

ICT-31-2014: Human-centric Digital Age

Project number: 645043



**A typology, method and roadmap for HUman-MACHine NETworks**

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# Analysis summary of HUMANE internal case study: eVACUATE #1

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## 1 Overview

This case study was conducted on 14 December 2015. The purpose was to evaluate the usefulness of the HUMANE approach (Følstad et al., 2015) as perceived by relevant developers (software engineers), and additionally ask if the HUMANE typology facilitates cross-disciplinary understanding.

eVACUATE is an EC FP7 project, which is about getting people out of dangerous situations. The main participants of the eVACUATE evacuation scenarios are: operational staff who are responsible for making sure people get out safely; the people to be evacuated; and the emergency services who are quasi autonomous but responsible for the safe evacuation of the site(s). There are two different types of machine “actors”: 1) the site itself, which is often equipped with various sensors (especially the cruise ship and airport cases), characterised by equipment with no particular autonomy in terms of execution, and 2) a Decision Support System developed in the eVACUATE project to assist the operational staff, which by contrast to (1) supports the operation of software components which act on and interpret the information coming from the non-autonomous equipment. Thus, we see this is a Human-Machine Network (HMN) where the ‘machine’ actors are both active and passive elements. The eVACUATE HMN is used under two main circumstances: (i) during *monitoring* (normal operation) where the emphasis is on periodic checking by operational staff based on default input from sensors, that individuals act appropriately and safely; and (ii) during *evacuation*, where the HMN changes to accommodate tighter interaction with sensors, even the recruitment of additional sensors, and the possible involvement of emergency services such as paramedics, the police, or special forces.

## 2 Methodological approach

### 2.1 Research question

It is one thing implementing a complex HMN including multiple human agents and a decision support system for aiding operational staff in facilitating the safe evacuation of large crowds from public places in a variety of scenarios (airport, cruise ship, football stadium and metro station), but it is quite another allowing all stakeholders to understand and communicate with one another. The eVACUATE case study looks a different potential use of the HUMAN typology and method, and asks the question:

Does the HUMANE typology facilitate cross-disciplinary understanding?

### 2.2 Method

Four software engineer colleagues involved in the eVACUATE project, but as yet unaware of the aims or outcomes of HUMANE, were recruited for a semi-structured focus group lasting approximately one hour. Each had been working in ICT-related projects after doctoral studies for a period of at least ten years. All had worked on eVACUATE since its beginning in 2013. The HUMANE approach was presented and explained to participants, who were then asked to comment in response to, though not exclusively confined to, the following questions:

- *Part 1 – network design*
  - *How would you normally collaborate with partners?*
  - *Is it easy working with people from other disciplines?*
  - *Do you think formal methods help?*
- *Part 2 – modelling and visualisation*
  - *Does this approach make sense?*
  - *Given that this is about cross-disciplinary communication, is there anything missing?*
  - *Would this approach help communication?*
- *Part 3 – typology and profile*
  - *Are the four analytical layers [in the profiling approach] useful?*
  - *Would you add any more dimensions?*
  - *What does this tell you about the HMN that you didn't already know?*

Note that these questions were displayed as part of a *MS PowerPoint* presentation during discussion, but not posed specifically. The first section focused on establishing the notion of a network and approaches to modelling an ICT system as a network. The second section focused on presenting the primitives from D1.1 (Tsvetkova et al., 2015), showing a network diagram as per Figure 1, and discussing the way in which such diagrams would be used as a means of communication between different stakeholders when designing a system. The final part focused on the typology, presenting the analytical layers and dimensions, and a network profile of the eVACUATE HMN as per D2.1 (Følstad et al., 2015).

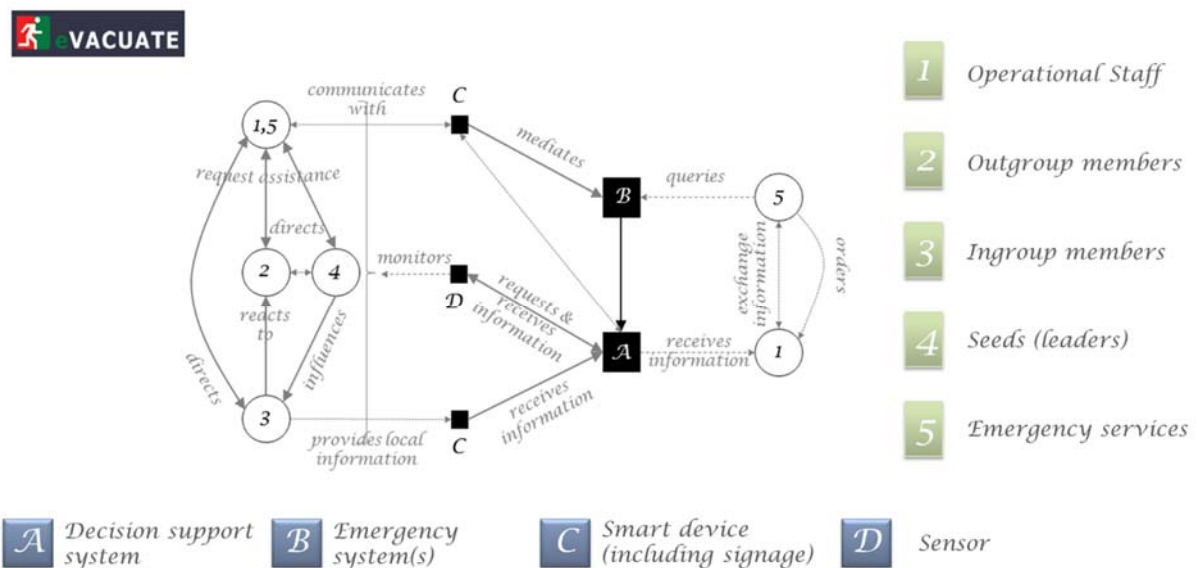


Figure 1: eVACUATE network diagram using D1.1 primitives.

The discussion was recorded and transcribed by a professional audio transcriber. It was then checked by project partners for accuracy. The checked version was then pseudonymised, changing each participants' name to a *quasi*-random identifier: P1 to P4. This pseudonymised version was then made available to participants for any comments they may have in terms of its accuracy.

Once validated, the transcript was then reviewed by two researchers for major topics as part of a thematic analysis (Braun & Clarke, 2006; Coolican, 2013; Howitt, 2013) of the participants' input. No formal attempt was made to quantify cross-coder consistency. However, a number of meetings were held to review consistency manually across the researchers' respective themes. In addition, a much more restricted Interpretative Phenomenological Analysis (IPA) (Larkin, Eatough, & Osborn, 2011; Smith, Jarman, & Osborn, 1999) was attempted with a view to identifying any specific problems or issues that software engineers might have currently in designing and implementing such complex HMNs. The results are outlined in the following section.

### 3 Findings in relation to research question

Although the discussion did tend to focus on specific dimensions (namely the absence of a machine-to-machine interaction type) and the overall visualisation of the network profile (the radar chart), the eVACUATE case study suggests that cross-disciplinary communication can be facilitated and may become more effective using something akin to the HUMANE approach. Appreciating the early conception of what HUMANE is doing, this case study also provided some insight into the types of issues that designers might have in using and understanding the dimensions of the HUMANE typology.

Notwithstanding that the Interpretative Phenomenological Analysis (IPA) shows some reservations, the summary outcomes of the thematic analysis for the initial internal use-case based on the eVACUATE project highlighted a number of specific factors that was taken into account when the HUMANE typology and method was further developed.

On the one hand, there is an indication that the dimensions and visualisation of network profiles may not yet be optimal and lack sufficient flexibility for further refinement. On the other hand, advantages to the approach include:

- *The humane approach facilitates cross-disciplinary communication*: the simple visualisations provided and as outlined in D1.1 and D2.1 allow an easy-to-understand representation of a complex HMN, like that represented in eVACUATE, which might well help stakeholders and users from different domains and disciplines appreciate what is being done and importantly how they fit; specifically:
- *Adding the detail of human interactions provides some additional information and benefit*: focusing on interactions between human and machine agents highlights responsibilities, but also promotes understanding of the purpose of the HMN; which in turn:

- *May provide supplementary information which encapsulates information about dynamic HMN-associated behaviours:* that is may well lead on to an appreciation of potential and emergent behaviours.

There is, therefore, clear (if guarded) support for the HUMANE approach in terms of what information is provided for designers, users and participants in HMNs. But in respect of potential behaviours, the approach may help make clear how future HMNs will develop as well as current networks may be used for unforeseen purposes.

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