Complexity of the Strategic Level and Tactical Level Disaster Management Tasks: Activity System Analysis Through the Lens of Information Behaviour*

Stratejik ve Taktiksel Seviye Afet Yönetim Görevlerinin Karmaşıklığı: Bilgi Davranışları Objektifinden Aktivite Sistem Analizleri

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Abstract

This research investigates information behaviour of the strategic and tactical level commanders' in emergency response context. The objective of the research is to observe and analyse the information processing of the emergency staff while carrying out complex, time critical tasks in emergency settings. Task studies in the recent literature discuss laboratory cases; this research has originality in investigating the real phenomenon. Fieldwork was conducted in AKOM (Afet Kordinasyon Merkezi – Disaster Coordination Centre) and Istanbul Fire Brigade settings. Data was collected via qualitative methods such as interviews and field observations. Emergency response tasks were analysed and categorised using Byström and Jarvelin's (1995) conceptual framework. Cultural Historical Activity Theory is used as a theoretical framework and conceptual data analysis tool. Leont'ev (1978) and Wilson's (2006b, 2008) activity system hierarchical structure was used to deconstruct tasks and scrutinise subtasks that has supporting role in emergency response context. Findings reveal that time pressure and task complexity has significant role on emergency response decision tasks and the way of responders' information processing. To hedge uncertainty and make effective timely decisions, tactical and strategic level commanders collaboratively share information using abstract and concrete tools such as ICT, language, mobile devices and radio. As practical implications, the results of this research shed lights onto redesign of ICT tools used during disaster times, and restructuring the disaster management organisations to facilitate effective knot working while emergency response.

Keywords: *Task complexity, information behaviour, emergency response*

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Öz

Bu çalışmada afet durumlarında acil müdahaleden sorumlu olan stratejik ve taktiksel seviye acil müdahale personelinin bilgi davranışları incelenmektedir. Araştırmanın amacı acil durum personelinin karmaşık ve zaman kısıtlı görevleri yerine getirirken bilgiyi ne şekilde işlediğinin gözlenmesi ve analiz edilmesidir. Bu çalışma betimsel bir calışma olup, geçmişte yapılan görev çalışmalarından farklı olarak sahada gözlem ve analizlerden oluşmaktadır ve bu durum çalışmanın sonuçlarının gerçek hayatla örtüştüğünü kanıtlamaktadır. Alan çalışması AKOM (Afet Kordinasyon Merkezi) ve İstanbul İtfaiyesinin birimlerinde yapılmıştır. Veriler görüşme ve alanda gözlem tekniğiyle toplanmış ve verilerin analizi de niceliksel metodlar kullanılarak yapılmıştır. Byström ve Jarvelin (1995)'in iş görevleri hakkında yapmış olduğu terimselleştirme araştırmacı tarafından acil durum görevlerinin analizinde kullanılmıştır. Kültürel ve Tarihsel Aktivite Teorisi kuramsal, terimsel ve analitik çerçeve olarak değerlendirilmiş ve bu kuramın hiyerarşik yapısı (Leont'ev, 1978; Wilson, 2006b, 2008) analitik çözümleme için kullanılmıştır. Bulgular zaman baskısı ve görev karmaşıklığının acil müdahale personeli üzerinde kayda değer etkilerinin olduğunu göstermiştir. Afet durumlarındaki kritik kararlar, stratejik ve taktiksel seviye, personelin karşılıklı sağlıklı bilgi paylaşabilecekleri ortam sağlandığı durumlarda hızlı ve etkin olmaktadır. Karşılıklı bilgi paylaşımı somut ve soyut vasıtalarla mümkün olmaktadır. Pratik etkileri bakımından araştırmada acil müdahale birimleri ellerinde mevcut bilgi ve haberleşme vasıtalarını karşılıklı ve sağlıklı iletişim kurmaya elverişli duruma getirmelidir ve farklı acil müdahale birimlerinin afet zamanlarında tek bir birimmiş gibi ortak hareket etmesi sağlanmalıdır sonuçlarına ulaşılmıştır.

Anahtar sözcükler: *Görev karmaşıklığı, bilgi davranışı, acil müdahale*

Introduction

The use of information in organisational decision-making and the process of information in organisations are initiated comprehensively in the early work of Daft and Lengel (1983) and O'Reilly (1982). There are various sources dealing with the decision tasks and the purpose of decision-making in organisations (Mckenzie, 2005; Michailova & Husted, 2004; March, 1996; Cyert & Williams, 1993; Simon, 1987; Simon et al., 1987; Hickson, Butler, Cray, Mallory, & Wilson, 1986). However, the information behaviour of the organisational members, while dealing with the complex and time critical tasks, in the decision-making process in emergency response settings has not been mentioned much in the literature (Mishra, Allen, & Pearman., 2011a, b; Mishra, Allen, & Pearman, 2013). The use of information in the decision tasks and decision process is widely mentioned in communication studies. Most of the studies are laboratory cases and do not deal with real phenomena. Therefore, in the following sections, the researcher sheds light onto the real phenomena while dealing with different emergency response tasks where time pressure and task complexity high in nature.

Disaster management organisations are divided into sub-units and social entities. The collective effort of these sub-units facilitates the effective response. As the inter-departmental systems, these sub-units involve different decision tasks to satisfy organisational needs (Hickson et al., 1986). Most of their works are on making decisions

and problem solving. In this regard, emergency response commanders (tactical level and strategic level) seek, share and use information that is relevant for the complex decision tasks (such as risk assessment, identifying the patients' situation, resource allocation during disaster times etc.) to reach a high-quality decision.

The objective of this research is scrutinising the way tactical and strategic level process information during disaster times and how they decide on timely and critical actions. Since the *time is lives* at the disaster times, the strategic level staff should access relevant information at the right time to allocate sources and command tactical level staff operating at the disaster site.

Literature Review

Tasks and Information

Tasks are purposeful sets of activities. Every activity involves tasks and every organisational member's job consists of different tasks. *"A task is usually seen as purposeful set of linked concrete or cognitive activities performed by people (or machines); normally, it has a meaningful purpose as well as an identifiable beginning and end"* (Byström, 2007, p. 2*)*.

In the information-seeking context, information-related tasks are categorised as complex and repetitive (routine) tasks (Byström & Jarvelin, 1995). The complexity of the tasks can be analysed through advanced pre-determinability. If the work process, the amount of information needed, the variety of the information sources and the expected outcome are determinable in advance, the tasks are categorised as less complex (Byström, 1999). Task complexity and the problem structure (structured or ill-structured) have a role on people's use of the information sources and their information behaviour (searching, seeking actions) in performing the tasks (Vakkari, 1999a). To perform a task, physical and cognitive actions are required. Tasks, especially complex ones, include sub-tasks which support the main tasks (Vakkari, 2003).

Byström and Jarvelin (1995) differentiate between task categories from simple to complex: automatic information processing tasks, which are determinable and repetitive; normal information-processing tasks, which are almost determinable; normal decision tasks which are quite structured and case-based; known, genuine decision tasks, which are *a priori* known information requirements and exist to perform the tasks; and genuine decision tasks which are unexpected, new and unstructured so that they are complex tasks. From this range, the task characteristics indicate whether the tasks are structured, repetitive and determinable, or unstructured and complex. Table 1 reveals the task categorisation and information processing inter-dependence.

Table 1: Tasks Categories (adapted from Byström and Jarvelin (1995))

Task category	Description
Automatic information processing tasks	A priori completely determinable so that, in principle, they could be automated –whether actually automated or not.
Normal information processing tasks	Almost completely a priori determinable, but require some case-based arbitration concerning, for instance, the sufficiency of the information normally collected. Thus, part of the process and information needed is a priori indeterminable.
Normal decision tasks	Still quite structured, but in them case-based arbitration plays a major role.
Known, genuine decision tasks	The type and structure of the result is a priori known, but permanent procedures for performing the tasks have not emerged yet. Thus, the process is largely indeterminable and so are its information requirements
Genuine decision tasks	Unexpected, new, unstructured. Thus, neither the result, the process nor the information requirements can be characterised in advance. The first concern is task structuring.

Different types of information needs occur during performing a task: problem information, domain information and problem-solving information. Problem information includes the structure, properties and requirements of the problem; domain information is the known facts, concepts, laws and theories in the domain of the problem; problem solving information is the methods of the problem treatment and the way the domain information is used to reach an effective solution about the problem (Byström & Jarvelin, 1995)

Task completion requires team coordination and collaborative effort in disaster management organisations. Thus, if the tasks are accomplished by information exchange, members are considered to be in collaborative information behaviour activity. As task completion information is a mean, information seeking and information searching activities are a mean too (Kulthau, 2004). As cognitive settings, people are surrounded by different kinds of tasks in real life. These are work tasks, assignments for school etc., all of which are influenced by the task requirements, a timetable and information quality (Byström, 2007). Moreover, in real life settings, organisational members need information, subject to task complexity and time constraints, to solve problems and complete the tasks in a satisfactory way (Schrah, Dalal, & Sniezek, 2006).

Disaster management tasks are real-life tasks bounded to situational factors. These situational factors are identified and considered to encompass the whole situation The performance of real-life tasks is influenced by the operating environment, the availability of information sources and the timetable, and the fact that members cannot consider all the variables in a detailed way (Byström & Hansen, 2005).

Information behaviour can be perceived as a sub-task to complete the organisational tasks. Information seeking, sharing and using exist collaboratively

between the organisational members and departments to complete the work tasks. Thus, *"information behaviour is a repertoire of actions and operations and judgements about timing and ethics brought into play across work cycles and routine."* (Widén-Wulff, & Davenport, 2007).

Time, Uncertainty and Task Complexity

Task complexity is an important element for task performance. Task complexity is the task perception of the individual through his/her prior experience and knowledge (Hyldegård & Ingwersen, 2007). Task complexity is associated with the pre-determinability of, or uncertainty about, the task (Vakkari, 1999b). Thus, uncertainty has an effect on the types of information needed and which sources are supposed to be used (Vakkari, 1999b). As mentioned above, information behaviour of the people depends on their task's features, time constraints and characteristics of the problems arising during accomplishing them (Byström & Jarvelin, 1995; Savolainen, 2006).

Byström (2002) points out that task complexity increases the importance of the experts as information sources as opposed to other people and other documentary sources. In disaster management organisations, responsible managers/directors are the experts who are responsible for making decisions. They use their domain expertise while searching for information and using that information in the decision-making process. The decision makers favour searching for expert advice when task complexity exists (Schrah et al., 2006). In this regard, expert information is used to reduce the effort for information search and ensure the accuracy of the decision. The advice of an expert is perceived as a recommendation and it is distinguished from task information, as mentioned in the previous section. In this situation, recommendations are the summary of the task information and consist of evaluations (Schrah et al., 2006). As a result, task complexity increases information need, the requirement for expert information and the required time to solve the problem, while it decreases decision quality and the quality of information seeking (Vakkari, 1999b; Byström & Jarvelin, 1995).

Another factor on task performance is time constraints. As time is embedded in all human activities, it is a temporal factor in human life (Savolainen, 2006). Time pressure exists in how the task is supposed to be completed (in minutes, hours or days) (Case, 2002). There are studies exploring time impact on information behaviour (Kulthau, 2004); however, they do not deal with rapid response cases. The existing models and theories discuss information processing via analytical, sequential mode to find the optimal solution (Wilson, 2006a); however, dynamic situations and complex tasks force the emergency response commanders to find the first working solution (Klein, 2008; Klein & Calderwood, 1991). The use of information to carry out disaster decision tasks, where time pressure exists in a dynamic environment, is an unexplored area.

Theoretical Framework and Methodology

Cultural Historical Activity Theory

Cultural Historical Activity Theory (CHAT) is used as a theoretical framework and an analytical tool. CHAT has rich vocabulary and is suitable for action research. To investigate phenomenon in a comprehensive way, CHAT deconstructs organisational tasks through fragmenting activities into sub-units (actions and operations) (Wilson, 2006b), so this case gives advantage to the researcher for analysing the activity systems in a comprehensive way. While analysing the data collected via field observations and interviews, the emergency tasks were fragmented into sub-units (activity, actions, operations) (please see Figure 1). By doing so, qualitative coding became more comprehensive and themes, nodes, and codes relations were established.

Leont'ev (1978) introduces the hierarchical level of the activity system. He explains well the concepts of activity, actions and operations related to motives, goals and conditions which enable activity to be performed by individuals (Wilson, 2008). Kuutti (1995) comprehends activities as long-term formations. The transformation to the outcomes cannot be done immediately; it can be achieved through processes or phases. Hence, actions and operations are the levels of activity. Leont'ev (1978) points out that activities are distinguished from each other according to their object, and that the object is the determinant direction of the activity. In this regard, he asserts that the object of any activity is the *true motive* for it, and activity is linked to the motive regardless of whether this is hidden or obvious. He expresses that activity cannot exist without a motive. For this reason, the motives are transformed objects that fulfil a need to achieve a goal (Kaptelinin, 1996).

The subordinate of the activity is the action that is held by conscious purpose. These are goal-directed processes and intermediate results in an activity system (Leont'ev, 1978). In other words, action involves the planning and problem-solving aspect to accomplish the goals of the activities; hence, it serves a functional purpose (Jonassen & Rohrer-Murphy, 1999). Actions are chains of operations, which are automated and well-defined routine behaviours used to respond to the conditions during performing the actions (Kuutti, 1995). With respect to this view, operations do not need to have conscious intentions (Jonassen & Rohrer-Murphy, 1999).

As a general consideration, viewing the hierarchical structure of the activity, this is composed of actions and actions are composed of operations. Motives generate activity, actions are directed by goals, and operations occur in certain conditions. Motives determine goals and goals are affected by conditions (Wilson, 2006b). Figure 1 illustrates the interaction between these components.

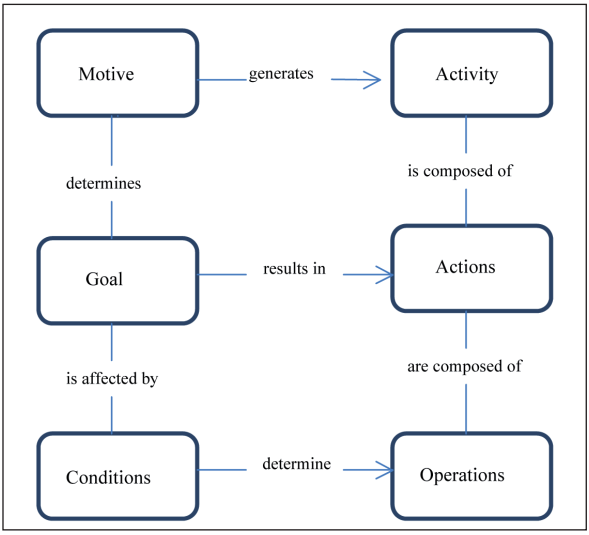

Figure 1. Activity, Actions and Operations (Wilson, 2006b)

Data Collection

This research uses qualitative methods for data collection (interviews and field observations and analysis (themes, nodes, and codes were generated) (Yin, 2009). The researcher had field observations and interviews in seven different institutions/ departments of İstanbul Metropolitan Municipality: The AKOM Central building located in Kağıthane, İstanbul; the Fire Brigade Head Department located in Nurtepe (temporarily, while the researcher was conducting this research the main building was under construction, so the pilot study and fieldwork were conducted in Nurtepe), İstanbul; the Fire Brigade Central Command Centre located in Kağıthane, İstanbul; the Fire Brigade Head Department of the Anatolian Side located in Üsküdar, İstanbul; the Fire Brigade Kayışdağı Department located in Ataşehir, İstanbul; the Emergency Medical Service located in Ataşehir, İstanbul; and the Emergency Aid and Rescue Directorate located in Eyüp, İstanbul.

Interviews

The researcher interviewed 16 staff members from AKOM and aforementioned disaster management organisations. Interviews were conducted at the working place of the interviewees. The researcher did not intend to make the interviews in a separate meeting room. The rationale behind this way was to discuss with them while they were carrying out their work tasks at their desks. When emergency occurred, the researcher

stopped the recorder and let the interviewee (directors or Command and Control [C&C] – Komuta Merkezi crews) carry out their task.

The exception was the fire fighters and paramedics as they operate at the incident site. Thus, it was not possible to follow this approach for their interviews. The researcher met them in a meeting room at an arranged time; however, in some cases the researcher postponed the interviews.

Initially, the questions in the semi-structured interview schedule (see Appendix 1) were addressed to the interviewees. In this way the work tasks they carry out during disasters were determined. Then, the interviewees filled in the relevant response cards provided by the researcher. According to the results of the responses, the researcher highlighted the complex, time-pressured tasks. In Sections B and C (open-ended questions, see Appendix 1), the interviewees have explained one of their experiences focusing on the tasks they have filled as complex and time-pressured.

The responses have been recorded via an IC recorder, and also the note-taking technique was used during the interviews.

Conceptual Data Analysis

The main objective is for the researcher to comprehend the phenomena through the field observations and semi-structured interview schedule. The researcher establishes a relationship between the departments, the tasks carried out and the information-related tasks as well as information behaviour, through interpretation of the organisational staff talks conducted.

The second stage of the data analysis is the transcription of the interview records. The interviews are originally in Turkish. The interview records were uploaded to the NVivo 8 computer program (see the themes schema, Table 2). The transcripts were recorded in Turkish and then translated into English. Themes, subthemes and nodes were generated and uploaded to the program for coding and establishing relationship between tasks and situational factors.

Table 2: Themes Schema

Themes (Tasks-Activities)	**Subthemes (Subtasks-Actions)**	**Nodes (Operations)**
Risk assessment (tactical level)	Information seeking Information sharing Sense-making	Subject Tools, Rules&Regulations Community Division of Labour
Identifying the needs of the patient (tactical level)	Information seeking Information sharing Sense-making	Subject Tools, Rules&Regulations Community Division of Labour
Coordination meetings (strategic level)	Information seeking Information sharing Sense-making	Subject Tools, Rules&Regulations Community Division of Labour

In the third stage, the tasks were categorised by the organisational staff during interviews from *time-critical* and *complex* to *less time critical* and *less complex*. The tasks, which were ranked more than 3 in the hand response cards, are determined as complex, and the rest as less complex. The organisational staff is asked to include in the hand response cards whether they are under *time pressure* during carrying out these tasks. Thus, the time-pressured tasks and less time-pressured tasks are determined. Then, the *significance of the tasks to sort out the issues* and *frequency* are determined. At the end of the third stage, the *time critical* tasks that are filtered as *significant to sort out the issues*, *frequently occurring* in work settings are determined as *time critical* and *complex*, while *less time critical* tasks that are filtered as *significant to sort out the issues*, *frequently occurring* in work settings are determined as *less time critical*, *complex* and *less complex* in the disaster management context.

After task selection, the fourth stage involves the generation of categories, themes and coding and establishing relationships between tasks and themes. This stage is the most comprehensive part of the data analysis as well as forming its longitudinal stage. This stage involves the interpretation of the transcripts, discourse and content analysis, and analysis of the field observation notes.

The categories are *time critical, complex, repetitive* tasks. The themes generated are called *activities-tasks*. Through the use of Activity Theory as an analytical tool, tasks are accepted as *activities*, and *information seeking, sharing, using behaviour* are accepted as *actions*. The nodes of the activity systems (mediators) are the operations.

Discourse analysis reveals how organisational members behave when they encounter *time-critical, complex, and repetitive* tasks. Triangulation of the data analysed has been performed to avoid biases and establish the relevance and validity of the data. Three different data collection methods (field observations, interviews and content analysis) facilitate the triangulation. The researcher checks the validity of the data and fills any information gaps in one of the methods used in the case studies.

Findings and Discussion

Table 3 reveals the findings regarding disaster management settings on tasks, which are perceived as *significant to resolve the problems* and *most often occurring* by the interviewees, along with task categorisation according to the information behaviour of task performers. The selection criteria for the below-mentioned tasks have been discussed in *conceptual data analysis* section. The varying complexity and information behaviour of the task performers are investigated.

Table 3: Disaster Management Tasks and Complexity Level

Situation	Task Name	Task Category
Time critical	Gathering information from the incident site	Normal information-processing task
Time critical	Relevant data and information support to the emergency response teams operating at the incident site	Normal information-processing task
Time critical	Risk assessment at the incident site	Genuine decision task
Time critical	Identifying the needs of the patients	Genuine decision task
Less time critical	Information pooling	Automatic information-processing task
Less time critical	Strategic level meetings at the operation centre	Known decision task

According to the interview analysis, the complexity level overlaps with the hierarchical level of the tasks. The researcher points out that when the complexity of the emergency response tasks increases, the numbers of the sub-tasks (actions or operations), which support the overall activity system, also increase in order to perform the objective. For example, the task of *identifying the needs of the patients* consists of many sub-tasks, such as information seeking, sharing, sense-making, cognitive information processing, recall of past experiences etc. Thus, various factors need to be considered in order to make this task more complex, as Vakkari (2003) discusses in his research.

The gathering information from the incident site task is an action supporting other emergency response activities, such as *relevant data and information support to the team operating at the incident site, risk assessment, identifying the needs of the patient* (in an indirect way).

This task can be perceived as a normal information-processing task as the features of the task commonly overlap with Byström and Jarvelin's (1995) task conceptualisation. The *gathering information from the incident site* task may be approached as a routine task since it is performed for every single incident, whether it is a large-scale or a simple disaster. The process, however, is similar every time and case-based arbitrations exist. For instance, floods, explosions, terrorist attacks, traffic accidents or several weather disasters have different information needs, as information needs are determined by the nature of the disasters.

The incidents or disasters are not pre-determinable in nature; however, after the first signals are received by the C&C centre or when an incident call is received, a priori information needs arise: *"What is* the *type of incident and what is the address?"* The answer to these questions is the initial information gathered from the incident site or about the incident. If the incident is perceived as single (not large-scale), the C&C crews of any of the emergency response institutions (Ambulance, Fire Brigade, Police and AKOM) seek information from the caller. The seeking process goes through questioning and seeking answers from the caller to make sense of the situation and identify the response needs (Dervin & Nilan, 1986). The communication and interaction are direct and limited between the agents when the problem is simple (Reddy & Jansen, 2008).

The gathered information is shared with the relevant emergency response team to prompt the team to the incident site. Thus, for incidents perceived as simple by the C&C crews of emergency response organisations, information needs are not complex and individual information behaviour exists.

Contrary to this case, rarely collaborative information behaviour exists even if the incident is perceived as simple. The initial information gathered from the incident site may need to be *triangulated* from varying sources (I 07, I 13).

> *I 07 (Interviewee 07): "The eyewitness on the phone is terrified most of the time. Sometimes they exaggerate or give misinformation. First of all, I act based on the initial information I receive and I allocate the first Fire team. Then, I turn to the MOBESE department to check the incident through their MOBESE live stream network. While I am acting with the information I receive from the eyewitness, other crews monitor the incident site (if it is available) through live stream network and share what they find with me."*

When the researcher shed light onto disasters, which are perceived as large-scale, such as severe weather (heavy snow in winter) or the 2009 İstanbul flood, it became apparent that the C&C Centre of AKOM takes the responsibility of coordination. Large-scale disasters are multi-agency response activities. Multiple agencies, such as the Ambulance, the Police, and the Rescue and Fire Brigade are *knot-worked* for emergency response. Thus, the information needs become complex. Continuous communication

is established between the C&C Centre of AKOM and the emergency response teams operating at the incident site. First of all, initial information needs about the problem are identified through collaborative sense-making (Karunakaran, Reddy, & Spence, 2013; Weick, 1993).

Various divisions of the AKOM centre and the other related emergency response organisations seek information about the scope of the disaster and the changing conditions. The information retrieved is shared with C&C crews and they allocate sources through referencing the retrieved information. They share this information with the emergency response team leaders operating at the incident site (if the information is relevant to them).

Large-scale disasters prompt the live-stream department of AKOM to use SNG (Satellite News Gathering) vehicles (trucks or helicopters). The live-stream video recordings are shared with AKOM's C&C Centre and AKOM's Operation Centre. At the same time, some of the C&C crews monitor the incident site through MOBESE cameras to gather live video recordings. C&C crews establish continuous communication with the emergency response team leaders operating at the incident site to make them aware of the changing conditions and allocate new sources or change the response strategy.

All the above-mentioned actions are held to integrate information gathered from different sources in order to reach collaborative sense-making about the situation. The advantage of collaborative information seeking, sharing and collaborative sense-making is to understand the problem through integrating different perspectives (Paul, 2010). I 01, a director in AKOM, summarised the actions they take when they encounter a large-scale disaster.

> *I 01: "Dark, black smoke invaded the sky. At the same time automated fire-warning systems alerted us about the fire in the Atatürk Airport. Initially, the Bakırköy and Yeşilköy Fire departments got prepared for response. According to the incoming emergency calls received from the airport, the colour of the smoke gave us an idea of the scope of the fire.*
>
> *… Then, we decided to benefit from SNG (Satellite News Gathering) vehicles and via helicopter we recorded the fire., At the same time, C&C crews were communicating with the Bakırköy and Yeşilköy Fire departments to gather updated information about the fire, such as "the cause of the fire, which department was mainly affected, any injured people, the potential danger of explosive materials" etc. … After the evaluation of the information gathered from different sources, we understood that the scope of the fire was greater. After that, I understood that our initial impression was not enough to comprehend the situation."*

Information gathered from the incident site enables the C&C crews to understand the scope, structure and requirements of the problem encountered (Byström, 2002). It is the first step for emergency response organisations to formulate the problem and take the initial actions. If information needs are not satisfied, an emergency response strategy cannot be built effectively as a response under lack of information involves high risks.

Relevant data and information support to the emergency response teams operating at the incident site is a normal information-processing task, whereby the process is pre-determinable and structured, although case-based arbitrations may need special attention to constitute the content of the process (Byström, 1999).

The C&C centre shares information with the relevant teams. For instance, health-related information is shared with the Ambulance Service and the risky buildings information is shared with Rescue Teams or the Fire Brigade. Motivated information sharing exists, which determines what information to share and with whom (Wittenbaum, Hollingshead, & Botero, 2004). The motivated information sharing strategy of the C&C centre facilitates the effective response of the emergency teams through saving time and avoiding information overload. The relevant information possessed by the C&C crews is shared with the teams, where collaborative information behaviour exists to take advantage of immediate information access and accessing necessary information to sort out the problems.

The Risk assessment task is a genuine decision task, which is not a priori determinable, unstructured, ill-structured or unexpected (Byström, 1999, Byström & Jarvelin, 1995). Risk assessment is necessary and is carried out at the incident site before the response action begins. Also, it is an on-going action since conditions change or new relevant information is gathered. The team leaders of the emergency response teams are responsible for the risk assessment. For single incidents, information is provided to the team leaders before they are despatched to the incident site. C&C crews share relevant information with the team leaders. Risk assessment is mainly carried out as an individual action in single incidents. The team leader processes the information gathered from the C&C cognitively and shares his/her judgement with the other team members. Information processing is individual-based for single incidents; however, the size and the magnitude of the incident forces collaborative judgement about the situation. Collaborative sense-making (Paul, 2010) exists to have common understanding about the phenomena by all the team members. This situation facilitates to integrate various perspectives to start effective emergency response. For example, large-scale disasters like the 2009 Istanbul flood, or the 1999 Gölcük earthquake and refinery fire involve many different factors to be considered. For example, the TÜPRAŞ (Türkiye Petrol Rafineleri Anonim Şirketi - Turkey Petroleum Refineries Incorporated Company) fire in 1999 after the Gölcük Earthquake was massive. The factors considered before the response at the risk assessment stage included the structure of the repositories, the

explosion risk of the tankers, and invasion risk of the fire to the nearest living spaces and the threat from disseminated chemicals. In this case, multiple agencies collaborated in the response.

The need to integrate the domain expertise of emergency response teams, the fragmented information held by different agencies and immediate access to these fragmented information sources to assess changing conditions, force multi-agency interaction and continuous communication (Reddy & Spence, 2008) in order to establish a shared understanding (Paul, 2010) of the situation and a collaborative risk assessment.

For instance, the AKOM C&C Centre investigated the potential health hazards from the electric transformers invaded by the flood. The AKOM C&C Centre communicated with TEDAŞ (Türkiye Elektrik Dağıtım Anonim Şirketi – Turkey Electric Distribution Incorporated Company) and TEDAŞ assessed the risks and shared the potential risks with AKOM. Conversely, infection risks from the floodwater were assessed by the Istanbul Directorate of Health and shared with AKOM. The traffic situation was sought from the MOBESE cameras and the Istanbul Directorate of Highways was needed to identify potential routes that were not affected by the flood that could be used for emergency response. This kind of information is organisational domain information and cannot be held by all the emergency response institutions. The C&C Centre of AKOM integrates the information gathered, and through continuous communication, shares this information with the emergency teams. Thus, the team leaders (Fire, Rescue, Ambulance and Police) gain a shared understanding of the situation.

Identifying the needs of the patient is a genuine decision task which involves unexpected process and structure, and whose information requirements cannot be pre-determinable (Byström, 1999; Byström & Jarvelin, 1995). Every incident has its unique characteristics and unique information needs, and every patient has a unique condition and information needs stimulated from his/her past health condition and the type of incident he/she was rescued from.

Intervention involving errors caused by lack of information or expertise cannot be tolerated. The value of quality decisions through information processing gains importance when we shed light on the potential results. These kinds of errors may result in the death of the patient. Therefore, emergency paramedics (Ambulance Services) are trained to gain a clear understanding of the condition of the patient and how to collaborate with the other emergency staff at the incident site. Lead paramedics are responsible for establishing communication with C&C, emergency teams at the incident site, and among their own team members (paramedics). By doing so, similar to the results by Reddy and Spence (2008), collaboration significantly facilitates the satisfaction of information needs and access to relevant health information at the right time.

During a single incident response, such as an Ambulance Service response, the first introduction of the patient to the health service is held through the paramedics' response. The first intervention of the paramedics is crucial to keep the health condition of the patient stable until their arrival at the nearest (or relevant) hospital.

Similar to Klein's (2008) NDM (Naturalistic Decision Making), paramedics recall from their past experiences or integrate clues at the site; however, if anything unexpected happens, they seek additional information from team mates or from the C&C Centre for NDM and mental simulations and deliberative information seeking under time pressure). By doing so, paramedics make sense of the condition of the patient through assessing the information gathered from the C&C Centre. En route to the incident site, they have a mental evaluation of what they will probably encounter (I 18).

> *I 18: "Before we depart from our station, we almost know what we will do. The station gives us the details of the incident. The type of the incident, such as a traffic accident, cracked bones, heart attack, delivering birth, trauma etc. alters our preparation. En route to the incident, we discuss the probabilities among each other in the ambulance as well."*

Large-scale disasters bring vague problems. Thus, the identification of the problems is not easy as in single incidents. Fire and Rescue crews are responsible for saving lives from collapsed buildings, fires and flood. By doing so, first aid is administered by Fire or Rescue crews. Paramedics are the second agents who interact with the patients in this case. Fire or Rescue crews may have an insight of the health condition of the patient and share it with the paramedics at the incident site. Paramedics use this information to determine the subsequent course of actions. If there are more information needs, lead paramedics seek information from the Directorate of Health where the historical health database of people is deposited.

The paramedics seek information from C&C and C&C seek information from the Directorate of Health. The Directorate of Health crews retrieve information from repositories. The information retrieved is shared among agents, to be used for evaluation by the paramedics in order to judge the situation of the patients.

Another point is the lack of expertise. Paramedics are trained to stabilise the health condition of the patient en route to the hospital. If any complications occur en route to the hospital, however, lead paramedics communicate with doctors and they try to find short-term solutions for the problem (I 8).

> *I 8: "We are all trained on birth delivery. But we are not very well trained on hedging the complications. For instance, we need to put the baby into the incubator, but we do not have it on the ambulance. We call the hospital, and* the *doctor instructed us after he understood the situation."*

Lack of expertise and the need to access the historical health records of the patient force paramedics to collaboratively seek and share information (Reddy & Spence, 2008). If the paramedics do not know the symptoms, the problem becomes more complex and paramedics share the problem information with seniors or doctors in order to reach a working solution (Stasser, Stewart, & Wittenbaum, 1995).

Another point is the complexity of information needs. The information needs of the Ambulance Service have different components (Reddy & Spence, 2008). For instance, Istanbul has a major traffic problem, and paramedics seek low traffic density roads. In some cases, however, the roads are blocked. Therefore, paramedics turn to C&C requesting another nearest hospital or to be transferred to a special unit if the health problem of the patient is specific (I 15).

> *I 15: "I pray not to go to a very* urgent *incident in peak hours*, b*ecause* the roads are *blocked and we try to find low density routes or change our direction to another available hospital."*

Another issue is the transfer of the patient to a specialised unit if required after the assessment of the paramedics and the doctor. For instance, deep burn patients are transferred to specialised hospitals, which have burn intervention units. Therefore, paramedics, C&C and related hospitals collaborate to assess the situation and reach a satisfying result in limited time. This kind of complex information needs, which involves many different components rather than just health-related issues, trigger collaborative information (Karunakaran et al., 2013).

Information pooling is an automatic information-processing task. It is a simple task. It requires no, or very little, case-based consideration (Byström, 2002). Reports produced after the response, historical reports of nationwide or worldwide disasters, satellite photos, and videos and photos from past incidents are pooled at AKOM to be used for further training and for strategic level long-term planning purposes. By doing so, during the decision-making period, the various information sources gathered facilitate quality and unbiased decisions (Scholten, Van Knippenberg, Nijstad, & De Dreu, 2007; Stasser & Titus, 2003; Franz & Larson, 2002; Stasser et al., 1995; Gigone & Hastie, 1993; Stasser & Titus, 1985).

Another point concerning the information-pooling task is the collaborative information behaviour, which exists in large timescales. Whilst others discuss the collaborative information behaviour as the use of found information, information pooling teams use found information a long time after it is retrieved. Information is sought and found for further use, so collaboration is established in two stages in the long run.

Strategic level meeting at operation centre is a known decision task. The type and structure of the result is known, but permanent procedures to perform the task have

not emerged yet (Byström, 1999). The directors of disaster management institutions gather at the AKOM Centre. The topic is known in advance. Long-term disaster planning is discussed among directors. Each of the directors brings different insights according to his/her institution's perspectives on the topic (Franz & Larson, 2002), and information is collectively pooled to be evaluated and used for decision making (Wittenbaum et al., 2004; Michailova & Husted, 2004; Winquist & Larson, 1998).

According to the responsibility and organisational structure, every disaster management institution possesses different domain information. For instance, the Fire Brigade produce reports about fire risks in historical buildings in Istanbul. The Directorate of Health produce reports about epidemic diseases during potential floods. The Rescue and First Aid Institution produce reports on search strategies during potential earthquakes etc. Information is collectively shared and evaluated. The reports and databases produced regarding disasters are discussed. The aim is to achieve a shared understanding in order to make decisions on long-term disaster management.

Conclusion

Man-made or natural disasters are inevitable and disaster management tasks are complex in nature. Uncertainty is high during disasters. To hedge the uncertainty and reduce the complexity emergency responders (tactical and strategic level) share information. Timely, quality decisions save lives or vice versa may cause catastrophic losses. In this regard, this study investigates how emergency commanders response to the disasters in timely manner, and act effectively while dealing with uncertainty and complexity at the incident site.

Emergency situation and tasks characteristics force the strategic level and tactical level commanders to collaborate. After the evaluation of the findings and interpretations, it is clear that emergency response organisations should integrate information. Information sources and the experiences are fragmented and spatially distributed among people and organisations. For effective team coordination and decrease the losses, emergency response organisations collaborate. The collaboration enabled through information processing and information seeking, sharing and sense-making is made via ICT tools. By doing so, fragmented information sources become mean and rich-quality information is pooled to use in emergency response.

As practical implications, emergency response organisations should be aware of the complexity level of the emergency response tasks, information is fragmented, distributed experience among institutions and people, spatial proximities hinder effective response. The hedge these barriers ICT tools should be redesigned facilitating collaborative information sharing. The emergency responders' (strategic level and tactical level) training modules should involve establishing healthy communication with C&C centres and other emergency response organisations. Shared objective

should be established instead of institutional objective. By doing so, all emergency response organisations (AKOM, Fire Brigade, Ambulance Services, Rescue Teams, Police, etc.) act as a single team, and the response become more effective.

Further Research and Limitations

The researcher designed the hand response cards that explain the factors influencing task complexity. However, the interviewees, according to their complexity perception, rated the factors. Thus, there could be some biases in task categorisation as complexity perception is subjective. For instance, a task can be very complex for a novice or a new team member, but less complex for expert staff.

The role of ICT technologies cannot be underestimated in collaborative work settings in a disaster management context. The use of Activity Theory has enabled the researcher to identify the role of ICT tools in collaborative information behaviour. In particular, the emergency response context can be explored to comprehend the historical record and future projections for improvement in ICT technology to provide effective inter-agency and inter-personal communication during large-scale disasters.

As mentioned in the conclusion above, Activity Theory has enabled the researcher to determine the tensions and contradictions in the systems, which are not directly linked to this research. These findings can be presented, discussed and interpreted in an article.

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Appendix 1.

Leeds University Business School
Interview Schedule

Name of the project: The influence of task and time on information behaviour: emergency response context

Name of the researcher: Alperen Mehmet Aydin

Date and Location:_____

Start and End Time:_____

Participant:_____

Organization:_____

Introduction

I'm doing research on the influence of task complexity and time pressure on information (seeking and sharing) behaviour of the emergency responders while acting at the incidents. I'm particularly interested in the behaviour of the emergency responders during the initial phases of the major incidents.

Section A

In the first section of the interview, I would like to explore with you the degree to which you feel that the tasks carried out in the initial stages of the major events are objectively complex or time pressured. I have prepared a list of tasks on this sheet (hand Response Card One)

I would like you to view the complexity of these tasks are determined by four different criteria: how much information needs to be absorbed, how many decisions need to be taken, how many people you need to involve, and how difficult to communicate information.

A1. Please could you review each of these tasks and rank them on a 1-5 scale how complex are these tasks according to different criteria by filling the relevant box on the Response Card 1? Scale is on the response card

(Respondent returns response card)

A2. I see that you have identified "Task X" as one involving high complexity in a couple of the measures. To what extent are you under time pressure during this task? (Interviewer notes the responses on the Response Card 1)

A3. Focusing on these tasks could you rank them in terms of their significance to the resolution of the incident / occur most often? (Please Rank 1 as insignificant and 5 as significant)

(Fill in the Response Card 2 please)

Section B

In the following section, I would like to understand more about how these tasks are undertaken in the field and would like you to share your experience about carrying out these in a recent incident.

B1. What was the incident?

B2. Where and when did it happen?

B3. Could you describe what happened?

B4. Thinking about this incident, I would like to talk about "task X" and "task Y". What information did you need?

B5. How did you gather required information?

B6. And how long did it take approximately?

B7. Which information sources did you use before you carried out this task and while you are carrying out this task? (Please, could you fill in the Response Card 3?)

B8. And which information source was prior for you to act? (Please, could you fill in the Response Card 3?)

B9. I see that you say that you didn't use information sources of any kind in the case of X.

B9a. What took the place of information in this case?

B9b. How did you decide how to deal with the task?

B10. In relation to Task X, how did you use the information you acquired? Please respond by using this Response Card 4.

Were there other ways you used the information that are not identified on the card? – then you can write on the card (perhaps on the back of it) whatever the reply is.

Section C

C1a. Do you feel there are constraints or problems when gathering information during an incident?

C1b. And why they occur?

C2a. Do you feel there are constraints or problems in sharing information during an incident?

C2b. And why it happened?

C3. What do you think to avoid this situation?

Section D

D1. Personal information

What is your department?

What role do you perform at an incident?

How many years have you been in this organization?

Thank you for your help

Response Card 1 – Tasks (related to A1)
In the initial phase of an incident the following tasks need to be undertaken: Please assign a score from 0 to 5 as shown.

	Tasks	**Information to absorb** **0: none at all** **1: almost none** **2: a small amount** **3: a manageable amount** **4: difficult to cope with** **5: too much**	**Decisions to take** **0: none** **1: very few** **2: a few** **3: quite a lot** **4: a great deal** **5: too many**	**People to involve** **0: only myself** **1: one or two others** **2: only my team** **3: my team and 1 or 2 others** **4: everyone in the incident** **5: all on site and some off the site**	**Difficulty to communicate information** **0: too easy** **1:easy** **2: moderate** **3: not very difficult** **4:easy** **5: too difficult**
1.	Risk assessment, ensuring the safety of the crew members and the other people around the incident milieu				
2.	Collaborative work with governmental and non-governmental disaster management institutions				
3.	Assessing the situation of the victims (trapped people), searching				
4.	Ensuring the healthy communication with the remote commanders				
5.	Rescue the victims				

	Tasks	**Information to absorb** **0: none at all** **1: almost none** **2: a small amount** **3: a manageable amount** **4: difficult to cope with** **5: too much**	**Decisions to take** **0: none** **1: very few** **2: a few** **3: quite a lot** **4: a great deal** **5: too many**	**People to involve** **0: only myself** **1: one or two others** **2: only my team** **3: my team and 1 or 2 others** **4: everyone in the incident** **5: all on site and some off the site**	**Difficulty to communicate information** **0: too easy** **1:easy** **2: moderate** **3: not very difficult** **4:easy** **5: too difficult**
6.	Fire suppression				
7.	Salvage operations				
8.	Ventilation				
9.	Opening the drainage channels, or removing the debris				
10.	Identifying the needs of the patient				
11.	Administering basic and advanced life support techniques: CPR and defibrillation (electric shocks)				
12.	Performing surgical procedures if required				
13.	Keeping the patient's airways open				

	Tasks	**Information to absorb** **0: none at all** **1: almost none** **2: a small amount** **3: a manageable amount** **4: difficult to cope with** **5: too much**	**Decisions to take** **0: none** **1: very few** **2: a few** **3: quite a lot** **4: a great deal** **5: too many**	**People to involve** **0: only myself** **1: one or two others** **2: only my team** **3: my team and 1 or 2 others** **4: everyone in the incident** **5: all on site and some off the site**	**Difficulty to communicate information** **0: too easy** **1:easy** **2: moderate** **3: not very difficult** **4:easy** **5: too difficult**
14.	Medicating the patient and administering injections if required				
15.	Administering intravenous fluid and drug therapy				
16.	Dressing wounds				
17.	Completing accurate patient records				
18.	Administering oxygen				
19.	Transporting the patients to the hospitals				
20.	Ensuring communication and interoperability with the other government or non-government organizations at incident				

	Tasks	**Information to absorb** **0: none at all** **1: almost none** **2: a small amount** **3: a manageable amount** **4: difficult to cope with** **5: too much**	**Decisions to take** **0: none** **1: very few** **2: a few** **3: quite a lot** **4: a great deal** **5: too many**	**People to involve** **0: only myself** **1: one or two others** **2: only my team** **3: my team and 1 or 2 others** **4: everyone in the incident** **5: all on site and some off the site**	**Difficulty to communicate information** **0: too easy** **1:easy** **2: moderate** **3: not very difficult** **4:easy** **5: too difficult**
21.	Relevant data and information support to emergency response teams operating at the incident milieu				
22.	AKOM Operation centre meetings				
23.	Gathering information from the incident milieu (call centre, public and news channels)				
24.	Gathering information from the incident milieu (remote and security cameras of the sites, live recording devices of the emergency teams, early warning systems, etc.)				

Response Card 2 (related to A3) Please rank them 1 as insignificant and 5 as significant.		
Tasks	Significance to the resolution of the incident	Occur most often

Response Card 3- Information Sources (related to B7, B8, B9)(Use separate for each task) **Name of the task:_____**				
Information sources	**Before carrying out the tasks**	**While carrying out the task**	**Prior for me to act**	**No Information sources used**
Face-to-face communication with other team members				
Face-to-face communications with the victims (verbal or non verbal communication)				
Telecommunications with the victims				
Situation of the victims or patients (health condition)				
Face-to-face communication with the public				
Paper work (static data), action plans and rules				
Information from the local bodies (cite managers, local governors, etc.)				
Electronic databases, maps showing the specifications and characteristics of the milieu, weather or the buildings				
Data gathered from remote cameras and dynamic live recording devices (video and stream data)				
Data gathered from early warning systems, sensors				
Information gathered from call centres				
Information gathered from news channels				
Information from frontline responders				
Commands from remote commanders through radio or any other electronic devices				
Personal knowledge, experience				
Personal knowledge, theoretical information				

Response Card 4 – Use of the information (related to B10) (Use seperate for each task) **Name of the task:**_____	
To judge the risks and assess the situation	
To make decisions for the next action	
To command the other team members/crews	
To share with other team members operating at the incident milieu (seniors or peers)	
To share it with the remote commanders	
To share with the patients or trapped victims	
To share with the other teams operating at the incident milieu	
To share it with the public to give them awareness about the situation	
To integrate the information comes from different sources	
To make decisions about or changing the strategy/ tactic of emergency response	
To produce the incident report	