consideration during the exercises.	1	2	3	4	5
9	L1	I learned new things from the full-scale exercises that I participated in.	1	2	3	4	5
10	L2	I learned a lot about the organisational structure and culture of participating organisations in the exercises.	1	2	3	4	5
11	L3	I learned a lot about the communication patterns among the participating organisations.	1	2	3	4	5
12	L4	I learned a lot about the way that participating organisations prioritise their activities.	1	2	3	4	5
13	L5	I learned new concepts and abbreviations used by the collaborating organisations.	1	2	3	4	5
14	U1	The exercises were useful to my real-life roles and responsibilities during actual emergency works.	1	2	3	4	5
15	U2	Based on what I learned, the exercises were useful for higher level (command) officers.	1	2	3	4	5
16	U3	Based on what I learned, the exercises were useful for ordinary operative staff (command officers not included).	1	2	3	4	5
17	U4	Participating in these exercises has been useful in my daily works.	1	2	3	4	5
18	T1	Learning from these exercises, I am now more willing to rely on the participating organisations' work-related judgements.	1	2	3	4	5
19	T2	After participating in the exercises, I am more willing to rely on participating organisations' task-related skills and abilities.	1	2	3	4	5
20	T3	Based on these exercises, I am now more willing to rely on the participating organisations to handle an important issue on our behalf.	1	2	3	4	5
21	T4	Based on what I learned, I am more willing to rely on participating organisations to represent our work accurately to others.	1	2	3	4	5
22	T5	Based on what I learned, I am now more willing to depend on the collaborating organisations to back us up in difficult situations.	1	2	3	4	5
23	T6	Through these exercises, I learned that the participating organisations are ready and willing to offer us assistance and support.	1	2	3	4	5
24	T7	Overall my trust towards the exercise participating organisations increased during the exercises.	1	2	3	4	5
25	T8	The development of trust towards the collaborating organisations is exhibited in their behaviour.	1	2	3	4	5
26	T9	The development of trust towards the collaborating organisations is exhibited in their statements.	1	2	3	4	5

Variables: C = Collaboration, L = Learning, U = Usefulness, T = Trust