**ICT-31-2014: Human-centric Digital Age**
**Project number: 645043**

**A typology, method and roadmap for human-machine networks**

Deliverable D2.2

# Typology and method v2

| | |
|---|---|
| **Editor(s)** | Asbjørn Følstad |
| **Lead Partner** | SINTEF |
| **Version** | V07 |
| **Date** | 31/07/2016 |
| **EC Distribution** | Public |

| | |
|---|---|
| **Project Number** | H2020 – 645043 |
| **Project Title** | HUMANE |

| | |
|---|---|
| **Title of Deliverable** | Typology and method v2 |
| **Date of delivery to the EC** | 31/07/2016 |

| | |
|---|---|
| **Editor(s)** | Asbjørn Følstad |
| **Contributors**<br>(in alphabetical order) | Vegard Engen (IT Innovation)<br>Taha Yasseri (UOXF)<br>Ruth Garcia Gavilanes (UOXF)<br>Paul Walland (IT Innovation)<br>Milena Tsvetkova (UOXF)<br>Eva Jaho (ATC)<br>Brian Pickering (IT Innovation)<br>Antoine Pultier (SINTEF) |
| **Reviewer** | Eric Meyer (UOXF) |

| | |
|---|---|
| **Abstract** | In the HUMANE research project, we aim to support analysis of, and design for human-machine networks. Towards this end, we have developed a HUMANE typology and method. The typology serves to characterize human-machine networks on dimensions pertaining to the level of agency in the actors of the network, the strength of the relations between the actors, and network organization and workflow. The method supports profiling human-machine networks along these dimensions, to analyse implications of the network characteristics, identify similar networks, and enable the transfer of design knowledge and experience in the form of design patterns. We have applied the method to conduct initial implication analysis and suggest potential design patterns of relevance to the six HUMANE cases, on the basis of their human-machine network profile. Furthermore, we have developed the prototype version of a tool for profiling human-machine networks and sharing design knowledge and experience in the form of design patterns. |
| **Key-words** | Human-machine networks, typology, method, design patterns |

# Versioning and contribution history

| Version | Date issued | Description | Contributors |
|---|---|---|---|
| V01 | 09.05.2016 | Outline | SINTEF |
| V02 | 27.05.2016 | Extended outline following partner input | SINTEF, ATC, IT Innovation |
| V03 | 07.06.2016 | Integrating new partner input, sections 7-9 | SINTEF, ATC, IT Innovation |
| V04 | 14.06.2016 | Integrating new partner input, sections 1 and 7-9 | SINTEF, ATC, IT Innovation |
| V05 | 20.06.2016 | Integrating new partner input, sections 7-9 | SINTEF, ATC, IT Innovation, UOXF |
| V06 | 08.07.2016 | Draft submitted to internal review | SINTEF, ATC, IT Innovation, UOXF |
| V07 | 31.07.2016 | Updated version following internal reviewer comments | SINTEF, ATC, IT Innovation, UOXF |
| | | | |

# Definitions and abbreviations

| Abbreviation | Definition |
|---|---|
| H2M interaction strength | Human-to-machine interaction strength (see Section 4.1) |
| HCD | Human-centred design |
| HMN | Human-machine network |
| ICT | Information and communication technology |

# Executive summary

In the HUMANE research project, we aim to support analysis of, and design for human-machine networks (HMNs), that is, collectives of humans and computer-based technologies that generate synergistic effects. The term HMN refers to a broad range of entities. This range is exemplified through the six HUMANE cases: (1) an open innovation platform, (2) a consumer-to-consumer (C2C) reselling platform, (3) a system for crisis management and evacuation support, (4) a collaboration platform for social media verification, (5) a co-production platform (Wikipedia) and (6) a citizen science platform. In all of these, synergistic effects are immediately evident, embodied, for example, in the crowdsourcing of the open innovation platform and citizen science platforms, the leveraging of an online platform for strengthening sustainable or green behaviour in the C2C reselling platform, and the collaborative work and co-production enabled in the platform for social media verification and in Wikipedia. However, for many HMNs such synergistic effects do not materialize to the degree expected; HMNs that were envisioned to strengthen sharing or collaboration often do not meet their objectives. In HUMANE, we assume that this is in part due to an incomplete understanding of the character and potential emergent properties of the envisioned HMN as well as a lack in ability to transfer design knowledge and experience from successful HMNs.

Towards this end, we have developed a HUMANE typology and method. At the heart of the method is the HMN profiling approach, where we profile an HMN on eight dimensions representing generic HMN characteristics such as the level of agency in the actors of the HMN, the strength of the relations between these actors, and the HMN workflows and organization. The profiling is intended to facilitate analysis of implications of the HMN profile for themes such as motivation, collaboration, innovation, and trust. For example, pertaining to how low levels of human agency may affect motivation or high levels of machine agency may affect trust. Through an implication analysis, areas of particular concern may be identified. For these areas, the method provides support for accessing design knowledge and experience through a design pattern approach. The design patterns should represent solutions of relevance to the areas of concern identified through the implication analysis, and can be identified through reflection on successful HMNs with profile characteristics similar to the HMN of interest.

The HUMANE method comprises five steps including (1) identification of the purpose and objectives of the HMN, (2) HMN profiling and network diagramming, (3) implication analysis and identification of similar HMN, (4) accessing design knowledge and experience in the form of design patterns, and (5) evaluation on the basis of the desired network profile and identified design patterns.

In this report, we present the second version of the HUMANE typology and method. This version serves as an extension of the first version and draws on the experiences from six case studies applying elements of the method.

The presented typology is aimed at resolving issues pertaining to the clarity in the typology dimensions identified in the first set of case studies. For this purpose, each of the typology dimensions are broken down into three or four aspects. These aspects should serve to clarify the

dimensions and were also intended to support reliable profiling of HMNs on each of the dimensions, though some reliability issues remain.

An initial implication analysis and design pattern exercise has been conducted for all six HUMANE cases. In this report we present the output of these implication analyses, to exemplify how the HMN profile may be used as basis for identifying and reflecting on implications pertaining to (a) user motivation and experience, (b) user behaviour and collaboration, (b) innovation and improvement, (d) privacy and trust, and (e) the underlying technical infrastructure. For example, in the case of a collaboration platform for social media verification the implication analysis served to identify trust implications pertaining to high levels of machine agency.

To suggest mitigations for the areas of concern identified through the implication analysis, a set of design patterns were suggested for each case. The design patterns are intended as brief summaries of potential solutions to areas of concern. For example, in response to the trust implication in the case of a collaboration platform for social media verification, a design pattern was suggested on how trust in machine actors may be strengthened through increased transparency in algorithmic filtering and processing of content.

Finally, we present a prototype version of an interactive tool intended to support the profiling of HMNs and sharing of design knowledge and experience in the form of design patterns. The prototype tool is available online.

The presented version of the HUMANE typology and method will be applied and validated in a second set of case studies. This validation will be conducted in the second half of 2016.

## TABLE OF CONTENTS

**Executive summary** ..... **5**

**1 Introduction** ..... **11**

1.1 Motivation ..... 11

1.2 The HUMANE approach ..... 12

1.3 Structure of the report ..... 13

**2 Background** ..... **14**

2.1 Defining HMNs ..... 14

2.2 HMN typology ..... 15

2.3 Profiling HMNs ..... 20

2.4 Findings from the initial case executions ..... 23

**3 Objectives and approach** ..... **26**

3.1 Objectives ..... 26

3.2 Approach ..... 27

**4 Typology dimensions refined** ..... **27**

4.1 Dimensions and aspects ..... 28

4.2 Developing the aspects for each typology dimension ..... 30

**5 The HUMANE method** ..... **30**

5.1 Background and scope ..... 31

5.2 Supporting the needs of HMN designers and developers ..... 32

5.3 Overview of the HUMANE method ..... 33

5.4 Application of the HUMANE method ..... 35

5.5 The HUMANE method to be refined through case executions ..... 46

**6 Profiling** ..... **46**

6.1 HMN profiles from the HUMANE cases ..... 47

6.2 The HMN profiles in the larger HUMANE project context ..... 49

**7 Implications** ..... **49**

7.1 The process of initial implication analysis ..... 50

7.2 Implications overview ..... 50

7.3 Concluding remarks on the initial implication analyses ..... 58

**8 Design patterns ..... 59**
8.1 The design pattern approach ..... 59
8.2 Design pattern format ..... 59
8.3 Initial design patterns for the six HUMANE cases ..... 60
8.4 Classifying the design patterns ..... 67
8.5 Concluding remarks on the design pattern approach ..... 76
**9 Tool support ..... 76**
9.1 Motivation – why do we need tool support ..... 77
9.2 Tool – overview ..... 77
9.3 Profiling a HMN in the tool ..... 78
9.4 Reviewing similar HMNs in the tool ..... 80
9.5 Identifying and sharing design patterns in the tool ..... 80
9.6 Browsing HMNs and design patterns in the tool ..... 82
9.7 Access rights ..... 84
9.8 Application of the tool as part of the HUMANE method ..... 85
**10 Conclusion and future work ..... 85**
10.1 Validating the typology and method ..... 86
10.2 Applying the typology and method to support future thinking ..... 87
10.3 Conclusion ..... 87
**11 References ..... 89**
**12 Appendix A – Summary of focus group following initial cases ..... 93**
**13 Appendix B – output from initial implication analyses ..... 99**
**14 Appendix C – Initial design patterns for the HUMANE case studies ..... 124**

**LIST OF TABLES**

**Table 1: HMN analytical layers and dimensions.....18**
**Table 2: Recommendations and suggestions for the second version of the typology and method .....25**
**Table 3: Typology dimensions refined through characterizing dimension aspects .....28**
**Table 4: Initial implications identified and analysed for each of the six HUMANE cases .....51**
**Table 5: Design patterns to support H2H interactions .....70**
**Table 6: Design patterns to support H2M interactions.....71**
**Table 7: Design patterns to support M2H interactions.....73**
**Table 8: Design patterns to support M2M interactions.....75**
**Table 9: Validation topics for the second iteration case executions. .....86**
**Table 10: Useful aspects of the HMN typology .....93**
**Table 11: Challenges and limitations of the typology.....94**
**Table 12: Recommendations for the second version of the typology and method.....96**
**Table 13: Suggestions for the second version of the typology and method .....97**

**LIST OF FIGURES**

**Figure 1: Prototypical purposes for HMNs; the initial set of HMN types ..... 17**
**Figure 2: Overview of profiling framework procedure ..... 20**
**Figure 3: Joint HMN profile for the C2C reselling platform ..... 22**
**Figure 4: Human-centred design process. ..... 31**
**Figure 5: The HUMANE method mapped to HCD methodology. ..... 33**
**Figure 6: A high level view of how the purpose of a HMN underpins its characteristics. ..... 35**
**Figure 7: Example two-state HMN profile – eVACUATE. ..... 37**
**Figure 8: eVACUATE network diagram for context analysis using D1.1 primitives. ..... 38**
**Figure 9: eVACUATE network diagram for context analysis using informal approach. ..... 38**
**Figure 10: Suggested mapping of implications of particular relevance to the HUMANE dimensions. ..... 43**
**Figure 11: eVACUATE network diagram for requirements elicitation. ..... 44**
**Figure 12: eVACUATE network for design implications. ..... 45**
**Figure 13: Initial* HMN profiles for the HUMANE cases. ..... 48**
**Figure 14: Overview of HUMANE method, indicating where the different steps are addressed ..... 49**
**Figure 15: Template for HUMANE design patterns. ..... 60**
**Figure 16: Design pattern types within HMNs ..... 68**
**Figure 17: HUMANE Network Profiler - Getting started (screen dump). ..... 78**
**Figure 18: HUMANE Network Profiler – Consolidated network profile (screen dump) ..... 79**
**Figure 19: HUMANE Network Profiler – list of similar profiles in the HMN profile page (screen dump). ..... 80**
**Figure 20: HUMANE Network Profiler – example design pattern (screen dump) ..... 81**
**Figure 21: HUMANE Network Profiler - Adding suggested design patterns in example HMN profile page (screen dump). ..... 82**
**Figure 22: HUMAN Network Profiler - Browse HMN profiles (screen dump). ..... 83**
**Figure 23: HUMANE Network Profiler - Browse design patterns (screen dump). ..... 84**
**Figure 24: Case 1 - open innovation – initial profile ..... 99**
**Figure 25: Case 2 - C2C reselling – initial profile ..... 103**
**Figure 26: Case 3 - eVACUATE – initial profile ..... 107**
**Figure 27: Case 4 - REVEAL – initial profile ..... 114**
**Figure 28: Case 5 - Wikipedia – initial profile ..... 118**
**Figure 29: Case 6 - Zooniverse – initial profile ..... 121**

# 1 Introduction

## 1.1 Motivation

Designing information and communication technology (ICT) increasingly implies designing for networks of humans and machines. Sharing economy solutions, social networks, crowdsourcing services, collaboration platforms, and command and control centres all are examples of ICT-based systems the success of which depends not only on the characteristics of the enabling technology, but of the larger networks of which the technology is part.

The importance of networks of humans and machines is seen in nearly all aspects of society. For European workers and citizens, life is increasingly affected by the characteristics of growing numbers of networks comprising humans and technology. For European public and private sector firms and organizations, productivity, innovation and civic participation are affected by the characteristics of the networks which these firms and organizations tap into.

The networked character of civic and working life is nothing new. What is new is the increasing importance of ICT components as enablers of, and as nodes in these networks, and the increasing opportunity of designing for such networks through the design of ICT. Hence, ICT needs to be designed with consideration of how people engage in everyday civic life, establishing and running a business, or partaking in political endeavours, as all these are activities involving the interaction of people and technology in increasingly interwoven and sophisticated networks.

To strengthen the quality and competitiveness of European industry, the public sector, and civic life, it is therefore essential to understand, design, and develop for efficacious networks of people and computer-based technology (Følstad et al., 2015). In HUMANE, we call these networks *K\u0002Y l·y\u0003 Y l·\u0000K\u0001y\u0000 y\u0000\u0001\u0002ø2\u0003\u0000ă* (HMNs), that is, collectives of humans and computer-based technologies that generate synergistic effects. In particular, we aim to provide knowledge needed to support the purposeful design for HMNs. We need new knowledge concerning how variations in HMNs affect aspects such as motivation, collaboration, innovation, and trust. For example, how the increasing reliance on algorithmic filtering of content, or the increased application of intelligent robots as work support, affect social processes and productivity in HMNs.

Furthermore, we need new processes and methods to design for HMNs. The challenge is that HMNs cannot be developed and implemented in the same manner as networks of machine nodes alone, or as organizations of human nodes. This challenge is seen in the failure rate of various HMNs. For example, social intranets that fail to engage workers in online collegial interaction (Lüders, 2013), online innovation platforms that fail to strengthen the innovation capabilities of the company (Lüders, 2016), or excessive use of bots in collaborative systems may challenge the culture of collaboration (Tsvetkova, García-Gavilanes, & Yasseri, 2016a). The cost of such failures are not only the investment in the development and marketing of the enabling ICT solution. In addition, such

failures represent lost opportunities to improve on the quality and competitiveness of European society (Guerrieri & Bentivegna, 2011)[1].

Creating successful solutions for HMNs requires awareness concerning the type of HMN to be established, insight into the implications of this particular HMN type, and a systematic approach to gather the needed design knowledge. However, there is a lack in capabilities for designing and establishing purposeful HMNs, because conceptual frameworks and abilities to model HMNs in the context of ICT development are missing.

In HUMANE we aim to provide some of the needed conceptual and methodological support, in the form of a typology of HMNs and an associated method: the HUMANE approach. In this report, we present the second version of the typology and method.

The typology is grounded in a comprehensive literature review, surveying key literature pertaining to a wide range of HMNs (Tsvetkova et al., 2015). Prior to this report, an initial version of the typology and method (Følstad et al., 2015) has been tried out in a set of initial case studies (Lüders et al., 2016). This version of the typology draws on the experiences from these cases, while building on the basis established in the first version. Furthermore, it is complemented with a new version of the HUMANE method, in which we have included support for a design pattern approach to assist in the transfer of knowledge and experience across HMN design projects.

## 1.2 The HUMANE approach

The HUMANE approach is an attempt to provide a conceptual framework for understanding and analysing HMNs, so as to support human-centred design. The foundation of this conceptual framework has the form of a typology, which can be used to characterise HMNs according to eight dimensions, including, e.g., agency, interaction and network size.

The dimensions of the HUMANE typology are domain agnostic, which allows us to see how HMNs share similarities even though they belong to different domains. Identifying similarities on the basis of the HUMANE typology allows for a cross-domain transfer of design experience and knowledge. This is beneficial, as designers and developers more often look towards successful networks from resembling domains for design experience or knowledge, rather than seeking out design experience from networks sharing more generic characteristics. Hence, we believe the value of the HUMANE approach to be an opportunity for transfer of design experience between domains where such transfer has previously been difficult or just not conceived of.

Identifying similarities on the basis of the HUMANE typology allows for a cross-domain transfer of design experience and knowledge. This is beneficial, as designers and developers more often look towards successful networks from resembling domains for design experience or knowledge, rather

[1] See also https://ec.europa.eu/digital-single-market/en/digital-single-market. Originally, the EU developed a strategy around a digital agenda in response to the 2008 financial crisis, initial results indicated the way ahead based on digital inclusion.

than seeking out design experience from networks sharing more generic characteristics. Hence, we believe the value of the HUMANE approach to be an opportunity for transferring the design experience between domains where such transfer has previously been difficult or just not conceived of.

In HUMANE, the transfer of design knowledge and experience is conducted by a stepwise process, starting out with establishing the purpose and objectives of the HMN, profiling of the envisioned HMN according to the HUMANE typology dimensions, engaging in an implication analysis, before extracting design experience and knowledge through a design pattern approach and finally applying the design patterns for assessing and improving on the HMN. We will detail the HUMANE approach in Section 5; an initial overview of the steps are outlined below.

1. Purpose: Explicate the purpose and objectives of the HMN.
2. Profile: Establish the HMN profile through the typology dimensions.
3. Implications: Identify similar HMNs and analyse implications of the HMN profile for e.g. motivation, collaboration, and trust.
4. Design patterns: Extract and transfer design knowledge and experience through a design pattern approach.
5. Evaluation: Assess and refine current design proposals on the basis of the input from the HUMANE approach.

The typology and method is intended to be used as part of a HCD process (ISO, 2010), supporting analysis, requirements, design, and evaluation, supporting the transfer of design knowledge from successful HMNs.

## 1.3 Structure of the report

In this report, we present the second version of the HUMANE typology and method. In Section 2 we present, as background, key outcomes of the work leading up to this version, including the typology dimensions and profiling approach. We then, in Section 3, detail the research objective and approach of this deliverable, and present the refined HUMANE typology (Section 4). Following this, we present the HUMANE method (Section 5) and how this is has been applied for profiling the HUMANE cases (Section 6). Following this, we detail how to analyse implications of the established profiles (Section 7), and subsequently move towards extracting design knowledge and experience from successful HMNs through a design pattern approach (Section 8). The implications and design patterns are generated in response to the six HUMANE cases. Finally, we present an online tool developed to support the HUMANE method (Section 9). Finally, in the conclusion (Section 10), we summarize the work in this report and point forward to the validation and use of the typology and method within HUMANE.

# 2 Background

The second version of the HUMANE typology and method, presented in this report, is based on the HUMANE literature review (D1.1), the HUMANE typology and method v1 (D2.1), and the first iteration of case executions using the first version of the typology (D3.2[2]).

D1.1: Tsvetkova, M., Pickering, B., Yasseri, T., Walland, P., Lüders, M., & Engen, V. (2015). *5MM {ëăűŜY·űλŎ [λűŜ·údzŜ wŜØλŜø*, EC H2020 HUMANE Project.

D2.1: Følstad, A., Eide, A. W., Pickering, J. B., Tsvetkova, M., Gavilanes, R. G., Yasseri, T., & Engen, V. (2015). D2.1 Typology and Method v1, EC H2020 HUMANE Project.

D3.2: Lüders, M., Pickering, J. B., Engen, V., Bravos, G., Yasseri, T., & Tsvetkova, M. (2016). *5oH wŜLJ2ű 2T ŦăűăŭŜű 2T Ŏ·ăŜπăúdzŘλŜă*, EC H2020 HUMANE Project.

The process of developing the typology and method started out with an extensive literature review (D1.1). Here, we established an initial understanding of HMN, four analytical layers for investigating HMNs, as well as an initial set of conceptual primitives to visualize HMNs. On the basis of the literature review, a first version of the typology and method was developed (D2.1). Here, we explicated the key dimensions of a HMN typology as well as a profiling approach. This first version of the typology and method was then applied and validated in a set of six case trials, in the first iteration of the HUMANE case executions (D3.2), providing input on the second version of the method and typology.

In this background section, we present key output from these preceding deliverables.

## 2.1 Defining HMNs

A HMN is defined as a "collective structure where humans and machines interact to produce synergistic effects" (Følstad et al., 2015). In the context of HMNs, a “human” means an entity that behaves like a single person (even if the entity is an organization). "Machine" may be used in reference to both physical and virtual machines, acknowledging that the increases in machine processing capacity, autonomy and flexibility justifies considering both humans and machines as capable of agency in HMNs.

The concept of HMN is to be understood as a perspective for analysis, that is, a way of addressing the phenomenon of humans and machines interacting in networks. The main concern of this perspective is to understand the synergistic effects in such networks and, as importantly, to support the design and prediction of such synergy.

Our understanding and definition of HMN has evolved through the process leading towards the second version of the typology and method. In particular, we now have an increased sensitivity concerning the agency of machine nodes in HMNs.

Through its concern for human and machine interaction, the concept of HMNs covers an area of interest at the interface of (a) networks of human nodes, as considered in organizational theory, and

[2] D3.2 is a confidential deliverable. However, we include findings from this deliverable in Section 2.4.

(b) networks of machine nodes. That is, networks where both human and machine components have agency and interact with each other. Building on the theoretical foundations of socio-technical systems (Baxter & Sommerville, 2011; Leonardi, 2012), machine components are seen as embedded in a context of systems of social and technological entities. Drawing on actor-network theory (Law, 1992), agency is seen as residing in the interaction of human and machines, rather than in humans alone. Following the position of double-dance of agency (Rose & Jones, 2005), in HMN agency is considered both for human and machine nodes.

Whereas any constellation of humans and machines may be said to have synergistic effects of some kind, networks of greater interest in HUMANE are those where the synergistic effects are immediately evident; as they are, for instance, in systems for mass-collaboration. The six HUMANE cases, presented e.g. in Section 6.1, are all good examples of networks with such synergistic effects. For example, in the case of Wikipedia synergistic effects are apparent both as the technology platforms facilitates human collaborators to expand and refine on each others' contributions, and also in terms of the interaction between machine actors (bots) and human actors in maintaining and improving Wikipedia content where, for instance, machine actors may flag the need to expand on a Wikipedia article whereas the human actors collaborate on making the actual expansion.

## 2.2 HMN typology

HMNs span networks of a broad range of purposes and configurations. The possible range is exemplified in the six HUMANE cases: Innovation platforms, consumer-to-consumer redistribution services, emergency management systems, social media verification systems, systems for mass collaboration, and citizen science systems.

Establishing a common analytical framework to cover such a broad range of networks is clearly challenging. At the same time, we believe that the reward for succeeding in establishing such a framework is significant as this will allow the transfer of design knowledge across HMNs of highly diverse purposes and configurations.

In the preceding HUMANE deliverables, we have pursued two approaches to classification: (a) prototypical purposes, and (b) analytical layers and dimensions.

### 2.2.1 Protypical purposes

One approach to classifying HMNs is to take as a starting point established prototypical purposes in a top-down approach, and then seek to describe these. As a starting point for the HUMANE literature review (Tsvetkova et al., 2015), eight such social-machine like prototypical purposes were identified and described through a framework of HMN primitives (See Figure 1). In the literature review, we referred to these prototypical purposes as *ΰèLJŜă*. However, to distinguish these from the types of the more generic typology developed later in the project, we here refer to these as *LJNƷΰƷΰèLJŎƖ·f LJdzNLJƷăŜă*.

In the literature review, we delimited our scope to interactions directly involving humans and machinery. Due to this choice of approach, these prototypical purposes reflect HMNs where

machines support interaction between humans, and only to a limited degree reflect HMNs with complex or dynamic machine-machine interactions. A full-blown set of prototypical purposes should also encompass HMNs characterized by interactions where machine nodes monitor, interact with or modify other machine nodes.

Though limited, this approach to the classification of HMNs proved highly beneficial for conducting the literature review, as it provided a firm basis for search and analysis. The literature review consequently resulted in a relevant and useful overview of current knowledge on the identified prototypical HMN purposes.

At the same time, such a top-down approach is limiting in the sense that the classification is predefined rather than emergent as the result of exploring HMNs according to more generic characteristics. Further, it captures a single type of activity and interaction at a single point in time, failing to capture or facilitate the description or analysis of state to state transitions and their consequences. As the project has progressed, these restrictions have become increasingly difficult to justify. Hence, a more exploratory approach was sought in the first version of the HUMANE typology and method (Følstad et al., 2015), by profiling HMNs through key dimensions.

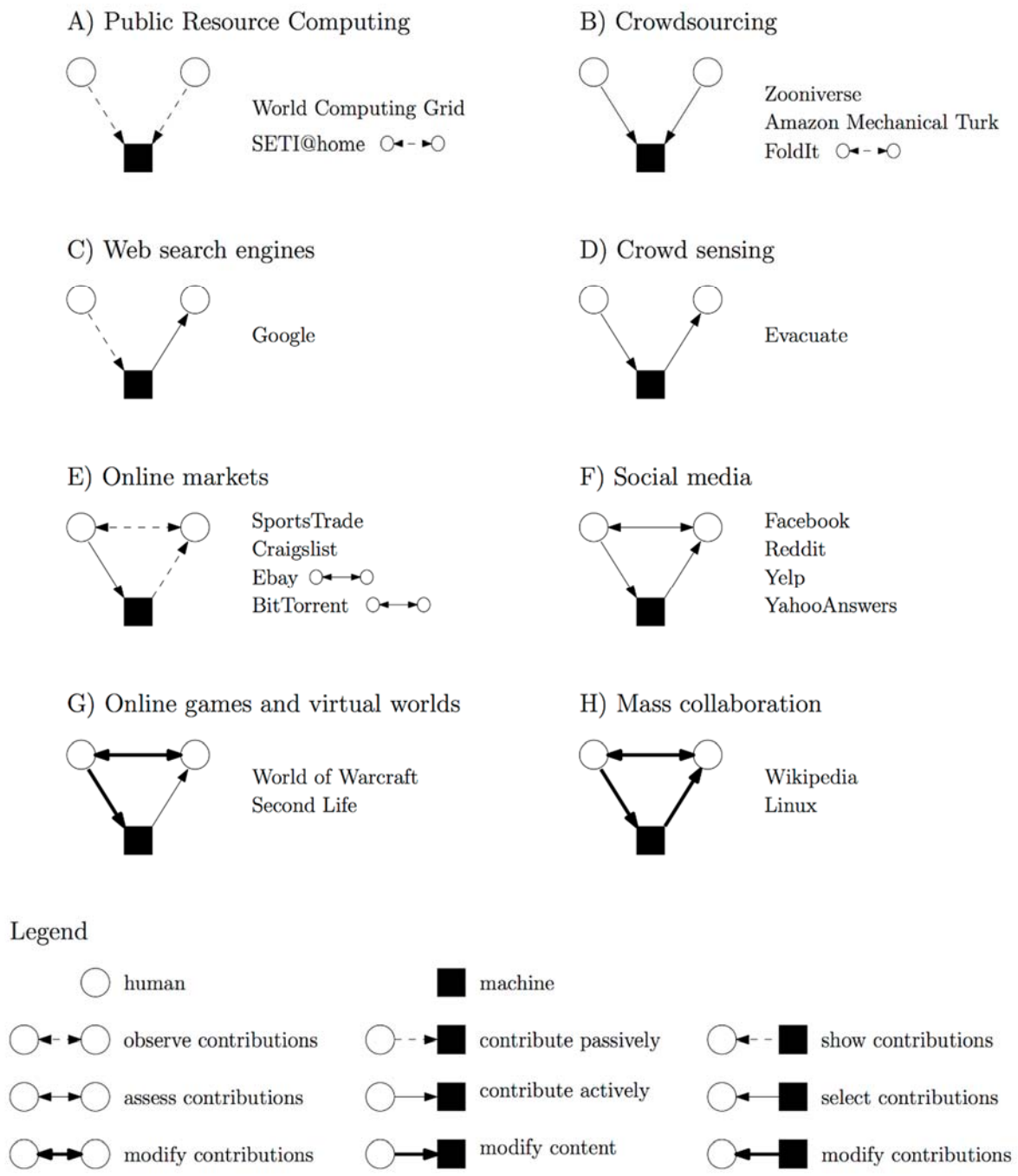



**Figure 1: Prototypical purposes for HMNs; the initial set of HMN types**

In addition to guiding the literature review, the analysis of initial prototypical purposes motivated the development of a set of primitives supporting the visual mapping of HM. Such visual mapping of HMNs was found useful in communicating some case HMNs, though needed to be extended and developed much further to account for the HMNs which we were engaged with as well as which we began to be more familiar with. These extensions will be pursued in later HUMANE work (D3.4).

### 2.2.2 Analytical layers and dimensions

To enable an exploratory approach towards establishing HMN types, we in the first version of the HUMANE typology and method (D2.1) identified eight dimensions intended as critical for differentiating and characterizing any HMN.

The dimensions are structured according to four analytical layers identified in the literature review: actors, interactions, networks, and behaviours. Actors are the nodes in the HMNs. We distinguish between human actors, who may be represented by individuals, organizational roles, or entire organizations, and machine actors, which may be represented by single devices, as well as by complex back-end systems, as long as they behave in the HMN as a single node. The human and machine actors interact in the HMN. Thus, at the interaction layer, we consider the (mediated) human-human interactions, human-machine interactions, and machine-machine interactions. The network layer concerns the integration of actors and interaction into larger compounds and aims towards defining types of such sets of actors and interactions. The behavioural layer concerns the emergent qualities of HMNs. Among these are the changing characteristics or roles of actors depending on network context, emergence of new patterns of interaction in the HMN, new applications of the network, and the overall evolution of the network.

We assigned two dimensions to each layer representing key defining characteristics of HMNs. The typology dimensions are presented in Table 1.

**Table 1: HMN analytical layers and dimensions.**

| Layer | Dimension | Description |
|---|---|---|
| Actors | 1. Human agency | The capacity of human actors in terms of what they can do and achieve in the network |
| | 2. Machine agency | The capacity of machine actors in terms of what they can do in the network, as well as the extent they enable agency in human actors. |
| Interactions | 3. Tie strength | The tie strength between the human nodes of the network |
| | 4. H2M interaction strength | The nature and strength between humans and machines (H2M) in the network |
| Networks | 5. Network size | The number of human nodes in the network |
| | 6. Geographical space | The geographical extension of the network |
| Behaviour | 7. Workflow interdependence | The level of interdependence between the actors of the network. |
| | 8. Network organization | Network organizations with implications for predictability and emergence (top-down vs. bottom-up) |

The *!ŏűž№ă* layer comprises the dimensions of *IdzY'I·y'I·∃Ŝyŏè* and *aI·ŏK\yŜ I·∃Ŝyŏè*. Agency is the capacity of the actors in terms of what they can do and achieve in the network. The two dimensions

enable distinctions between HMNs characterized by varying degrees of autonomy and expressive capacity for human actors, and varying degrees of automation, artificial intelligence and prevalence of robot actors. We do not imply that machines can exhibit agency on the same level as humans. However, building on the theoretical foundations of actor-network theory (Law, 1992) and the theory of double-dance of agency (Rose & Jones, 2005), we see the benefit of conceptualizing machine agency as they may be perceived as having agency (anthropomorphism) (Nass, Lombard, Henriksen, & Steuer, 1995) and may influence and affect the agency in human actors.

At the *LyűŜℕI·ŏűĺ2yã* layer, we consider the strength of *ă2ŏλI·f űλŜă* between human actors as well as the strength of the human to machine relations in the network. Strong social ties may imply familiarity and trust, whereas weak ties may imply social heterogeneity and access to complementary skills and knowledge. While social tie strength is much explored in the literature, human-to-machine interaction strength is less studied. However, as machine agency increases, e.g., with the use of social robots, the interaction strength between humans and machines may become increasingly important to HMNs, as is for example seen in some health-care areas (Broekens, Heerink, & Rosendal, 2009).

At the *bŜűǿ2ℕ ļ* layer of HMNs, several dimensions were considered. In the initial version of the typology, we chose to include the dimensions of *yŜűǿ2ℕ ļ ăλÎŜ* and *ƎŜ2ƎℕI·LJKλŏI·f ăLJI·ŏŜ*, due to their importance for the sustainability of HMNs. Growth in terms of size and spread are today seen as key objectives for many HMNs. In particular, social networks such as Facebook and Twitter rely on network effects both for functional and commercial reasons. Furthermore, network size and geographical space have important implications for other dimensions of the network, such as the need for increased machine agency and decreasing of social tie strength with increasing network size.

Finally, at the *. ŜKI·ØĺI2dzℕă* layer, HMNs are characterized by their levels of workflow interdependence and network organization. Both dimensions concern the HMNs capacity for emergent change. The former concerns the degree to which the actions of the actors in the network are dependent on and need to be synchronized with the actions of others. The latter concerns the degree of bottom-up vs. top-down organization of the network, where in a top-down network the organization is imposed and controlled whereas a bottom-up network is self-organising and organic. For example, emergent change may be more prevalent in networks characterized as bottom-up, where initiatives may spread from the grassroots. While efficient spread and refinement of emerging practices may require a certain level of interdependence between the network actors.

## 2.3 Profiling HMNs

### 2.3.1 Profiling approach

The typology and dimensions alone provide limited support for HCD. To facilitate use by others, we in the first version of the HUMANE typology and method (Følstad et al., 2015) developed an initial profiling framework as summarized in Figure 2.

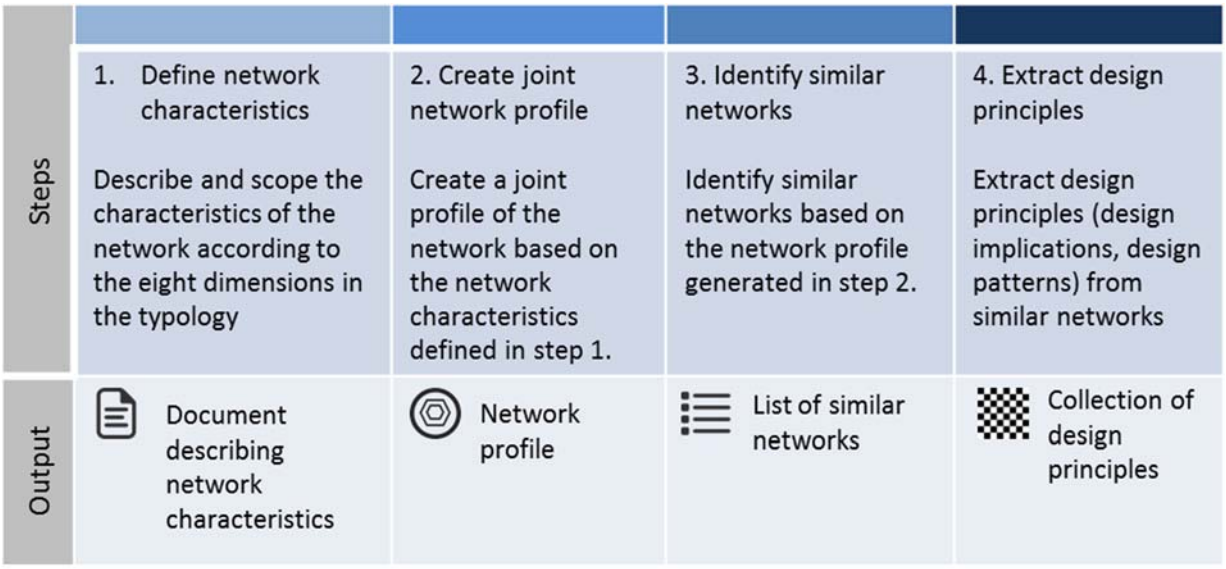



**Figure 2: Overview of profiling framework procedure**

The initial profiling framework comprised four steps, during which various levels of interaction and discussion are possible, and lead to a set of comparative descriptors for a given HMN along with some indication of common HCD design features and issues. In D2.1 (Følstad et al., 2015), we addressed steps 1 and 2. In this second iteration, we are also addressing steps 3 and 4, which is part of the HUMANE method (see Section 5).

Step 1, as shown above, involves an initial estimate of the overall characteristics of the network as defined in regard to the four analytical layers and associated dimensions. Human agency, for example, may be seen as high, but machine agency as low or intermediate; this would relate to a network where most activity is initiated by human actors, with technology components simply responding to their requests. Once some indication of values associated with dimensions has been achieved, collectively these would lead to an overall profile of the HMN (Step 2). Through profiling of multiple HMNs, a set of profiles can be created which may be used to compare similar networks (Step 3). Such cross-network comparisons will potentially identify common features and designs for similar networks (Step 4), revealing parallels in the HCD of HMNs not previously evident.

In the new version of the HUMANE typology and method, the initial profiling framework has been extended to also include (a) analysis of the purpose and objectives of the HMN, (b) network diagramming, and (c)) evaluation on the basis of extracted design principles. However, all the steps

of the initial version of the profiling framework have been kept. See Section 5 for more details on the new version of the profiling framework.

### 2.3.2 Application to the HUMANE cases

The initial HMN profiling approach has been applied in all six HUMANE cases, reported in the deliverable of the first case trial executions (Lüders et al., 2016). The case trials provided a basis for new insight into the design of the HMN design in the six cases. Furthermore, through the case applications, we had a first trial of the applicability of the typology and method.

To exemplify the insights to be gained from applying the typology and methods in the cases, we include a summary from Case 2 (peer-to-peer redistributions markets) below. The summary is based on a paper presented at HCII (Eide et al., 2016). After this, in Section 2.4, we detail our case experiences with the typology and method, gathered to guide our subsequent development.

**Summary of the initial Case 2 application of the HUMANE typology and method (from Eide et al., 2016)**

The HMN typology and profiling framework was applied to the Conserve & Consume project (http://conserveandconsume.wordpress.com/), which focuses on Consumer-to-Consumer (C2C) reselling markets. Here, we utilized the dimensions of the typology to analyse and discuss a recently launched iOS/Android app for such markets. The app was designed to enable direct selling of goods: sellers snap a photo of the item for sale, add a maximum of 58 character description, and publish the ad. Potential buyers see a thumbnail of the image, the distance to the seller, the price, and the time since the ad was published, and can then choose to open the item to read the description. The analysis has included data from developer and stakeholder collaboration, user interviews, as well as content analyses of classified advertisements posted by users. The resulting profile is shown in Figure 3. Here, we will focus on the dimensions network size, geographical space and machine agency.

As is seen in the profiling, network size and geographical space are scored at different values (desired and current profile), reflecting the developer and stakeholder aim of increasing network size and eventually to become an app with global reach.

**Figure 3: Joint HMN profile for the C2C reselling platform[3]**

Machine agency is considered to be intermediate, with an important role for human nodes in the network. In its current version, the app performs a small set of functions, notifies users, and influences user-experience. The latter is apparent in how the app is designed to take off as much of the work-load in creating ads as possible, and in the features helping users discover items, and follow peers. End-user interviews demonstrate how users appreciate these functions, making the app functional, efficient and enjoyable both for users as sellers and buyers.

From working with the typology and profiling, several aspects of the network design became apparent as a consequence of how network size, geographical space and machine agency interrelate.

First, the desired increase in network size may require increased, or improved, machine agency to facilitate emergent change. As the group of typical users of the network evolves, the categories of items sold through the network also need to evolve. To support this, the developers prioritize functions for automatic classification of content in ads based on image- and text-recognition, and supports automatic updating of filtering categories to keep up with the evolving characteristics of the stuff sold through the marketplace. Hence, the link between machine agency, network size, and network capacity for emergent chance (related to the behaviour layer) has become apparent to the Conserve and Consume project through the profiling activity.

Second, whereas the app has a national reach, with some occasional users present also across the world, networks of human nodes seem to be established in a more local geographical contexts.

[3] The joint profile for Case 2 differs from that presented in the HUMANE technical report ¢èLJ2f2Ǝè I·yŘ YˆŜűK2Ř ØM [5], due to updates following data collection and collaboration with the users and stakeholders.

Transactions between buyers and sellers are typically conducted through physical meetings, and end-users requested improved functions to filter items for sale with respect to their local area. Such user-patterns and preferences call for design supporting local C2C, even for HMNs that on an aggregate level are global.

Third, the profiling activity provides terminology for discussing characteristics, and enables stakeholders to consider both the current state of an HMN and the desired state. For example, whereas the importance of supporting geographically proximal C2C interactions, content-analysis of ads also indicates some heterogeneity in the user-patterns: While geographical proximity indeed appears important for transactions to be completed, analyses of users' ads show that close-by items not necessarily get more views than far-away items. This may point both towards an unresolved challenge concerning filtering in the C2C reselling platform, but may also imply opportunities for supporting other C2C interactions than those that are merely local.

## 2.4 Findings from the initial case executions

The second version of the HUMANE typology and method presented in this deliverable has been developed in consideration of the experiences from the case executions of the first version typology and method.

In accordance with the project plan, experiences from these case executions have been gathered and summarized on two levels. First, through the deliverable presenting the findings from the six cases. Second, from a project-internal focus group following the case executions. In the following we present the main findings.

### 2.4.1 Findings from initial case executions

The key findings from the initial case executions are gathered and summarized here from the confidential HUMANE deliverable D3.2 (Lüders et al., 2016). The cases served to validate the usefulness of the first version of the profiling approach, and to validate the completeness and adequacy of the eight dimensions of the typology. In addition, the cases served to provide input concerning implications of HMN profiles.

**The profiling framework** was found to be engaging to use, and useful for analysis of end-user data. However, concern was voiced regarding possible oversimplification in the profiling. This may be related to the first version of the HUMANE approach not yet connecting the dots between the HMN-profile and the social implications and design implications. The first version of the HUMANE approach was intended to provide an increased understanding of a particular HMN, yet was at this stage not explicit on what these HMN-profiles imply for design or for nodes in the network.

**The typology dimensions** were all found to be relevant. However, the findings show that end-users need simpler and more unambiguous definitions of the dimensions, and guidance in reliably

evaluating the value on each dimension. It was also suggested that the set of dimensions may need to be extended, e.g. to cover machine-to-machine interaction.

On the basis of the findings, three key goals were posed for the second version of the typology and method:

1. Designers and developers without prior knowledge with HUMANE should be able to grasp the intention and purpose of the HUMANE framework.
2. Designers and developers without prior knowledge with the HUMANE dimensions should be able to grasp the intended scope of the dimensions and scales rapidly and reliably apply these to their HMN.
3. The HUMANE profiling exercise should result in design-recommendations, and point to relevant consequences for e.g. motivation, trust, enjoyment, sustainability and interaction between human as well as machine nodes.

### 2.4.2 Findings from focus groups following initial case executions

Following the initial case executions, a session of feedback interviews in the form of a focus-group involving the HUMANE project participants was conducted at project plenary meeting, January 2016. This activity verified and complemented the findings provided in the deliverable from the first set of case executions.

A detailed overview of the output from the focus-group is presented in Appendix A. In the following we present the main points.

**The profiling framework** was found to be useful as an analytical tool and also, potentially, for theoretical purposes. However, it was reported as problematic that the link between the profiling and the typology on the one hand, and the implications of the profiling on the other, was weak. It was also reported as problematic that the profiling seemed to require previous HCD competency.

**The typology dimensions** were reported to be relevant. However, some of the dimensions were in need of clarification. In particular, the dimensions should be readily understandable also without previous knowledge of the HUMANE terminology. Also, the reliability of the dimension assessment was questioned. It was also voiced concern regarding the need to extend the set of dimensions to better cover machine-to-machine interaction.

On the basis of the findings, a set of recommendations were posed for the second version of the typology and method (see Table 2). These extend and complement the findings from the report on the first iteration case studies.

**Table 2: Recommendations and suggestions for the second version of the typology and method**

| # | Recommendations | Description |
|---|---|---|
| 1 | Show how the dimensions and typology has consequences for trust, privacy, shared responsibility, and motivation | The consequences of the dimensions and typology for trust, privacy, shared responsibility, and motivation is not made sufficiently clear. In the second version of the typology, we should explicitly address how different states of the typology dimensions, or different HMN types, affect these consequences. |
| 2 | Reduce ambiguity in scales | Effort needs to be made to reduce the ambiguity in the dimension scales, to a point where we reach adequate inter-rater reliability when profiling the same HMN with different analysts that all know the HMN well. |
| 3 | Update dimensions | The current set of dimensions needs to be updated. The current dimensions may be kept, but dimensions that are difficult to understand or apply should be clarified and adapted. |
| 4 | Provide support to identify HMN types | The current support to identify HMN type following profiling is weak. This needs to be strengthened in the second version of the typology. One approach to achieve this could be to profile a large number of HMNs and identify types on the basis of cluster analysis. |
| 5 | Provide support to elicit and access design implications | In the second version of the typology, we need to support designers and developers getting design implications from the profiling. |
| 6 | Validate the typology | The typology needs further validation. Firstly, we need to validate the completeness of the typology; are all key dimensions included? Secondly, we need to validate the value of the typology and profiling framework in the context of concrete design processes. |
| 7 | Clarify the role of the typology in the HCD process | The typology is intended as support in HCD. As of now the link to the HCD process is insufficiently clarified. We need to make this clarification in v2 of the typology. |

The focus groups also returned a set of suggestions for possible future directions for the typology and method. Suggestions of particular note included:

- **A HUMANE profiling game?** Profiling HMNs was found to be engaging. Maybe an online profiling game could be an interesting way to engage the HUMANE target audience and gather data on HMN profiles.
- **A HUMANE dialogue tool?** The typology and profiling framework may support cross-disciplinary communication and dialogue. It may be considered to pursue this potential use of the typology, for example by developing a dialogue tool on the basis of the profiling framework.

- **Requirements specification support?** An extension of the above dialogue tool, could be to apply the profiling framework for requirements specification. For example as a supplement to specifications based on UML.
- **Visualize change?** Possibly the typology dimensions could be used to study and visualize change. For example, on the basis of historical data for a particular HMN (Wikipedia was mentioned), to gain insight into how the dimensions of the typology co-vary and how this affect design implications.

# 3 Objectives and approach

In the preceding sections, we have motivated our work with the HUMANE typology and method, and provided an overview of relevant background. Before moving on to presenting this work we briefly summarize our objectives and approach.

## 3.1 Objectives

A key objective of HUMANE is to develop a typology of HMNs that is useful and easily applicable in the design of future ICT. Towards this end, in D2.1, we established a profiling approach where HMNs may be characterized on the basis of eight dimensions. Furthermore, we outlined how these dimensions can be used to identify types of HMNs, and how a tool-supported method may apply the profiling approach to gain insight into relevant implications and design knowledge in the form of design patterns.

For the work presented in this report, we have following objectives:

- **Dimensions:** Refine the typology dimensions on the basis of the experiences from the initial set of case executions.
- **Method:** Provide guidelines on how to apply the typology and profiling approach to access and use design knowledge throughout the phases of the HCD process, reflecting the experiences from the initial set of case executions. Clarifying the links between the HUMANE method and the HCD methodology.
- **Implications:** With the basis in the literature review, the first set of HUMANE case executions, and other relevant background, we will extract and discuss key implications of different HMN profiles.
- **Design patterns:** Use a design pattern approach to explicate design knowledge for particular HMN types. The provided design patterns will, in particular, target needed design knowledge in the six HUMANE cases.
- **Tool-support:** Establish interactive tool-support for profiling HMNs to (a) identify similar HMNs and (b) access related design knowledge.

The work towards each of the listed objectives is presented in the subsequent sections

In the final section of the deliverable, we will detail how this version of the typology and method should be validated in the second iteration case studies.

### 3.2 Approach

The approach for the work towards the listed objectives consists of three main steps. First, the typology dimensions and method has been refined and extended following the findings from the initial case executions. Second, the typology and method has been applied to the six HUMANE cases for initial identification of implications and design patterns. Third, a prototype version of an interactive tool to support the HUMANE method has been developed.

- **Refining the typology dimensions and method:** The findings from the initial case executions have been thoroughly reviewed. On this basis, the typology dimensions have been refined, by specifying three to four aspects pertaining to each dimension. Furthermore, the method has been extended and refined to encompass needed additional steps. The work towards this is presented in Sections 4 and 5. Furthermore, in Section 6 we provide an overview of how the typology has been applied for profiling the six HUMANE cases
- **Towards implications and design patterns:** Elements of the refined typology dimensions and method has then been applied to move towards the identification of types on the basis of HMN profiles, implications, and design patterns. This work is presented in Sections 7 and 8. Method details are presented in association with each of these strands of work.
- **Tool support:** To make the HUMANE typology and method easily available also outside the HUMANE project, an interactive tool has been developed. The tool is in a fully functional prototype version, mainly targeting the profiling of HMNs and the transfer of design knowledge and experience through design patterns. The tool is available online[4], and is also presented in Section 9.

## 4 Typology dimensions refined

While the typology dimensions were found relevant and useful, the case experiences from the first iterations indicated a need for updating and refining the dimensions to make assessment more reliable, and to make some of them more easily understandable.

To improve the clarity in the dimension descriptions, as well as the reliability in dimension assessment, a set of aspects were defined for each dimension. These aspects were developed during an iterative process within the HUMANE consortium, and aim to address the key defining criteria for each dimension. The aspects should also support a more reliable assessment of each dimension. Instead of assessing a HMN on a general dimension, the HMN can now be assessed on a set of more precise aspects. The reliability of the dimension scores is strengthened by seeing each dimension score as the average of the scores for its associated aspects.

In this section we first present the refined typology dimension and aspects. We then present the process leading up to the final set of aspects.

[4] A temporary address for the tool is https://networkprofiler.recordlivinglab.org. The permanent address will be https://networkprofiler.humane2020.eu

## 4.1 Dimensions and aspects

The refined typology dimensions and aspects for the HUMANE typology and method v2 are presented in Table 3. Each dimension is defined by three or four aspects.

**Table 3: Typology dimensions refined through characterizing dimension aspects**

| DIMENSION/ASPECT | DESCRIPTION |
|---|---|
| **D1. Human agency** | **The capacity of the human actors in terms of what they can do and achieve in the network.** |
| D1.1 Varied activities | People can perform a diverse range of activities in the HMN |
| D1.2 Influence | People are able to interact freely and influence other participants in the HMN, whether human or machine |
| D1.3 Open activities | The activities people can perform allow them to express their personalities, behave diversely, freely, creatively and even use the HMN unpredictably |
| D1.4 Self-decided goals | People can use the HMN to help them achieve goals (set by themselves) that they may otherwise not be able to achieve, e.g., via other people or technology in the HMN |
| | |
| **2. Machine agency** | **The capacity of the machine actors in terms of what they can do in the network, as well as to what extent they enable agency in human actors.** |
| D2.1 Varied activities | Machines (technological actors/agents) in the HMN can perform a diverse range of activities |
| D2.2 Influence | Machines can interact freely with - and may influence other participants in the HMN, and may help human agents achieving goals they cannot achieve on their own |
| D2.3 Open activities | The activities the machine agents can perform are open, giving opportunity for dynamic and perhaps unpredictable behaviour |
| D2.4 Human-like | The behaviour of the machines in the HMN can be seen as intelligent and autonomous, with human-like appearance or behaviour |
| | |
| **3. Tie strength** | **The tie strength between human nodes in the network.** |
| D3.1 Intimacy | People in the network are typically connected to one another by friendship or other close affiliation |
| D3.2 Duration | Relationships betweein people in the HMN typically last a long time |
| D3.3 Reciprocation | People in the HMN are typically mutually supportive |
| | |

| **4. H2M interaction strength** | **The nature and strength of the interaction between humans and machines (H2M) in the network.** |
|---|---|
| D4.1 Trust | People strongly trust the machines in the HMN |
| D4.2 Reliance | People tend to accept what the machines of the HMN do and would only rarely intervene |
| D4.3 Dependency | People depend on the machines in the HMN to achieve their goals |
| | |
| **5. Network size** | **The number of human nodes in the network.** |
| D5.1 Uptake | The HMN includes a broad range of users |
| D5.2 Number of users | The HMN includes a large number of users |
| D5.3 Growth rate | The HMN has grown, or is expected to grow very rapidly |
| | |
| **6. Geographical space** | **The geographical extension of the network.** |
| D6.1 Transnationality | The HMN includes members and sites in many countries or states |
| D6.2 Cultural diversity | The HMN includes members or sites across different cultural groups |
| D6.3 Geographical reach | The HMN spans large geographical areas |
| | |
| **7. Workflow interdependence** | **The level of interdependence between actors of in the network.** |
| D7.1 Coordination | Actitity in the HMN require that people interact in a highly coordinated manner |
| D7.2 Interdependence between actors | The actions and communication between people in the HMN very much depend on the actions and communications of others |
| D7.3 Collaboration | There is extensive collaboration between the people in the HMN |
| | |
| **8. Network organization** | **Network organization with implications for predictability and emergence.** |
| D8.1 Top-down organization | The organization of the HMN is highly centralized or predetermined |
| D8.2 Stability | The HMN has a stable organization that does not easily adapt to different conditions |
| D8.3 Regulation | The HMN is regulated by thorough and detailed policies |
| | |

For each of the aspects pertaining to the respective dimensions, the approach we have taken is to score each in a range of 0 to 100, with 0 indicating strong disagreement with the respective statement (i.e., it is not the case) and 100 indicating strongly agree with the respective statement (it is fully the case). The score for each dimension is then calculated as the mean of the scores for each of the dimension's respective aspects. This can then be mapped to the scales of the spider diagram visualisations we introduced in D2.1 (Følstad et al., 2015) – see e.g. Figure 3.

Our choice of scale (from 0 to 100) is intended to be thought of as reporting a per cent agreement to the statement, an approach which is often used in combination with sliders for reporting scores.

### 4.2 Developing the aspects for each typology dimension

The list of aspects presented in Table 3 was the output of an iterative process involving all project partners. The process started out with an initial proposal for the aspects. The aspects were then distributed to the project partners and discussed. The key criterion against which to discuss the aspects was compliance with the description of the corresponding dimension in the initial typology and method (D2.1). Following the discussions, the set of aspects was updated.

The refined set of aspects was then used in a trial profiling of three HMNs (three of the HUMANE use cases). The trial profiling was conducted by four persons from the HUMANE consortium, doing the profiling independently. Following this, inter-rater reliability was assessed by means of Pearson correlations between the raters and found insufficient (mean correlation among any two raters: $\mathbb{N}$ = 0,25). The aspects with lowest inter-rater agreement were identified and reworked through sharing of experiences and discussions among the profilers.

The new refined set of aspects were then used in a second trial profiling of three other HMNs (the remaining three HUMANE use cases). As before, the trial profiling was conducted with four persons, doing the profiling independently. Inter-rater reliability had improved to the extent that the aspects now may be suitable for reliable profiling (mean Pearson correlation among any two raters: $\mathbb{N}$ = 0,70).

## 5 The HUMANE method

The HUMANE method describes how the HUMANE typology can be used in practice. In D2.1 (Følstad et al., 2015), we established the scope and objectives of the method, as well as discussing the general usage patterns of the method, e.g., for designing new HMNs or evaluating / updating existing HMNs. This second iteration is more specific in terms of how the outputs from the HUMANE project can be used as part of the human-centred design process, taking into account the experiences from the first set of case study trials executed in the project (Lüders et al., 2016).

In D2.1 (Følstad et al., 2015), we defined the first version of the HUMANE typology and proposed a profiling approach; both of which have been discussed in Section 2. There are two significant extensions to the method in this second iteration: 1) supporting the analysis of implications of network designs and 2) helping extract and transfer design knowledge and experience through a

design pattern approach. In this section, we maintain a more high level view of these aspects, which are covered in detail in Sections 7 and 8.

## 5.1 Background and scope

HUMANE is focusing on providing ICT design support via the ISO standardised methodology on human-centred design (HCD) for interactive systems (ISO, 2010), which is depicted below in Figure 4. This methodology aims at including a human-centric perspective into the software development process, which comprises four phases, omitting the initial phase of planning the human-centred design process (Maguire, 2001):

- **Context analysis:** understanding the environment for which the HMN will operate, identifying stakeholders, surveying existing users and establishing characteristics the HMN should support. This forms the basis for identifying requirements in the following phase.
- **User requirements:** requirements elicitation and analysis for the HMN, which includes *iyúŜW I·tlI·* stakeholder analysis and cost-benefit analysis, and establishing clear statements of design goals and benchmarks that the designs can be tested against.
- **Design:** an iterative process of producing design ideas, including mock-ups and possibly simulation of the system with the aim to rapidly seek feedback to progress the designs.
- **Evaluation:** prototypes from the previous phase are evaluated against the benchmarks established in the user requirements phase. The prototypes may be paper-based or software-based. The purpose is to measure and demonstrate how well the objectives have been met, as informing potential re-designs.

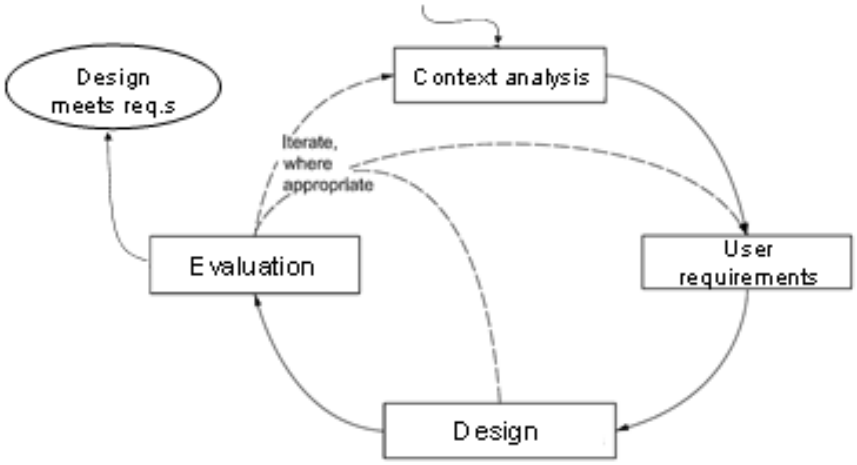



**Figure 4: Human-centred design process.**

The HCD methodology is not intended to replace software development methodologies, but to complement them in order to involve the user's perspective more fully. Similarly, the HUMANE method is intended to complement the HCD methodology via the use of the HUMANE typology.

## 5.2 Supporting the needs of HMN designers and developers

In HUMANE, the aim is to support the needs of the people who are designing and developing for HMNs. We target practitioners of HCD in particular, and we emphasise that this methodology is intended to include cross-disciplinary design participants. Therefore, although there may be a focus on non-technical human-centred aspects, this methodology does apply to and include the more technically focused software engineers and system architects. This latter group of system designers may not be mindful of non-technical aspects of systems they are designing, which was evident in one of the HUMANE case studies discussed in D3.2 (Lüders et al., 2016)[5]. In contrast, human-centred designers may not be mindful of technical architectures and other technical implications pertaining to software engineering. Therefore, we emphasise here the benefit of the HUMANE approach to cross-disciplinary communication, supporting the non-technical and technical designers in understanding better the implications of the design options that are developed.

One of the key phases of the HCD methodology covers requirements elicitation, which should establish what kind of system that should be built. For example, the technical architecture[6] to underpin the HMN. However, there is often a significant challenge in moving from requirements to an architecture design (Boehm, 2000; Nuseibeh, 2001). There is no direct mapping possible and the relationship between the two is considered to be intertwined (Nuseibeh, 2001). That is, not only do the requirements inform the architecture, but at any given point in time, the architecture design will in turn inform requirements. This relates to one of the key challenges highlighted by (Boehm, 2000), and (Nuseibeh, 2001) observe that some software development organizations start from architectures because requirements may not really emerge until users have been able to view early stage models or prototypes. The HUMANE approach should benefit HMN designers, whichever route they take, by encouraging early-stage network profiling and drawing network diagrams to be used in the requirements phase, which was seen as valuable according to feedback from the HUMANE case studies (Lüders et al., 2016).

In terms of design for an HMN, it is important to understand both technical and non-technical aspects or implications of the network and how it's anticipated to be used. Non-technical implications include, for example, user adoption, user behaviour, participation, sustainability, trust, motivation, collaboration, safety and understanding any dynamic characteristics of the network that need to be supported by the HMN. Technical aspects include, for example, scalability, robustness / reliability, failover, responsiveness, availability, interoperability, integrity and security. The HUMANE method encourages HMN designers to consider such implications and aspects specifically. For example, trust is one key factor that has been analysed in HUMANE, particularly in terms of the implications different levels of machine agency and human-to-machine interaction have on trust.

The HUMANE method aims to help designers and developers reflect on key potential issues and discuss potential implications of an envisioned or actual HMN. It is generally not possible to provide

[5] D3.2 is not a public deliverable, but the feedback from the case studies are summarised in Section 2.4.1.
[6] For simplicity, we use the word 'architecture' here in a broad sense, to cover hardware (infrastructure, sensors, etc.) and software components.

definite answers to designer's questions, as the implications for one HMN of certain characteristics may be significantly different to those of another HMN even though they appear to be similar. Therefore, the main contributions of the HUMANE method are a set of tools for describing and analysing HMNs, to help bring about new insights by guiding designers through discussion and reflection.

## 5.3 Overview of the HUMANE method

The HUMANE method comprises five steps (see Figure 5). Each step depends on the former, similarly to the phases of the HCD methodology. The figure below also shows what phase(s) each step targets.

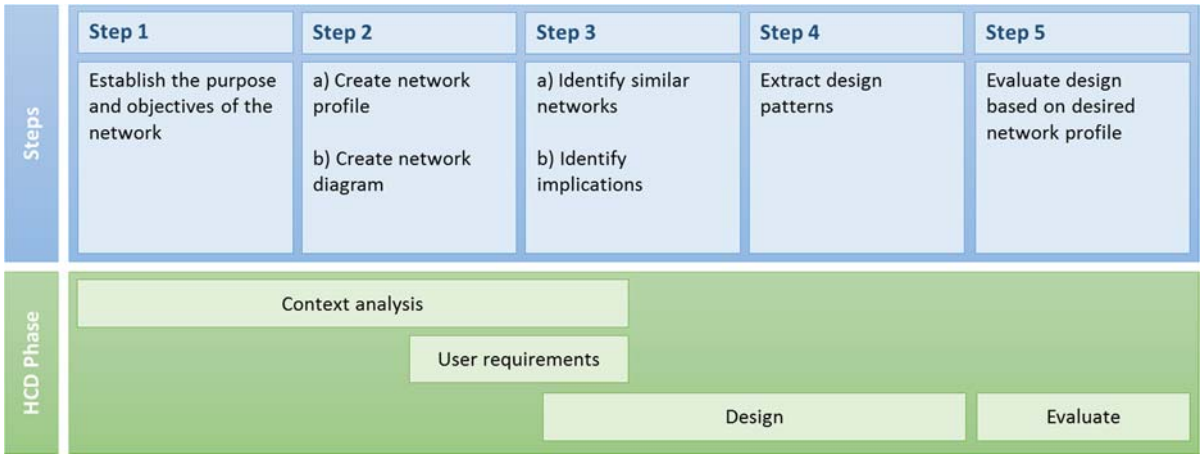



**Figure 5: The HUMANE method mapped to HCD methodology.**

### 5.3.1 The five steps

The five steps are outlined here, and detailed in Section 5.4 below.

**Step 1:** Identify and describe the purpose of the HMN, broken down into objectives that can be used when assessing implications of design options.

**Step 2:** This is where we a) create a network profile of the HMN, using the HUMANE typology. This step should also b) create an initial network diagram, depicting the known agents and how they are connected to form the HMN. The step overlaps the two first phases of the HCD methodology.

**Step 3:** Based on the HMN profile and network diagram from Step 2, a) identify similar networks as a basis for transfer of design knowledge and experience, and b) analyse the implications the HMN profile and network diagram with consequences for user requirements.

**Step 4:** Having found similar networks in Step 2, those that successfully achieve things the HMN under design (or re-design) should be analysed with regards to potential design patterns they have implemented that may be of benefit.

**Step 5:** Based on the desired network profile, this can be used as a benchmark for evaluating the design options.

The steps are seen as supporting a creative or exploratory design process, and cannot be expected to be applied mechanically to achieve the desired results. Rather the steps facilitate discussion and reflection pertaining to e.g. implications of the HMN and transfer of knowledge and experience from successful HMNs. This is discussed further below.

### 5.3.2 The use of the HUMANE method in the HCD methodology

The use of the profiling and network implication analysis in the HUMANE method is intended to be applicable in the different phases of the HCD process. Their use is not constrained to a single, or multiple specific phases. This does also depend on how designers and developers follow the HCD methodology in practice. For example, the HUMANE method may help refine the analysis done in the 'context analysis' phase as part of the 'user requirements' phase. However, for simplicity, we will present the purpose of the profiling and network analysis in terms of the key phases in which they are intended to be used.

To provide an overview here, the HUMANE method can be applied in the different phases of the HCD methodology as follows:

- **Context analysis:** First, establish the purpose and objectives of the HMN, which will provide the necessary basis for assessing implications in later phases (step 1). Second, creating an initial network profile (step 2a, using the HUMANE typology), which provides the basis for identifying the HMN network type that can be used later to identify similar networks and extract design patters. Third, creating a network diagram (step 2b), which illustrates the entire HMN in terms of the different actors and how they are connected. This helps depict responsibilities, which was identified as one of the key benefits in D3.2 (Lüders et al., 2016).
- **User requirements:** The visual presentation of the network, created in the previous phase, can be reused and updated here for cross-disciplinary communication of the HMN, as found to be a key value in D3.2 (Lüders et al., 2016) for requirements elicitation (step 2b).
- **Design:** Based on the network profile from step 2a), identify similar networks (step 3a) and extract design patterns for ICT solutions supporting successful HMNs of the same type as the envisioned network (step 4). Also, based on the network diagram created in step 2b), identify implications pertaining to the connection between agents in the network, whether machines or human, such as trust and sustainability (step 3b). These implications can be used to facilitate the identification of suitable design patterns, as per step 4.
- **Evaluation:** Analytical evaluation and critical reflection on the design, on the basis of comparing or contrasting the design to identified HMN implications and design patterns (step 5).

## 5.4 Application of the HUMANE method

In this section we detail the five steps of the HUMANE method, with examples of how the method can be applied.

### 5.4.1 Step 1 – purpose and objectives

It is important to first specify the objectives of the HMN as any analysis and evaluation of design options would depend on this in order to interpret implications. The HMN is effectively the means of fulfilling those objectives. Figure 6 provides a high level view to help show how the purpose underpins the objectives, which in turn inform the chosen business models and HMN, and, ultimately, the characteristics of the HMN. We shall not delve into business models here, but it is important to be aware of them as there is a relationship between them and the HMN, especially over time as a HMN may evolve through its lifetime. For example, as demand increases, both the business models and HMN itself are likely to need to evolve in order to continue to be sustainable. Therefore, design decisions should consider, where possible, any long-term expectations and plans for business models, to ensure that future demand can be supported as easily as possible.

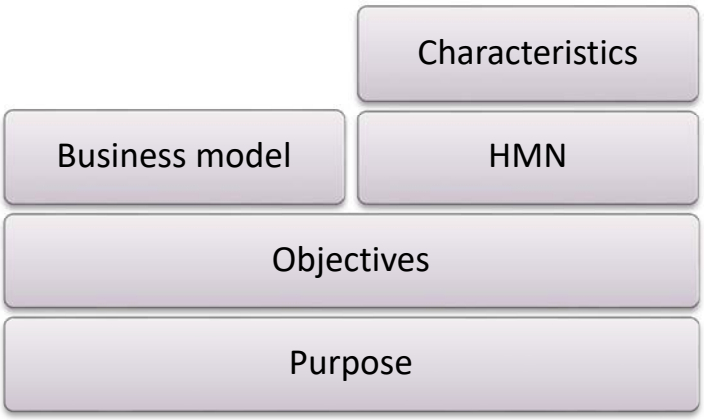



**Figure 6: A high level view of how the purpose of a HMN underpins its characteristics.**

To clarify the distinction between these two, you can, for example, define the purpose by answering *ØKè* the network exists, or should exist. The key means of achieving the purpose can thereafter be broken down into objectives. Moreover, the purpose of a network is likely to remain the same over time, while the objectives, business models and the HMN itself are likely to change. Although we use a stack visualisation in Figure 6, we do note that the different layers may cross-influence each other rather more dynamically. For example, technical limitations or new technical developments may either constrain or open up business model opportunities, which in turn may lead to new or modified objectives to achieve the purpose of the HMN more effectively and/or efficiently.

We note here that there are different levels in which one can view the purpose and objectives of a network. For some networks, there may be a higher level, business related, purpose of a HMN. Let's take YouTube as an example. We could, for example, say that the purpose of this HMN is to allow people to view and share videos. We may refer to this as an external view of its purpose. As such,

this may indeed be an important view to sustain in order to maximise the user base. Also, for a HMN designer, this view may be sufficient. However, as an internal view, YouTube is one of Google's ways of serving ads for financial income. Ads can be tailored to videos, which, in turn, would be implicitly tailored to people who are interested in watching the videos. Following this, you can specify objectives such as encouraging people to stay on the platform for as long as possible in order to serve more ads. Further, being able to classify the video content allows for people's interests to be derived on the basis of what they watch, which can contribute towards profiles of people that Google can use to tailor ads on other Google services.

As the HUMANE approach aims to support HMN designers in understanding the implications of design options and offer advice in the form of design patterns, potential implications need to be interpreted in the context of the purpose and objectives of the respective HMN. This is important to consider as implications for a particular HMN may not be applicable to other HMNs, even if they appear to be similar. Let's take enterprise online communities as an example to explain why this is. IBM Connections is a platform that hosts a magnitude of enterprise communities within IBM. Although each community is facilitated by the same platform, and, thus, have the same features, they may have distinctly different purposes and objectives (Rowe et al., 2012). For example, there are 'Idea Labs', which are meant to be short-lived communities for people to brainstorm a particular topic. If we just take one of the dimensions of the HUMANE typology, tie strength, the desired characteristics of such a community would be different to that of 'Communities of Practice', which are long-lived groups of people who share information and perform networking around a particular topic. In the former, stronger ties are important as it implies high intensity, intimacy and reciprocation (Granovetter, 1973), while in the latter, weaker ties are not an issue and may actually have positive implications for sharing novel information, as discussed in Section 4.3 of D2.1 (Følstad et al., 2015).

### 5.4.2 Step 2 – HMN profile and network diagram

After the purpose and objectives of the HMN have been specified, the HUMANE typology can be used to help specifying the characterisations of the network. This may, at first, be an initial view of what is expected at the time, which may be further refined in the different phases of the HCD methodology (user requirements and design in particular).

#### 5.4.2.1 Create HMN profile

Part of this step is creating (and later maintaining) a profile of the HMN. This can be done by assessing the HMN on the aspects associated with the dimensions of the HUMANE typology, as detailed above (Section 4.1). From the questions an aggregated score for each dimension can be calculated and visualised, e.g., as a spider diagram, which is the approach taken in the HUMANE project.

If one is re-designing an existing HMN, two profiles may be created; one for the current network and one for the desired network. The latter can then be used in the evaluation phase, as discussed below

in Section 5.4.5. If it's a new network, this profile should reflect the properties expected and desired of the network under design.

At this stage, it's important to establish if the HMN would have different states. If so, are the transitions between the states important? Does the state change size and/or complexity of the HMN?

In practice, multiple network profiles may be created. For some networks it may be appropriate to make aggregations across the different agents in the system. However, in networks where some agents (of the same type) exhibit very different properties, e.g., in terms of human agency, it may be necessary to reflect this by creating multiple profiles for the different key stakeholders that should be analysed. This should be done where it's deemed important to for deriving implications, for example, where aggregations may hide important information.

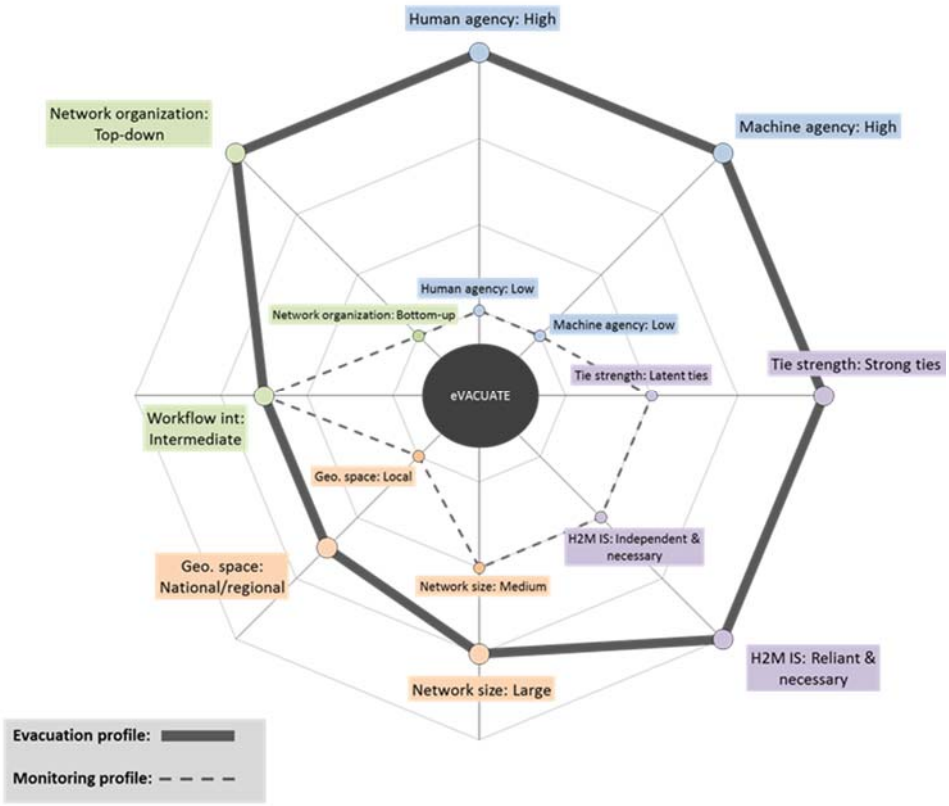



**Figure 7: Example two-state HMN profile – eVACUATE.**

### 5.4.2.2 Create network diagram

Also, in this step, we recommend drawing a network diagram of the HMN, comprising the different agents (both human and machine) and depicting how they are connected. We have proposed a set of network primitives in D1.1 (Tsvetkova et al., 2015) that can be used to depict HMNs. See an example

diagram using the primitives for the eVACUATE case study in Figure 8, below. However, also an informal approach may work well, especially as it may be more intuitive for different stakeholders involved in the design process who are non-technical. See an example of this in Figure 9, which we will build upon in the following steps.

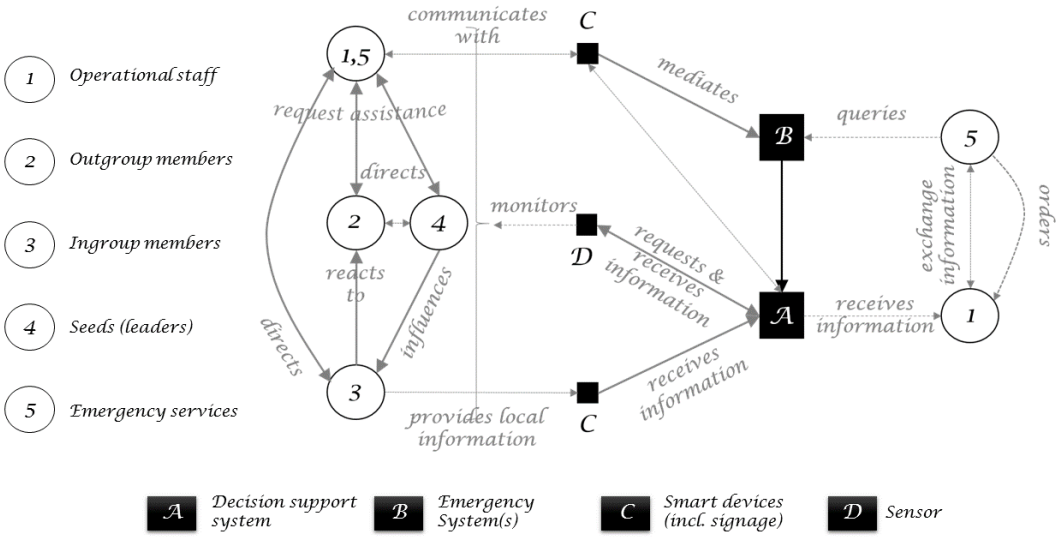



**Figure 8: eVACUATE network diagram for context analysis using D1.1 primitives.**

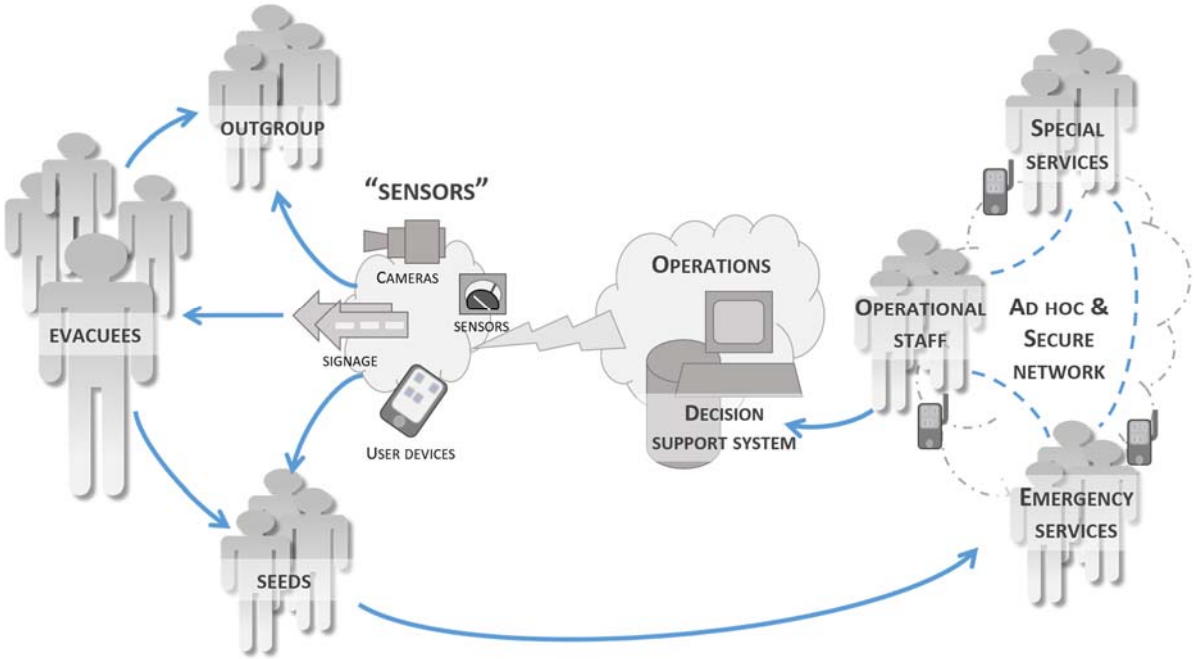



**Figure 9: eVACUATE network diagram for context analysis using informal approach.**

Drawing such a diagram helps illustrate and communicate the scope the HMN and the responsibilities of agents and how they may influence other participants in the network. Regarding the scope, the network diagram may depict other external networks or agents that make up the wider network. In doing so, part of this exercise involves identifying which agents may exert influence on others, and, to some degree, how. The focus for the design activities should be on the agents that form part of the HMN that directly interact with the system that is designed and the immediate components that form part of it. That is, agents that can use, control or influence core parts of the HMN or its objectives. For example, in the eVACUATE case, special services and emergency services are depicted as actors, but are not part of the HMN for the most part. However, they may be involved in managing a crisis situation.

At this stage, it is also useful to explore whether there are distinctions that should be made regarding certain types of agents that may otherwise be reflected as one type of agent. For example, are there types of human participants or groups of participants that would exert a particular behaviour or may be able to perform activities others may not? In the eVACUATE case, we have made distinctions for the population of evacuees, to reflect two important things: 1) outgroups and 2) seeds.

> Outgroup: refers to human to human relationships which would not necessarily be on an equal or necessarily co-operative level: opposing fans at a football match would by default be antagonistic towards each other, and certainly towards the stewards / police etc.
>
> Seeds: refers to evacuees who are the 'de facto leaders' of evacuation groups. This is a type of person that can build relationships between groups, who then collaborate in the evacuation process, and may interact with the operational staff or emergency services.

Both of the above have implications for the network's characteristics, informing expected behaviour and gives rise to opportunities that can be considered, such as how seeds may be involved in the evacuation procedures.

### 5.4.3 Step 3 – Similar networks and implications

In step 3, we (a) introduce the notion of learning from other networks and (b) conduct an implication analysis.

In this step, we also encourage a deeper analysis on the basis of the network diagram drawn in the previous step to start identifying implications. In addition, the network diagram approach can be used as part of requirements elicitation. Effective and efficient requirements elicitation relies on good communication, which can be a challenge when dealing with cross-disciplinary teams. Even within technical teams, formal methods such as UML is not necessarily well understood (Lüders et al., 2016). In the first round of case studies in the project, the HUMANE approach was seen as helpful for cross-disciplinary communication for requirements elicitation.

#### 5.4.3.1 Identify similar networks

Learning from successful solutions is an important aspect of design practices. To do so for HMNs, we need to be able to identify successful HMNs that are similar to the HMN we are designing for, with respect to relevant characteristics. Identifying similar networks could be done in the following ways:

1. **Learning from other networks of a similar purpose**
   Firstly, we assume that the network designers know the purpose of the HMN they are designing, e.g., a support system to medical staff to aid in clinical diagnosis. If there are existing HMNs that share the same or a similar purpose, these should be analysed to determine if they are a) successful and b) what makes them successful. From there, one may further analyse features and technical implementation to help inform the design decisions. A key point to note here is that networks that share a similar purpose may actually have a very different profile. In such cases, if they are considered successful, learning about what they do differently can be particularly valuable.
2. **Learning from networks that have a similar profile**
   Based on classifications of networks, a tool such as that described in Section 9 can then perform pattern matching to find networks that have a similar profile to the desired one for the system that is under design (or re-design). As above, these networks can then be analysed. However, note that the networks may be of different types and may be designed to meet different objectives. Therefore, the assessment of such networks need to be done mindfully in terms of how the implications may be different as the context is different.

Similarity in purpose is a well-established means of classification. In the background section (see Figure 1), we listed some prototypical HMN purposes within the area of social machines, such as crowdsourcing, crowd sensing, social media, and online games. In the field of ICT development, design knowledge is typically transferred between systems of similar purpose. E.g. when developing a platform for open innovation, it is advisable and common to consider design solutions in other open innovation platforms; when developing a solution for e-commerce, it is advisable and common to consider design solutions in other e-commerce solutions.

In HUMANE, we supplement this approach to identify similar networks, by supporting a notion of similarity on the basis of generic dimensions rather than the specific purpose of the HMN. The HUMANE dimensions apply to HMNs of any purpose, and may thus help uncover similarities across purposes or domains.

The basis for identifying similar networks in terms of the HUMANE typology, is the HMN profile. Here, the profile scores may be used to identify other HMNs with similar profiles; that is HMNs belonging to the same type of HMNs. Profile similarity may be considered from only one or a small number of the HUMANE dimensions; for example, given that the dimensions of *KŒYI·y′I·∃Ŝyŏè* and *ă2ŏłI·f ŭłŜă* are considered particularly important in the design of a HMN, scores on these dimensions could be used as the only criteria for identifying other similar HMNs. Or, one may aim to identify HMN types on the basis of the entire HMN profile, as is discussed in D2.1 (Følstad et al., 2015).

#### 5.4.3.2 Analyse network implications

The basic characteristics of a HMN have consequences for how users perceive, behave, or collaborate within the network. We refer to such consequences as network ÌYLJfÎÔÍ·ûÌ2yã. In HUMANE, we have set up five groups of implications[7] that typically needs to be discussed for any HMN, that is, implications for:

- **Motivation and experience**, that is, implications of HMN design for how users perceive, experience, and respond to HMNs. May, in particular, concern motivation, user experience, attention, or reputation
- **User behaviour and collaboration**, that is, implications of HMN design for how users behave and collaborate in the HMN. May, in particular, concern collaboration, behaviour change, patterns of interaction, shared responsibility, or sociability.
- **Innovation and improvement**, that is, implications of HMN design that affect the capacity for renewal and change in the HMN. May, in particular, concern sustainability, flow of ideas, knowledge integration, learning within industrial and societal contexts.
- **Privacy and trust**, that is, implications of HMN design for how users sense of privacy or trust in each other, in the machine components of the network, or in the HMN at large.
- **Underlying technical infrastructure**, that is, implications concerning aspects of the underlying infrastructure and machine components of the HMN, such as flexibility, scalability, or resilience.

When applying the HUMANE method, we assume that implications within these groups may be identified and analysed on the basis of the HMN profile and network diagram established in Step 2. The role of the implication analysis is to identify and discuss consequences of the network characteristics that are of particular concern for a successful implementation of the HMN. Potential challenges that are identified may then be sought mitigated through a design pattern approach in the subsequent method step (Step 4).

The implication groups cover a broad range of potential consequences of the characteristics of a given HMN; potentially too broad to cover meaningfully in a single implication analysis. When applying the HUMANE method is specific design or development projects we foresee the implication analysis mainly to cover one or a small number of highly relevant implications. However, to explore the potential usefulness of the implication analysis, we in this report cover a relatively large number of implications for the involved cases.

[7] The five groups of implications are based on the set implications considered in the initial case studies (Lüders et al., 2016), that is, motivation, enjoyment, sustainability, and trust. However, the current groups of implications cover a broader set of potential implication so as to be more universally applicable for implication analysis.

In the following, we first present how to apply the HMN profile, then the network diagrams, as a basis for implication analysis.

**Implication analysis from HMN profiles**

Using the HMN profiles to identify and analyse network implications may be done through a process of reflecting on the dimensions from the perspective of relevant implication groups. To focus the analysis, the development team may at the analysis outset scope this to target only one or a small number of implications as particularly relevant for the HMN in question. For example, the analysis may be conducted mainly with a concern for implications pertaining to privacy and trust.

On the basis of the HMN profile established in Step 2, the development team reviews the dimensions or sets of dimensions that are assessed to be of particular interest for the implication analysis. This may be supported by the identification of other HMNs with similar profiles or similar scores on profile dimensions of particular interest.

Following this, each dimension is considered sequentially from the perspective of one or several of the implication groups. For each dimension, the initial identification of implications could take the form of a brainstorm, where the team members identify what they see as key implications of the particular dimension score. Implications are then prioritized and high-priority implications are analysed in detail.

It should be noted that while the implication analysis aims to support the discovery and analysis of implications which might otherwise not have been covered, the implication analysis is not assumed to provide a comprehensive identification of all potentially relevant implications. However, if well conducted, the implication analysis should enable a design or development team to systematically consider important implication groups in light of the HMN profile.

In principle, all groups of implications may be relevant for any of the dimensions or their combination. However, to start the process, we on the basis of our initial case experiences with implications analyses suggest some implications to be particularly relevant for some dimensions. Indications as to which implications may be of particular relevant for which dimensions are provided in Figure 10. Here, for each dimension the associated coloured implications groups are suggested as particularly relevant.

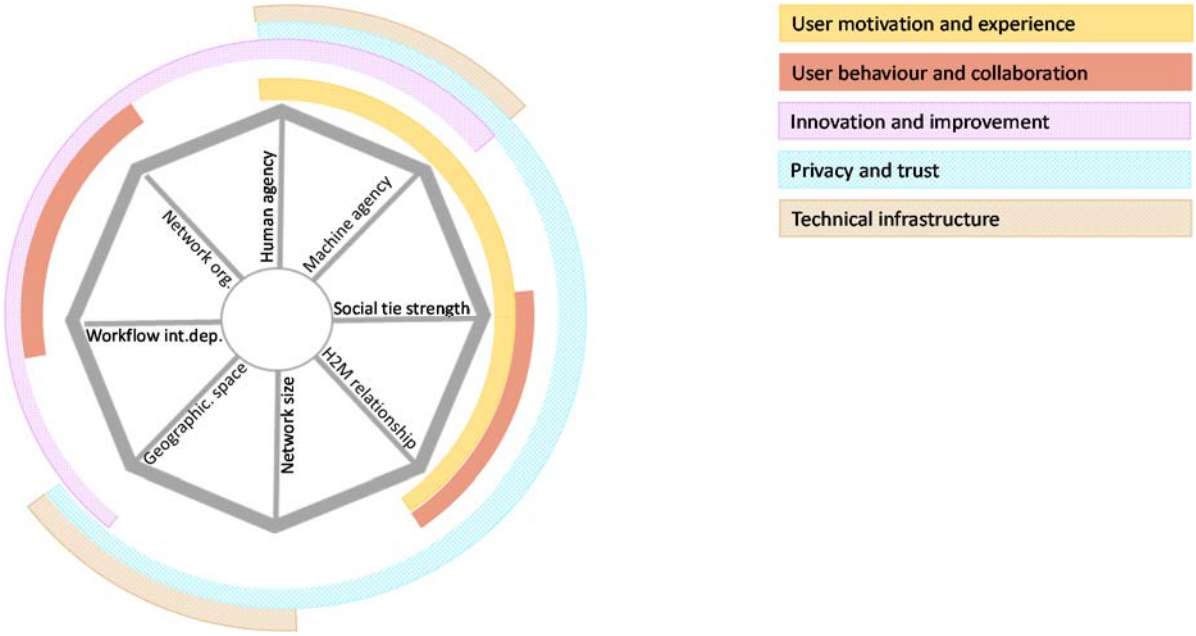



**Figure 10: Suggested mapping of implications of particular relevance to the HUMANE dimensions.**

For example, in a HMN characterized by high human agency and social ties, it would be relevant to brainstorm these characteristics from the perspective of e.g. motivation and experiences, user behaviour and collaboration, and privacy and trust. In Section 7, we detail the implication analysis further, with preliminary examples from the six HUMANE cases.

**Implication analysis from network diagrams**

Having drawn a network diagram in Step 2, this can be used to facilitate requirements elicitation. This can be done in two ways: 1) to present and discuss the purpose of the HMN especially to communicate the responsibilities of the different agents, and 2) to facilitate a more specific analysis of both technical and non-technical implications for the connections between the agents.

Given the example of the eVACUATE HMN, the second point above can be facilitated by being specific about the connections between agents as illustrated in Figure 11. One of the benefits of discussing specific connections in this manner is that the context of the entire HMN is retained, as wider considerations will then be more obvious, unlike the isolated approach to use case analysis in UML (for each stakeholder), for example.

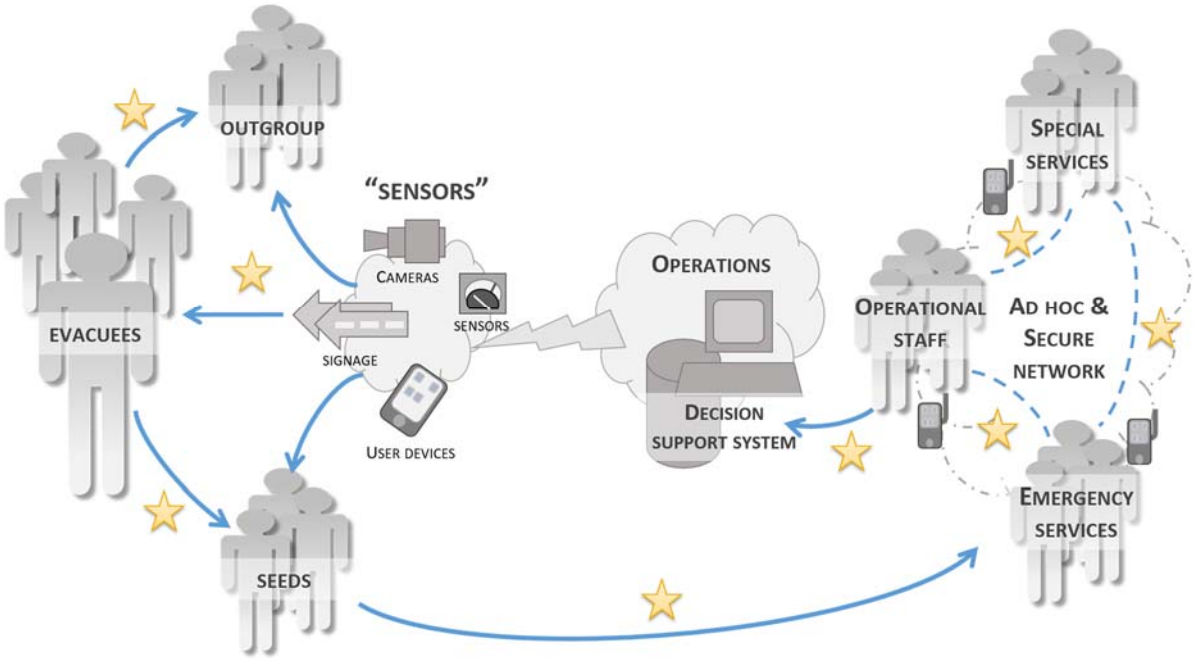



**Figure 11: eVACUATE network diagram for requirements elicitation.**

Using a similar approach to network analysis in the user requirements phase, the HMN network diagrams can be used to facilitate a deeper analysis of implications in the network pertaining to key areas such as motivation, collaboration, innovation, and trust.

At this stage, it should also be possible to assert some key information pertaining to each connection. As illustrated in Figure 12, for the eVACUATE HMN, we have noted things like operational staff being suspicious of the decision support system and the strength of the ties between the evacuees. This information should be clearer after profiling the HMN, as discussed above.

For each type of implication, each connection between agents in the HMN should be assessed. Figure 12 provides an example of an analysis of the trust implications in the network. Potential implications can be phrased as questions, for which possible design solutions may be sought. For example, can the operational staff rely on the decision support system? It has been identified that they are suspicious of the technology, governed by fears that it may replace their job. The designs should consider these aspects, as it will influence the uptake and use of the system.

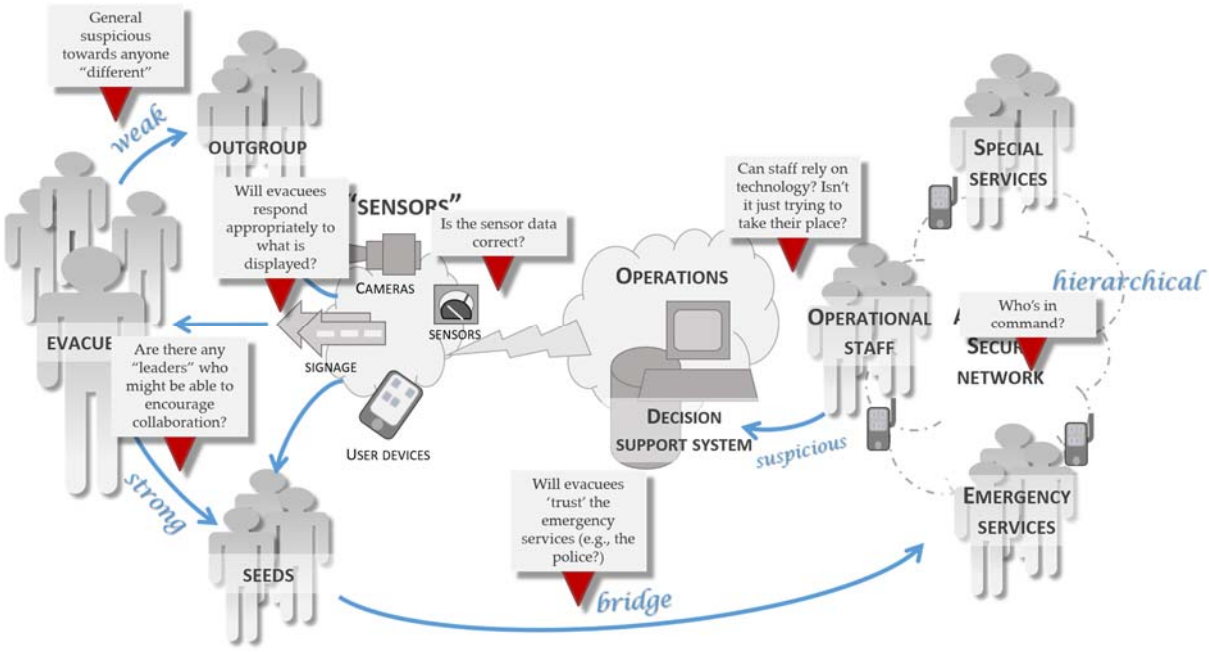



**Figure 12: eVACUATE network for design implications.**

### 5.4.4 Step 4 – extract and apply design patterns

Whereas the implication analyses serve to identify issues or themes of particular relevance or concern, they do not necessarily provide insight into how to resolve or mitigate the concern. For example, for an HMN with high levels of human agency the implication analysis may show that motivation of the human actors is both important and challenging. However, the implication analysis does not in itself suggest how as to strengthen the motivation.

To make it possible to act in response to identified implications, the HUMANE method suggests a design pattern approach to the transfer of design knowledge and experience. The basic assumption of a design pattern approach it that solutions to a design problems have often already been solved elsewhere; what one needs to do is to identify the solution from analysing successful examples.

Following the implication analysis in Step 3, key implications are prioritized for being followed up in a design pattern approach. Here, solutions for the implications are sought in HMNs sharing similar profiles. The solutions may already be explicated as design patterns. If not, new design patterns need to be established.

Details on the structure and process pertaining to design patterns is presented in Section 8 and a full overview of suggested design patterns from initial analyses of the six HUMANE cases are presented in Appendix C.

In the profiling tool described in Section 9, each network identified in the previous step may explicitly link to design patterns used in their implementation. These design patterns should then be assessed as to whether they would help address the objectives of the HMN under design, noting that the

networks may be of different types and may be designed to meet different objectives. Therefore, the network implications as well as what is considered relevant design patterns will differ between HMNs with different characteristics.

### 5.4.5 Step 5 ? evaluation

Having established a desired HMN profile in the earlier phases (context analysis and user requirements), designs established in the previous phase (design) can be evaluated here. This can be done by establishing the profile the current design option(s) is/are expected to have, comparing this with the desired profile (used as a benchmark). Progress through iterations of this HCD methodology can thus be recorded as part of the acceptance criteria for a design.

The HUMANE design patterns are set up so as to facilitate analytical evaluation or critical discussion of suggested HMN design. For each design pattern, a possible solution is contrasted to possible counter-productive approaches to design. For example, as is seen in the design pattern illustrations (see appendix), each illustration suggests how to move from a counter-productive approach to a suggested solution.

The evaluation on the basis of design patterns may be further explored as part of the external case executions (D3.3).

## 5.5 The HUMANE method to be refined through case executions

It should be noted, as described earlier in this report, that the presented version of the HUMANE method is an interim version only. This is particularly important to accentuate for the Steps 3-5 as these have not yet been tried out in practical analysis. For these steps, the method description is to be seen as an early outline which will be tried out in five case executions, and then refined on the basis of the experiences from these. For the purpose of this report, we have conduced some initial explorations of the implication analysis and the design pattern approach (see Section 7 and 8); however, these have not yet been made subject of in-depth case work. For this, please refer to the future HUMANE deliverable on the second set of case executions (D.3) and the final version of the HUMANE typology and method (D2.3).

# 6 Profiling

Establishing HMN profiles is conducted as Step 2 in the HUMANE method, following an analysis of the HMN purpose and objectives (Step 1). As part of the development (Følstad, et al., 2015) and trial (Lüders et al., 2016) of the initial HUMANE typology and method, we have established HMN profiles for all six HUMANE cases. These profiles will be used as basis for the subsequent work on implications and design patterns presented in this report.

Hence, for easy reference, we in this section provide an overview of the HMN profiles from the six HUMANE cases. Furthermore, we detail how these HMN profiles are applied in the larger HUMANE project context.

## 6.1 HMN profiles from the HUMANE cases

The six HUMANE cases are a varied set of HMNs intended to reflect the range of HMNs that may benefit from the HUMANE typology and method. The cases range from a large scale co-production platform (Wikipedia), via a consumer-to-consumer reselling platform (Snapsale), to a crisis management and evacuation support system (eVACUATE). The six cases have all been profiled according to the HUMANE typology.

The profiling process and outcome is detailed elsewhere (Følstad et al., 2015). Here, we provide an overview of the profiles for the six cases (Figure 13).

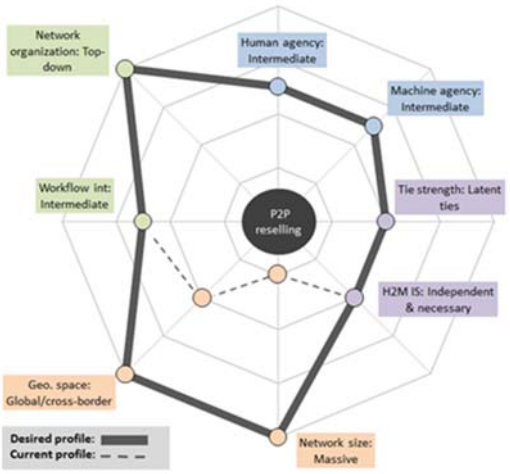
The HMN profiles show how the HUMANE cases differ on the typology dimensions. Consider, for example, the two dimensions pertaining to the HMN actors. Here, Case 3 (eVACUATE), being a network for evaluation management during an emergency situation, is the only case with high levels of both human and machine agency. Here, both human and machine actors are acknowledged to take part in a wide variety of tasks, with high levels of autonomy, and opportunity to influence other actors in the network. Case 6 (Zooniverse) on the other hand, being a citizen science platform where users contribute in highly structured and limited tasks, is the only case low on both human and machine agency. Here, both human and machine actors are acknowledged to have a highly restricted and determined set of tasks with limited opportunity for autonomy and for influencing others in the network.

The HMN profiles also indicate where the HUMANE cases are similar. Consider, for example, how Case 1 (open innovation platform) and Case 2 (C2C reselling platform) share profiles for the network interactions, where both social ties between the human actors and the human-to-machine interaction strength is considered low. This highlights that human actors have neither strong existing relations to each other nor to the platform, which may have important implications for example for motivation and collaboration. Likewise, Case 3 (eVACUATE) and Case 4 (Reveal) both have high human-to-machine relationship strength, highlighting that these are HMNs in which the human actors need to strongly rely and depend on the machine components, with important implications for trust.

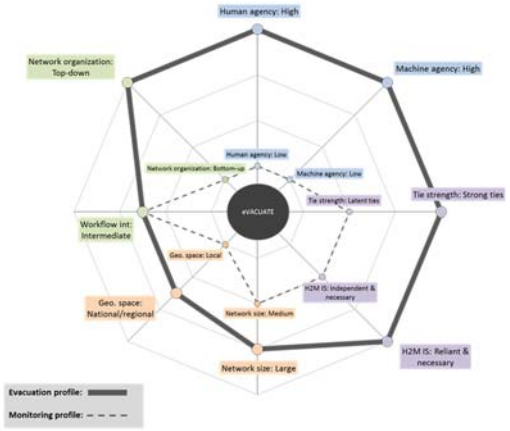
In Section 7 HMN profile characteristics, as well as similarities and differences from other HMN profiles, are used to identify and analyse implications of the HMN profiles.

Case 1 – open innovation platform (Center for Service Innovation)

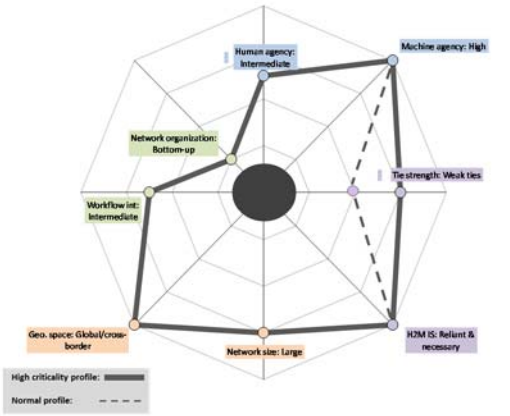
Case 2 – consumer-to-consumer (C2C) reselling platform (Snapsale)



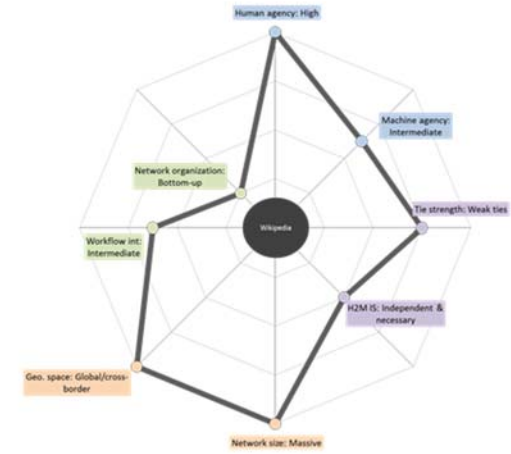

Case 3 – crisis management and evacuation support system (eVACUATE)




Case 4 – collaboration platform for verification of social media (Reveal)




Case 5 – large-scale co-production platform (Wikipedia)




Case 6 – platform for citizen science projects (Zooniverse)

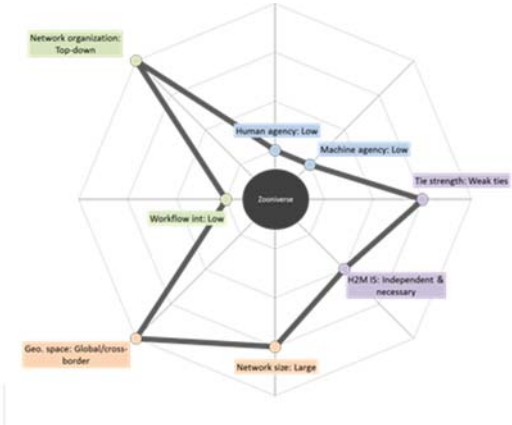



**Figure 13: Initial* HMN profiles for the HUMANE cases.**

*) The Case 2 and 3 profiles have been updated after being presented in D2.1 (Følstad et al., 2015).

## 6.2 The HMN profiles in the larger HUMANE project context

The HUMANE case profiles presented above, serve as the basis for the implication analysis (Step 3) and extraction of design patterns (Step 4) presented below in this report.

Figure 14 clarifies how the previous work in the deliverables D2.1 and D3.2 serve to complete the HUMANE method steps. Here, we see how in each case, the Steps 1 and 2 has been addressed in the report on the initial HUMANE typology and method (D2.1) and in the subsequent initial case executions (D3.2). The identification of similar networks was also outlined in these previous reports.

In this report, we present the initial identification of implications for each case, and also present the extracted design patterns (Steps 3 and 4). In the second iteration case executions to follow this report, we will elaborate on the implications and design patterns, and also apply the design patterns for evaluation purposes (Step 5).

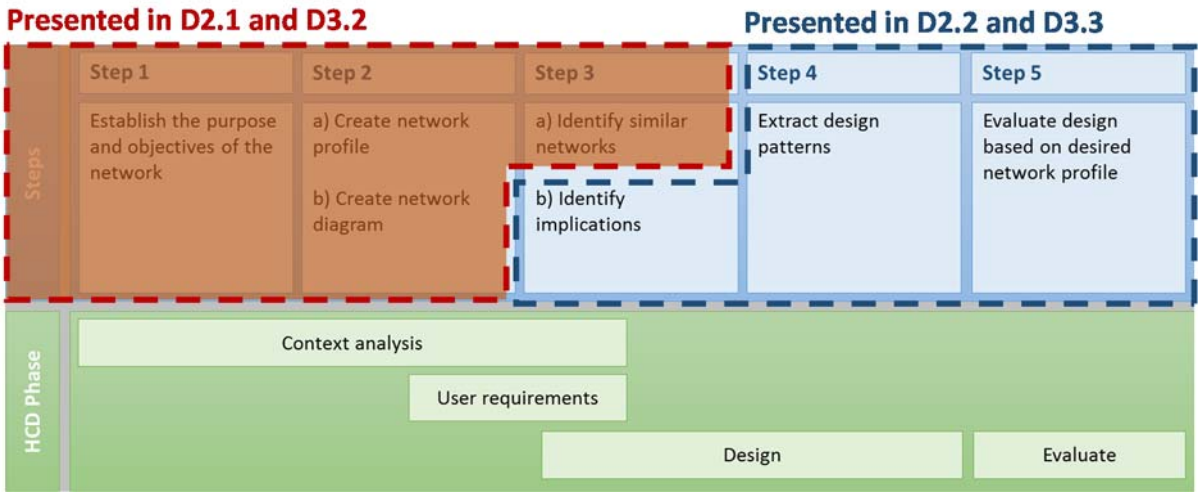



**Figure 14: Overview of HUMANE method, indicating where the different steps are addressed**

# 7 Implications

Identifying and analysing implications of HMN profiles is conducted as Step 3 in the HUMANE method. LYLJtîÔI·ûl2yã are understood as consequences of the characteristics of a HMN for how users perceive, behave, or collaborate within the network. In this section, we present the outcome of the initial implication analysis conducted in the six HUMANE cases.

The purpose of this initial analysis was to explore the potential of this approach to generate useful and relevant insight on the basis of the HMN profile. Hence, a broad range of implications were considered, and we did not attempt complete coverage of these implications. In the second iteration case executions, conducted on the basis of this deliverable, we aim to go more into depth on selected implications rather than consider such a wide range of implications as what is presented here.

## 7.1 The process of initial implication analysis

For each of the six HUMANE cases, an initial implication analysis was conducted. The implication analysis followed the process outlined in the method section. With a starting point in the HMN profile of the case, the HUMANE researchers in direct contact with each respective case conducted a brainstorming process for relevant implications pertaining to particularly relevant HUMANE dimensions.

**Which dimensions?** During the brainstorming process, the researchers considered both singular dimensions independently and sets of two or more dimensions. The selected dimensions in this initial implication analysis were those judged to be of particular relevance by the involved researchers. In the implication analyses of the second iteration case executions, the dimensions and combinations of dimensions will be considered more systematically. In subsequent analyses, it is also foreseen that more complex type descriptions, drawing on most or all of the HUMANE dimensions simultaneously, may be applied as basis for implication analysis.

**Which implications?** To prime the researchers on relevant implications, the respective research teams were instructed to consider implications included in the five groups listed in Step 3 of the method (Section 5.4.3.2): (a) Users motivation and experiences, (b) user behaviour and collaboration, (c) innovation and improvement, (d) privacy and trust, and (e) underlying technical infrastructure. Following the brainstorm on potential relevant implications, the implications to be made subject of analysis were prioritized on the basis of the researchers assumptions concerning what would be seen as beneficial and useful from the perspective of the case developers and designers. In subsequent implication analyses, it is foreseen that a smaller number of implications will be considered to allow for more in-depth coverage.

**Analysing implications.** The HUMANE method provides support for helping the researchers discuss and reflect on these potential implications. However, the actual implication analysis also needs input from other sources. To support analysis of implications, the researchers were instructed to draw upon their own case experiences and background from the literature. Furthermore, the listed similar networks was suggested as a useful supplement for input concerning implications. For each case, all prioritized implications were subject to brief analysis, as shown below.

The implication analysis hence provides a simple framework for exploring and prioritizing relevant implications pertaining to the HMN in question. The implications hence serve to pinpoint areas of concern, for which design support is needed.

## 7.2 Implications overview

In Table 4, we provide an overview of the output of the initial implication analysis conducted by the researchers of the HUMANE consortium. Here, we see which implications were identified and analysed for each of the six HUMANE cases. The detailed output of the implication analysis is presented in Appendix B.

From the overview of the initial implication analysis, we see that implications pertaining to (a) motivation, (b) collaboration, (c) innovation and improvement, and (d) trust have been given particular attention in the cases. To exemplify the output of the implication analysis, and illustrate how the HUMANE typology and method helped identify and analyse implications of relevance for the different cases, we present some of the output from the implication analyses for these four implication areas in the following sections. To prepare for the transfer of implication analysis output across HMN of similar profiles, we also suggest the extent to which these implications may be transferrable to other HMNs.

**Table 4: Initial implications identified and analysed for each of the six HUMANE cases**

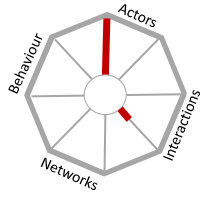
| | **Case 1** Open innovation platform (CSI) | **Case 2** C2C reselling platform (Snapsale) | **Case 3** Evacuation support (eVACUATE) | **Case 4** Social media verification platform (Reveal) | **Case 5** Co-production platform (Wikipedia) | **Case 6** Citizen science platform (Zooniverse) |
|---|---|---|---|---|---|---|
| **User motivation and experience** | | | | | | |
| Motivation | X | | | X | X | X |
| Attention | X | | | | | |
| Experience | X | | | | | |
| Reputation | | | | X | | |
| Information overload | | | | X | | |
| **User behaviour and collaboration** | | | | | | |
| Collaboration | X | X | X | | X | X |
| Loyalty | | X | | | | |
| Behaviour change | | X | | | | |
| Shared responsibility | | | X | | | |
| **Innovation and improvement** | | | | | | |
| Innovation and improvement | X | X | | | | X |
| Product quality | | | | | X | X |
| Network growth | | | | | | X |
| **Privacy and trust** | | | | | | |
| Trust | X | X | X | X | | |
| Privacy | | | | X | | |
| Security | | | | X | | |
| **Technical infrastructure** | | | | | | |
| Architectural, memory, and computational requirements | | | | X | | |
| Resilience | | | | | X | |

Note that whereas the implication analyses serve to point out areas of concern, possible solutions are suggested through a design pattern approach (presented in Section 8). When presenting the example implications below, we point out which design patterns that has been suggested as solutions.

### 7.2.1 Motivation – example implications

For four of the cases, the motivation was considered a key implication of respective HMNs. Due to the differences in HMN profiles for these cases, the implication for motivation differ. However, the observations are complementary and the implications from each case are arguably transferrable to other HMNs with similar profiles. In the following, we illustrate this by presenting implications for motivation from two of the cases (1 and 6).

In Case 1 (open innovation), motivation was addressed from the perspective of *KλƎK KdzY'I·y'I·ƎŜyŎè* and *f2ó IнaλyűŜNI·Ŏűλ2y'ăúNŜyƎűK* (see frame below). This implication arguably is valid also for Case 5 (Wikipedia), which shares the same profile scores on these two dimensions. However, this implication is not expected to be relevant for Case 6 (Zooniverse) as the network profiles here strongly differ.




*IdzY'I·y'I·ƎŜyŎè KλƎK*φ

*Inaλ yűŜNI·Ŏűλ2y' ăúNŜyƎűK f2óφ*

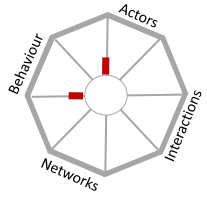
**Case 1 (open innovation platform) - implications for Motivation:** In the CSI open innovation platform, *KdzY'I·y'I·ƎŜyŎè* is high, that is, human contributors to the open innovation platforms are expected to contribute to goal setting, display creativity and self-expression, with self-decided and open tasks. At the same time, *Inaλ yűŜNI·Ŏűλ2y'ăúNŜyƎűK* is low, meaning that the human contributors not have particularly strong dependency, reliance and trust in the machine components of the networks.

This HMN profile has important implications for motivation. Contributing in tasks characterized by flexibility in goal setting, creativity, and self-expression require relatively high levels of effort and attention. This requires high levels of motivation in the contributor. Without such motivation, the contributor may just opt out (i.e. stop participating). In particular, when the interaction strength between the contributors and the machine components is low, and the contributions are not part of an established routine or behaviour pattern.

In the literature, it is argued that tasks requiring independent goal setting and creativity benefit from *λyűNλyãλŎ Y'2űλØI·űλ2y'* (Ryan & Deci, 2000)φ Hence, to establish the needed motivation the HMN needs to trigger intrinsic motivation in the individual contributor, for example, through strengthening the sense of engagement and mastery in the task.

*ó¢Kλă λY'LJŧλŎI·űλ2y'fŜŘ ű2 űKŜ ădzƎƎŜăűλ2y'2ŧ ŘŜăλƎy'LJI·ûűŜNy'мпφмφпφмΣ LJφ момΣ øKŜNŜ λyűNλyãλŎ Y'2űλØI·ûλ2y'λă ăúNŜyƎűKŜyŜŘ űKN2dzƎK ŜyƎI·ƎλyƎ LJ2űŜyűλI·f Ŏ2yűNλōdzű2Nă 2ŧ Ŏ2yűŜyű I·ă Ŏ2yãdzY'ŜNăφú*

In Case 6 (Zooniverse), motivation was addressed from the perspective of *t2ó KdzY'I·y'I·ƎŜyǒë* and *t2ó ó2ℕ]Ŧf2ó ƚyűŜℕŘŜLJŜyŘŜyǒŜ*. Note that the implications pertaining to this case is different from that of Case 1, due to substantial divergence in profile characteristics.




*I dzY'I·y'I·ƎŜyǒë t2ó*

*² 2ℕ]Ŧf2ó ƚyűŜℕŘŜLJŜyŘŜyǒŜ t2ó*

**Case 6 (Zooniverse) - implications for Motivation:** Volunteers on Zooniverse can freely choose which science project to participate in but within project, they are quite restricted as to the kind of tasks they can execute. In addition, most tasks are done independently and do not interact in any way with input by others. What is more, the tasks are by definition redundant, since crowdsourcing crucially relies on input by multiple independent actors.

These HMN features can undermine users' motivation. If users are not able to exercise agency in the HMN through goal-setting and creativity and do not receive feedback and share knowledge through collaboration with others, they are likely to perceive their own contribution as less meaningful (Kittur et al., 2013). As a result, they may choose not to participate at all.

A potential design challenge hence may be to strengthen *ŜĖűℕƚyãƛǑ Y'2űƛØI·űƛ2y'* (Ryan & Deci, 2000) for participation, for example in terms of making the participation attractive in terms of contributing to a greater good or in terms of tangible incentives.

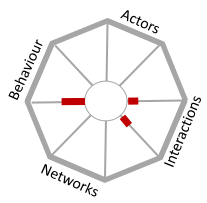
*ó¢Kƛă ƚY'LJŧƛǑI·űƛ2y'fŜŘ ű2 űKŜ ădzƎƎŜăűƛ2y'2Ŧ ŘŜăƛƎy'LJI·űűŜℕy'мп¢м¢п¢oΣ LJ¢ mop ŘƛăǑdzăăƚyƎ űKŜ ƚyűℕ2ŘdzǑűƛ2y'2Ŧ ℕŜØI·ℕŘƚyƎ I·yŘ ℕŜŐ2Ǝyƚűƛ2y'ăëăűŜY' ØƛűK Ŝ¢Ǝ ōI·ŘƎŜă I·yŘ ōI·ℕyãűI·ℕă¢ú*

### 7.2.2 Collaboration – example implications

Implications pertaining to collaboration was addressed in five of the cases. Also here, profile differences directed implications to take on different aspects and areas of concern. However, awareness of implications of different profiles may be beneficial in terms of understanding strengths and weaknesses of current and alternate profiles.

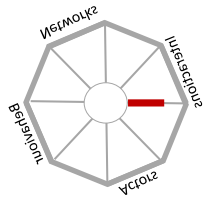
One example of this is found when contrasting Case 1 (open innovation platform) and Case 5 (Wikipedia). Here, low scores on social ties in Case 1 is found to imply challenges pertaining to collaboration; in particular, for situations where H2M interaction strength is low and workflow interdependence is intermediate. At the same time, the analysis from Case 5 indicates potential challenges also pertaining to higher levels of social tie strength, such as the so-called revert-wars in Wikipedia.

The implications pertaining to collaboration from these two cases are presented in the frames below. The remaining implications on collaboration are presented in Appendix B under their respective cases.




**Case 1 (open innovation platform) - implications for Collaboration:** In the CSI open innovation platforms, social ties are typically non-existent or latent; that is, the users typically do not have an existing social relation. The exception to this is when the innovation platform is used for company-internal idea gathering. Here, however, the users typically also have other means of contributing their ideas or suggestions (indicated by H2M interaction strength being low. Finally, workflow interdependence is at best intermediate. Collaboration on ideas is possible, but ideas are often submitted to the platform without any coordination or collaboration with others.

Hence, while the open innovation process would strongly benefit from high levels of interaction within the HMN, users are typically not interacting as much as desirable (Lüders, 2016). The default mode of participation for most users is by submitting ideas, with only limited incentives to collaborate on improving or strengthening the ideas. Or by browsing other users ideas, but without engaging. Interaction within the HMN hence typically needs strengthening, while the HMN profile suggests that this may be challenging as low social ties, low H2M interaction strength and low to intermediate workflow interdependence do not strongly encourage such interaction.




**Case 5 (Wikipedia) - implications for Collaboration**: Wikipedia editors can interact with each other in numerous ways – by conversing on article history pages, writing on each other's user pages, debating publicly on new administrative proposals, sending questions to e-mail lists, etc. Since not all editors get involved to the same extent in these activities so overall, the ties tend to be weak overall.

Nevertheless, this does not prevent social interactions from impacting the editorial activity. Previous research suggests that edits and in particular, reverts of other editors' contributions, can be used to wage wars around controversial articles (Brandes, Kenis, & Lerner, 2009; Sumi, Yasseri, Rung, Kornai, & Kertész, 2011). Our study from D3.2 shows that negative social interactions such as revenge and serial attacks indeed occur on Wikipedia and are often associated with how senior the involved editors are (Tsvetkova, García-Gavilanes, & Yasseri, 2016b). In a sense, project contributions can be used strategically in social interaction and thus, social processes can affect collaboration.

| | |
|---|---|
| | ó¢Kλă ƛYLJfλŎI·ûλ2y´tŜŘ ű2 űKŜ ădzƎƎŜăûλ2y´2ŦŘŜăλƎy´LJI·ûûŜℕy´мп¢н¢н¢оΣ LJ¢ мпп ŘλăŎdzăăλyƎ K2ø 2ℕƎI·yƛÎλyƎ ă2ŎλI·t ŜØŜyűă YI·ë λyŎℕŜI·ăŜ ûλŜ ăúℕŜyƎűK I·yŘ KŜyŎŜ ăúℕŜyƎűKŜy´Ŏ2ftfI·ō2ℕI·ûλ2y¢ú |

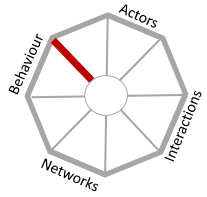
* Note that "weak" is the second highest level of social ties in the HUMANE typology; lower scores reflect social ties that are *y2yfi ŜĖλăúŜyű* or *fI·ûŜyű* social (unrealized potential ties).

### 7.2.3 Innovation and improvement – example implications

Innovation and improvement is critical for HMN to stay sustainable as this provide value to the participants in the HMN who may otherwise migrate to competitors. Implications for innovation and improvement were considered for four of the cases. In the following we present examples concerning how both the dimensions associated with the network actors, as well as the dimensions associated with behaviour in the network, may be relevant for innovation and improvement.

The implication analyses from these cases reflected an example of how the analysis of networks with similar profiles reached similar implications. In Case 1 (open innovation) as well as in Case 6 (Zooniverse), high levels of network organization, that is, network organization that is top-down and centralized, was suggested to challenge the propensity for innovation and improvement in the network. These implications are arguably relevant also for Case 2 (C2C reselling) and C4 (eVACUATE) due to profile similarity on network organization.

The implications for improvement and innovation from Case 1 and Case 6 are presented in the frames below. The remaining implications on improvement and innovation are presented in Appendix B for their respective cases.



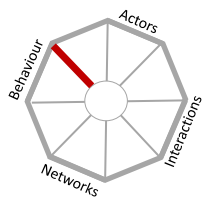

*bŜűø2ℕ⟅ 2ℕƎI·yƛÎI·ûλ2y´KλƎK óű2LJπŘ2øy¢ú*

**Case 1 (open innovation platform) - implications for Innovation and improvement:** Open innovation platforms typically have a top-down organization, implying centralized control, and low levels of adaptability. The structure of the platform and the process for contributing and refining content is typically decided by company policy.

This has important implications for the innovation platform to innovate and improve itself. The contributors are typically invited to contribute ideas on other fields of interest than the platform itself, and users typically are highly restricted in their ability to affect the idea contribution and innovation process of which they are part. Hence, innovation platforms may lack the ability to improve itself that is needed for a HMN to fit rapidly changing contexts. Practices for renewing implemented innovation platforms may hence be a critical challenge.

*ó¢Kλă ƛYLJfλŎI·ûλ2yƛŘŜyűλŦƛŜŘ ƛy´/I·ăŜ мΣ YI·ë ōŜyŜŦλű ŦℕƧY´ Ŏ2yűƛŘŜℕƛyƎ ûKŜ ŘŜăλƎy´ LJI·ûûŜℕy´ădzƎƎŜăûŜŘ ƛy´ℕŜăLJ2yűŜ ű2 I· ăλYƛfI·ℕ ƛYLJfλŎI·ûλ2yƛŘŜyűλŦƛŜŘ ƛy´/I·ăŜ cΣ úKI·ű λăΣ ŘŜăλƎy´LJI·ûûŜℕy´мп¢о¢м¢оΣ LJ¢ мрп ŘλăŎdzăăλyƎ K2ø I·ŘŘλyƎ I·y´*

λyŦ№I·ăúNdzŎűdz№Ŝ Ŧ2№ λyŦ2№YI·t Ŏ2ftI·ō2№I·űλ2yΎŎ2dztŘ ăú№ŜyƎűKŜyΎλyŷ2ØI·űλ2yΎ ŎI·LJI·ōλftűλŜă λyΎűKŜ I a bΦú




bŜűǿ2№ʅ 2№ƎI·yλÎI·űλ2yΎKλƎK óű2LJπŘ2ǿyΎΦ

**Case 6 (Zooniverse) - implications for Innovation and improvement**: Zooniverse is organized top-down, meaning that volunteers can rarely have input into what projects should be pursued and how projects should be organized. This is common for most crowdsourcing systems.

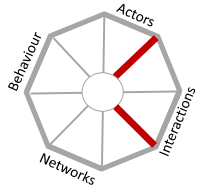
Such top-down organization may stifle creativity and innovation in the HMN. Through spending hours poring over the data or the tasks, users could observe patterns that the scientists or the employers did not foresee. If the project is not designed to record such observations, this knowledge will be lost. Due to extensive experience, users are also likely to have a better idea how to design a project in order to attract and sustain high-levels of participation and high quality of contributions. If users are not allowed and encouraged to experiment with designing their own projects, learning will occur much more slowly.

ó¢Kλă λYLJftŎI·űλ2yΎfŜŘ ű2 űKŜ ădzƎƎŜăűλ2yΎ2Ŧ ŘŜăλƎyΎLJI·ûűŜ№yΎмпΦoΦмΦoΣ LJΦ мрп ŘλăŎdzăăλyƎ K2ǿ I·ŘŘλyƎ I·yΎλyŦ№I·ăú№dzŎűdz№Ŝ Ŧ2№ λyŦ2№YI·t Ŏ2ftI·ō2№I·űλ2yΎŎ2dztŘ ăú№ŜyƎűKŜyΎλyŷ2ØI·űλ2yΎŎI·LJI·ōλftűλŜă λyΎűKŜ I a bΦ ¢KŜ ŘŜăλƎyΎLJI·ûűŜ№yΎλă I·fă2 LJ2űŜyűλI·ffë №ŜfŜØI·yű Ŧ2№ űKŜ ăλYΎλftI·№ λYΎLJftŎI·űλ2yΎŦ2№ /I·ăŜ м LJ№ŜăŜyűŜŘ I·ō2ØŜΦú

### 7.2.4 Trust – example implications

The last examples from the implication analysis to be presented here concerns trust. Implications or trust was considered in four of the six cases, and the implication analyses presented below indicates the extent to which implications for trust may depend on a wide range of the HUMANE dimensions.

In C4 (Reveal), trust was considered from the perspective of high YI·ŎKλyŜ I·ƎŜyŎè and high I н a λyűŜ№I·Ŏűλ2yΎăú№ŜyƎűK. Hence, this implication arguably is relevant also for C3 (eVACUATE), as these two cases share HUMANE profiles for these two dimensions. This trust implication, however, is not relevant for HMNs with low levels of machine agency, such as Case 1 (open innovation platform) and Case 6 (Zooniverse).




**Case 4 (Reveal) - implications for Trust**: In the REVEAL platform, YI·ŎKλyŜ I·ƎŜyŎè is high, as the machine components of the systems may strongly influence the actions and intentions of the contributors, and conduct actions reflecting intelligence (retrieving content based on user preferences, predicting trends, assessing credibility). The REVEAL platform provides a

| | |
|---|---|
| *aI·ŏKλyŜ I·∃Ŝyŏè Kλ∃K¢*<br><br>*Iнa λyűŜℕI·ŏűλ2y˘ ăűℕŜy∃űK Kλ∃K¢* | specific frame and options by which users can retrieve social media content.<br><br>At the same time, *Iнa λyűŜℕI·ŏűλ2y˘ăűℕŜy∃űK* is high, meaning that the human contributors have particularly strong dependency and reliance in the machine components of the networks.<br><br>The sentiment analysis and credibility score is presented to the users, along with the rating for each modality, but calculation details are more complex and remain hidden.<br><br>It is also reasonable to claim that the machine output has an additional impact on the users, both because it is acting as a proxy for different social media (without the user having to access these media directly), and because it quantifies the credibility of the messages and information sources. Thus, the user opinion is greatly affected and shaped by the machine output.<br><br>HMNs with high machine agency may entail challenges concerning trust. The fact that REVEAL only produces the outcome of processing tasks to the end-users, and does not present all details about the underlying algorithms (i.e. operates as a "black-box", to some degree) implies that users initially have a low level of trust, which needs to be built in order for the tools to be successful.<br><br>*ó¢Kλă λY˘LJ₮λŏI·űλ2y˘fŜŘ ű2 űKŜ ădzƎƎŜăűλ2y˘2Ŧ ŘŜăλƎy˘LJI·ŭűŜℕy˘мnΦnΦoΦnΣ LJΦ мcфΣ ŘλăŏdzăăλyƎ K2ǿ úℕdzăű λy˘űKŜ 2dzűŰLJdzű 2Ŧ YI·ŏKλyŜ I·ŏű2ℕă λy˘űKŜ I a b ŏI·y˘ōŜ ăűℕŜy∃űKŜySŘ ōè YI· ʔλy∃ I·ŧ∃2ℕλűK Y˘ă Y˘2ℕŜ úℕI·yãLJI·ℕŜyűΦú* |

In Case 3 (eVACUATE), a more detailed implication analysis was conducted for trust. Here, trust was considered from the perspective of a larger number of the HUMANE dimensions, making it highly tailored to the perspective of eVACUATE with its concern for transition between a passive monitoring state (between emergency evacuations) to the active state of an emergency situation.

| | |
|---|---|
| <br><br>*bŜűǿ2ℕʅ ăλÎŜ λyűŜℕYŜŘλI·űŜ*<br><br>*DŜ2∃ℕI·LJKλŏI·ŧ ăλÎŜ λyűŜℕYŜŘλI·űŜ*<br><br>*IdzYI·yI·∃ŜyŏèI* | **Case 3 (eVACUATE) - implications for Trust (abbreviated):** the eVACUATE network for evacuation support has two operational states: during monitoring, to check that there are no potentially dangerous situations detected; and during emergency situations where evacuees must be helped to leave a given venue safely. Considering an emergency evacuation, the network size and geographical distribution remain modest, confined to the devices and individuals associated directly with the evacuation, but may include additional human actors (such as emergency services and possible special services, such as anti-terrorist units) as well as additional technical components (the devices which emergency workers or special forces use). Interestingly, the evacuees have now become direct participants rather than |

| | |
|---|---|
| KλƎK | passive objects to be monitored. |
| a l·ŎKλyŜ l·ƎŜyŎè KλƎK<br>I н a λyűŜℕl·ŎűλƨY ăűℕŜyƎűK KλƎK óŘŜLJŜyŘŜyűπ yŜŎŜăăl·ℕèú | At the same time, however, both Human and Machine agency are significantly increased as the human actors in the network must act and interact to effect a successful and effective evacuation; further, existing devices (the main decision support system) must now operate at the highest level of efficiency and speed. Sensors and signage must, if possible, now respond to specific requests for information from the decision support system; further, additional devices may become active parts of the network (such as those from the emergency services at a collaborative level; of the special services, on a request-for-information basis only; and even potentially any smart devices like 'phones owned and used by the evacuees).<br><br>As the HMN shifts into emergency mode and not least on account of the changing responsibilities of components and individuals, potentially bringing new devices into the network, each and every level of interaction relies increasingly on trust:<br><br>∉ The Human actors must be able to trust and rely on one another, including evacuees on the guidance from operational staff, and both groups on the emergency services as well as optionally on Special Forces.<br>∉ Human actors must also trust the information provided by the various technology elements: operational staff on the decision support system, and evacuees on signage and any smart devices programmed or activated to pass supportive information or direction.<br>∉ Machine actors must cater for human override, for ethical as well as technical reasons, indicating the need to design for flexibility and cyclical operation of modules.<br>∉ Machine actors must also provide secure and robust interfaces between themselves: the data passed via these interfaces must be reliable, so their integrity must be guaranteed as well as the physical connection remaining operative.<br><br>ó9fŜYŜyűă 2ŦűKλă λYLJfλŎl·űλ2yfŜŘ ű2 űKŜ ădzƎƎŜăűλ2y2Ŧ ŘŜăλƎyLJl·ûűŜℕyмπΦπΦoΣ LJΦ мcmΣ ŘλăŎdzăăλyƎ K2ó úℕdzăű λyl·y I a b Ŏl·yōŜ ăűℕŜyƎűKŜyŜŘ ōè ûdzℕyλyƎ 2yŜπ ól·è λyűŜℕl·Ŏűλƨyã λyű2 YdzfűλπŘλℕŜŎűλ2yl·f l·ă óŜff l·ă YdzfűλπűKℕŜl·ŘŜŘ λyűŜℕl·ŎűλƨyãΦú |

## 7.3 Concluding remarks on the initial implication analyses

In this section, we have presented the outcome of the initial implication analyses for the six HUMANE cases. Here, we have aimed to explore the potential of this analysis to identify a diverse set of implications in response to HMN profiles. Hence, we have in the six cases covered example

implications concerning motivation and experience, behaviour and collaboration, innovation and improvement, privacy and trust, as well as implications pertaining to the underlying infrastructure.

In consequence of its wide range, this initial set of implications does not provide complete coverage of the relevant implications to be drawn from the case HMN profiles. Rather, the initial implications should be seen as exemplifying the potential range of implications to be drawn. In the subsequent case executions, we will aim to provide more complete coverage of a smaller number of implications for each case and discuss lessons learnt in this regard.

# 8 Design patterns

## 8.1 The design pattern approach

The basic idea of design patterns is to analyse successful real-world solutions to design problems with the aim of identifying solutions that may be re-used for similar design problems. Hence, the design pattern approach concerns the documentation of generic solutions to design problems at an appropriate level of abstraction, on the basis of experiences with existing successful designs.

Design patterns have been defined as:

> "[describing] a problem which occurs over and over again in our environment, and then […] the core of the solution to that problem, in such a way that you use this solution a million times over, without ever doing it the same way twice" (Alexander, Ishikawa, & Silverstein, 1977).

And by extension:

> "In software engineering, a **design pattern** is a general repeatable solution to a commonly occurring problem in software design. A design pattern isn't a finished design that can be transformed directly into code. It is a description or template for how to solve a problem that can be used in many different situations"[8] (original emphasis)

In HUMANE, the design patterns are seen as a format for transferring design knowledge and experience from successful HMNs. Whereas the implication analysis (Step 3 of the HUMANE method) serves to identify areas of particular concern, the design pattern approach (Step 4) serves to identify possible solutions in response to those concerns. These solutions may be identified through considering HMNs with similar HMN profile or similar purpose, and may be described in a design pattern format for sharing and re-use across development projects.

## 8.2 Design pattern format

Design patterns are typically seen as an approach to describe and communicate solutions to multiple design problems, often to be developed as a community effort. For consistency and ease of sharing

[8] https://sourcemaking.com/design_patterns

and aggregating, it is beneficial for the design patterns to follow a specified format. The format typically is set out to allow for a structured presentation of the following elements (Borchers, 2001; Seffah, 2015):

- Context: A brief presentation of the context and background for the pattern is presented
- Problem: The problem to be solved is outlined.
- Forces: The different factors that affect the problem are discussed. Typically an optimal solution may require the balancing of forces.
- Solution: The solution is presented as a generic abstraction, drawing on lessons learned from the examples.
- Examples: Successful real-world solutions are provided as examples.

In HUMANE, we propose the following template based on the recommendations in the literature concerning pattern format (see Figure 15).

**<Reference number> <Descriptive title>**

HMN type: ƒλŦ ℕŜŤŜØI·yűΣ űKŜ Y2ăű ăI·ťŜyű ŘλYŜyãλ2yI·ăă2ŎλI·űŜŘ ǿλűK űKŜ LJI·űűŜℕyT 2űKŜℕǿλăŜ ábκ!éú
Implication: ƒűKŜ ű̈ëLJŜ 2Ŧ λYLJťŎI·ûλ2yI·ăă2ŎλI·űŜŘ ǿλűK űKŜ LJI·ûűŜℕyƀ Design Pattern Group(s): ƒűKŜ ăŜŎûλ2yã λyűKλă ŎKI·LJűŜℕ Ŏ2ØŜℕλyƎ IнIΣ IнaΣ анI l·yŘ ана λyűŜℕI·Ŏûλ2yãú

**Problem:** a brief description of the issue which the pattern is intended to resolve

**Background:** a detailed narrative about a typical situation in which the problem might occur and therefore when the pattern might be appropriate.

**Solution:** a brief overview of the proposed pattern

**Illustration**: a visualisation representing the pattern-based solution. The illustrations are not intended as detailed descriptions of the solutions, but rather reflecting its overall approach.

**When to use:** typically the development or deployment stage when the pattern might be used

**Sources:** if appropriate, where the pattern was derived from or what it is related to

**See other patterns:** a cross reference to related patterns

**Figure 15: Template for HUMANE design patterns.**

## 8.3 Initial design patterns for the six HUMANE cases

For each of the six HUMANE cases, we conducted an initial implication analysis (Section 7). This exercise was purely internal and based on our knowledge of the network in question, and our interactions with those involved with that network. Much of this will be further validated as part of

WP3 in direct discussion with the network developers or other relevant stakeholders. In response to prioritized implications from the cases a set of initial design patterns has been developed. These design patterns are high-level descriptions of solutions relevant for the HUMANE cases.

As of now, some of the design patterns should be seen as aspirational rather than implementational. That is, they are to be seen as initial suggestions to be further developed, refined or extended as part of the second iteration case studies (D3.3). Nevertheless, in their current form, the design patterns serve as an illustration of the HUMANE method, and point towards how a body of design patterns may be developed to support design for HMNs.

In total, 36 initial design patterns were suggested. The full set of design patterns are presented in Appendix C. In the following, to provide some examples and to illustrate how the design patterns serve as responses to the identified implications, we present some of the suggested design patterns pertaining to motivation, collaboration, innovation and improvement, and trust as these were prioritized implications for several of the HUMANE cases.

### 8.3.1 Example design pattern for motivation

In Case 1 (open innovation platform, CSI), motivation was identified as a key implication, specifically the need to design for intrinsic motivation in HMNs characterized by high levels of human agency and low levels of H2M interaction strength. The following design pattern was developed in response to this implication.

**14.1.4.1**[9] **Motivating users to contribute content in HMNs**

HMN type: Open innovation platform. Implication: Design for intrinsic motivation. Design Pattern Group(s): Human agency

**Problem**

Users do not contribute content to the HMN

**Background**

A variety of HMNs depend on users producing and sharing content. For example, open innovation platforms, content sharing sites such as YouTube, peer-to-peer redistribution marketplaces, and academic networks for self-archiving. Common to all these are that their success, rightly, is seen as dependent on gathering sufficient content for the network to be interesting. Hence, owners of the HMN see it as a key priority to make the users create content. This priority may in some cases lead platform owners to disregard the silent majority of content consumers. This is particularly so for cases where the content is not seen as the value proposition, but rather as a means towards another end, such as for open innovation platforms or for peer-to-peer redistribution marketplaces

[9] The four digit reference number for a given pattern provides a link to the subsection in the Appendix where the pattern is described along with other patterns within a similar area.

**Solution**

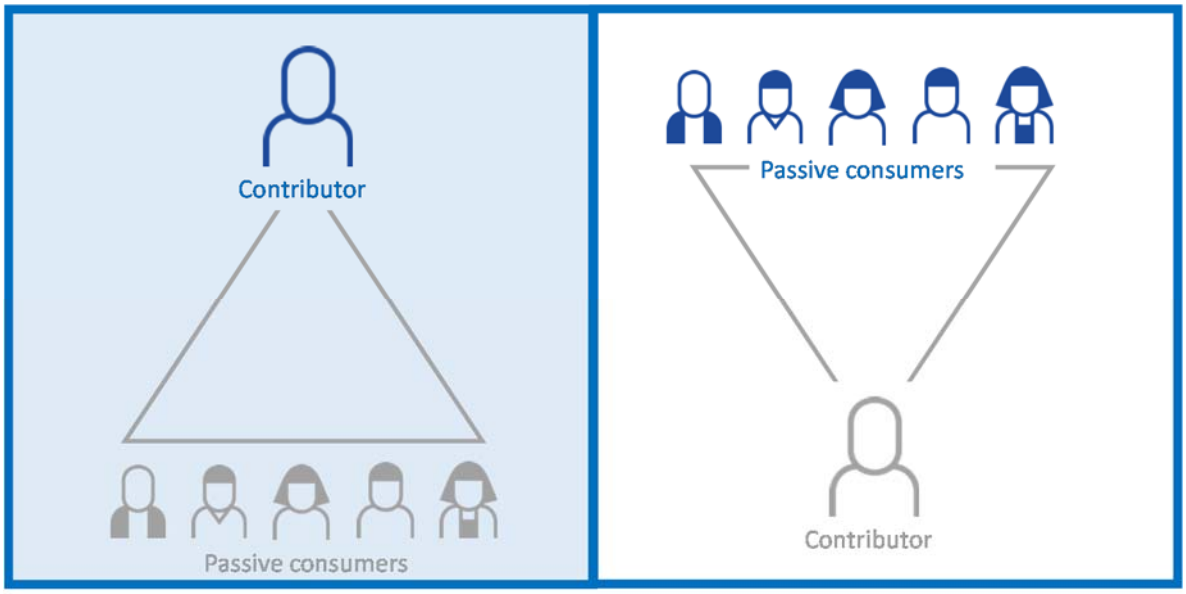
*5ŜǎλƎƴŦƧℕ Ŏ2yãdzYˆŜℕ ŜyƎI·ƎŜYˆŜyΰƴ ¢dzℕyˆΰKŜ LJèℕI· Yˆλŕ 2Ŧ I·ΰΰŜyΰΰλ2yˆdzLJǎλŕŜ Ŕ2ǿy₡ Lyΰΰ̈ŜI·Ŕ 2Ŧ Ŏ2yãλŕŜℕλyƎ ΰKŜ ySŜŘă 2Ŧ ΰKŜ ŦŜǿ Ŏ2yΰℕλōdzΰƧ2ℕăΣ ℕI·ΰKŜℕ Ŏ2yãλŕŜℕ ΰKŜ ySŜŘă 2Ŧ ΰKŜ YˆI·yê Ŏ2yãdzYˆŜℕă*

In HMNs relying on user-generated content (UGC), reader engagement is critical. While the platform owner's concern may be to make users contribute, we know from research on online participation that most users only consume[10]. This silent majority of consumers are often derogatorily referred to as lurkers; however, acknowledging the role these play in is critical for the success of the HMN. The silent majority of consumers should be leveraged as a source of motivation for the minority of users that actually contribute, to make these contribute more.

Designing for consumer engagement implies a need to make content attractive. Here, idea crowdsourcing platforms and peer-to-peer reselling services have something to learn from other UGC platforms, such as successful video or music sharing sites. At the level of interaction design, it may be relevant to prioritize the following:

- Engaging content presentations
- Preference-based content filtering, for perceived relevance
- Features for engaging with content (likes, comments)
- Recommendations on the basis of interactions

**Illustration**




**When to use**

Use in the processing of planning for a HMN that rely on UGC, or for assessing an existing HMNs. In particular, the pattern should be useful for HMNs where the content may be seen as a means towards an end, rather than a goal in itself, such as for innovation platforms and idea portals, as

[10] See e.g. https://www.nngroup.com/articles/participation-inequality/

well as for platforms for peer-to-peer reselling.

The patterns should be used during the early design phases, to make sure that the benefit of the HMN to the passive content consumers is acknowledged and will be designed for.

**Sources**
YouTube is a good example of this pattern. Though this platform for UGC depends on user contributions, the design of the platform concerns has prioritized the presentation and consumption of content.

**See other patterns**
Pattern 14.3.1.1

### 8.3.2 Example design pattern for collaboration

In Case 5 (Wikipedia), collaboration was identified as a key implication. Given, among other factors, a complex set of social ties among editors, there is some risk of disagreements or so-called revert wars. The following design pattern was suggested in response to this implication.

**14.2.2.3 ⁇ Organize social events to increase tie strength**

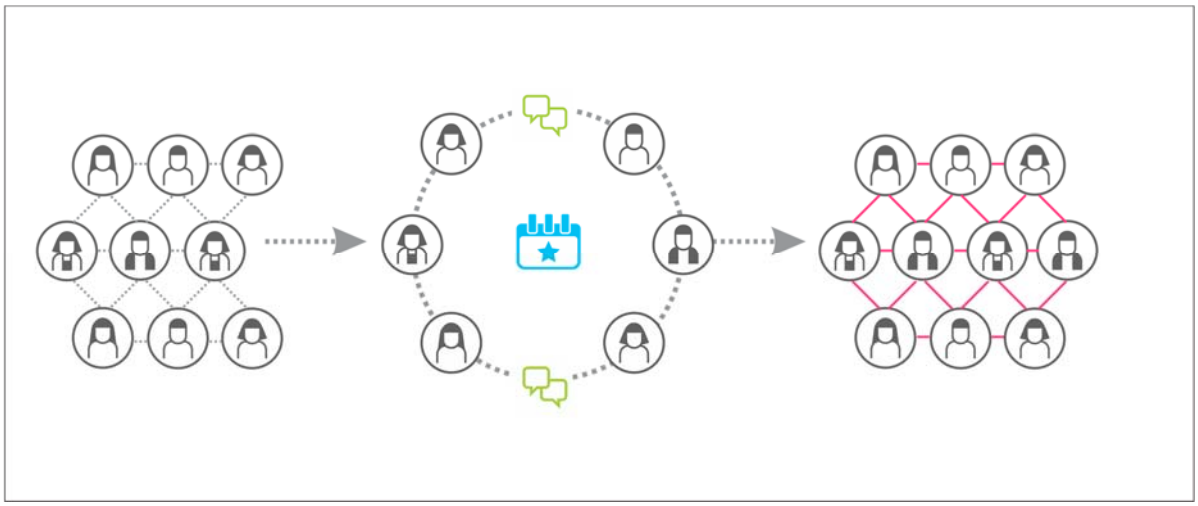
HMN type: ¢ŝŜ ăűŴŜyƎűK ǿŜI·⁇¢ Implication: /2ftfI·ō2ŇI·ûλ2yΓ Design Pattern Group(s): I н I Σ a н I

**Problem**
[I·Ŏ⁇ 2Ŧ Ŏ2ftfI·ō2ŇI·ûλ2y˝ŘʤŜ ű2 tI·Ŏ⁇ 2Ŧ ă2ŎλI·t ûλŜă¢

**Background**
In HMNs that have weak or latent, or no social ties, collaboration might be difficult. Collaboration is always entangled with conflict and opinion clashes. To avoid destructive interactions, it is important to make strong social ties between users. Friendship and strong social bounds facilitate more successful and sustainable collaboration and prohibits opinion clashes and conflicts of contributions.

**Solution**
A solution to this issue can be organizing real life events through which users get to meet each other in person and bound social ties. Research has shown that these external events can help to keep the users active and motivated in collaborative systems such as OpenStreetMap.

**Illustration**



**When to use**
The social ties are crucial for collaboration as long as the projects are ongoing. Different communities might form and dissolve, but it is important to keep the users within the social structure of the network.

**Sources**
Wikipedia community of editors have been organizing meet-ups and OpenStreeMap users have “mapping parties”. Both demonstrated positive effects on collaboration (Hristova et al., 2013).

**See other patterns**
Patterns 14.2.2.1, 14.2.2.2, 14.2.2.4

### 8.3.3 Example design pattern for innovation and improvement

In Case 6 (Zooniverse), innovation and improvement was considered a particularly relevant implication as the top-down network organization of this HMN bars typical users from engaging in improving the network. In response to this implication, the following design pattern was suggested.

**14.3.1.3 ζ Strengthen innovation through infrastructure for informal collaboration**

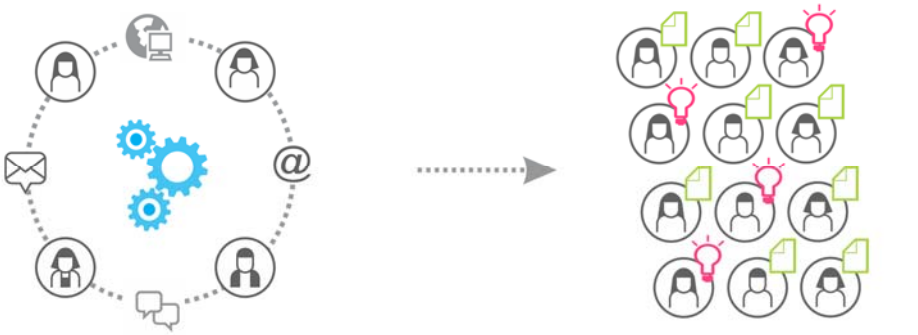
HMN type: *bŜűǿ2ℕ⟅ 2ℕ∃I·yϰÎI·ůλ2y˝ů2LJπŘ2ǿy¶* Implication: *λyŷ2ØI·ůλ2y˥* Design Pattern Group(s): *aнIΣ ана*

**Problem**
*[I·Ŏ⟅ 2Ŧλyŷ2ØI·ůλ2y˝ŘʊzŜ ů2 ů2LJπŘ2ǿy˝2ℕ∃I·yϰÎI·ůλ2y¶*

**Background**
In HMNs that the network organization is top-down (and often human agency is low), innovation is not likely. Users will stick to the assigned tasks and little "serendipity" happens. This would be problematic considering both users' motivation and emergent value of the network. The HMN should be larger than the sum of its parts and this only happens when there is synergetic innovative contribution. A top-down organization might hinder innovation and "out of box" thinking.

**Solution**
Parallel to the general workflow in the HMN, there must be infrastructure for informal collaboration and interaction. User forums can serve as a common place for brainstorming and discussing matters outside of the normal workflow of the network.

**Illustration**



**When to use**
This pattern should be considered in the design phase and maintained throughout the project lifetime

**Sources**
Relevant background for this design pattern is provided by Gay et al. (2010). In compliance with this pattern there are user forums and discussion pages in Zooniverse projects.

**See other patterns**
Patterns 14.2.2.2, 14.2.2.3

### 8.3.4 Example design pattern for trust

In Case 4 (collaborative social media verification, Reveal), trust was identified as a key implication; in particular given the high levels of machine agency in this HMN possibly making human actors uncertain regarding the credibility of the machine output. The following design pattern was suggested in response to this implication.

**14.4.3.4 Increasing trust of users through transparent algorithms**

HMN type: [illegible] Implication: [illegible] Design Pattern Group(s): [illegible]

**Problem**

When advanced processing algorithms are used on crowdsourced data, content curation mechanisms or the details of the algorithms to produce statistics or generate new information are usually hidden from the users. This is partly justified by the complexity of the algorithms and the difficulty for the wider public to understand them. However, it increases scepticism for the validity of the processing performed and creates a barrier for users to adopt and use the tools.

**Background**

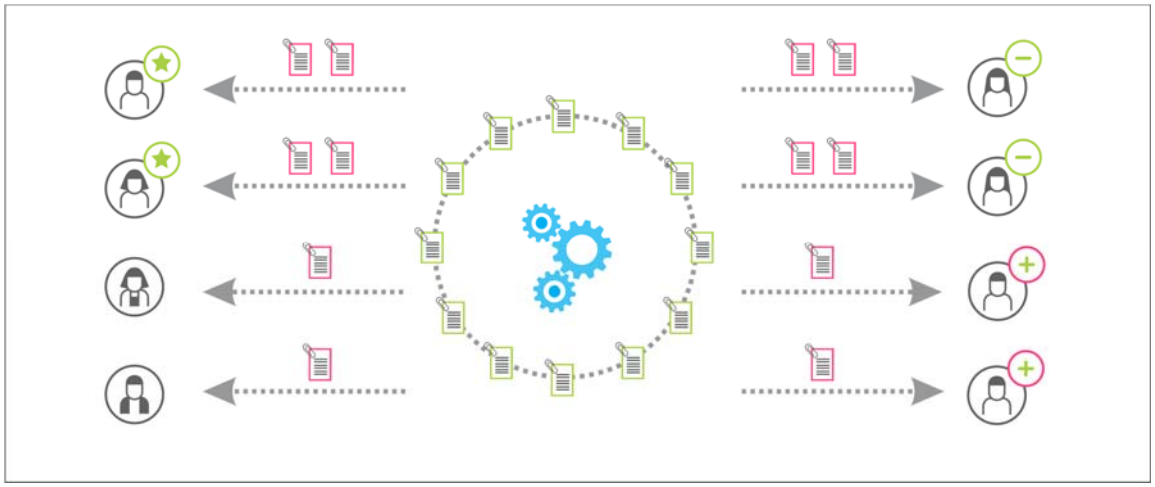
A large number of Internet HMNs are built specifically to support problem-solving of some form. In particular, there has been a growing interest in exploiting the wisdom of crowds, together with advanced data mining techniques, for facilitating tasks in real life and work. Examples of such tasks include: prediction services (e.g. market prediction), Q&A systems, recommendation systems, news aggregators and citizen journalism platforms.

The common processing steps for these systems is that they collect data from a large number of sources (crowdsourcing), generate statistics and new information by processing the data, evaluate the quality of the information, and publish it. In some cases, the higher the machine agency, the more reluctant the human actor is to accept and make use of the information.

**Solution**

A solution for increasing trust in the processing algorithms is to provide more details about the algorithms, that is, to increase transparency. Different levels of details can be disclosed for different levels of expertise (e.g. novice and expert users). The publication of algorithm details and the acceptance of the methods by the scientific community are also important steps for building trust. Additionally, it is important that results can be verified by third-party analysis, that they agree with the "common sense" of the users and are coherent, meaning that very similar content and sources should receive similar scores.

**Illustration**



**When to use**

Transparency on algorithm details for data processing could be provided at any time, although it would be better to be transparent from the start. However, it is common for developers of such tools to constantly improve their algorithms, especially in the start, therefore some time may pass before the algorithms van be fully disclosed. This is also done to protect intellectual property rights, as the inventor of such methods may want to protect them with patent applications.

**Sources**

The Google PageRank algorithm is perhaps the most well-known example of an algorithm that is widely used, well documented and accepted by the scientific community.

## 8.4 Classifying the design patterns

To provide an accessible resource, bodies of design patterns may be systematized in design pattern libraries. Such design pattern libraries serve as a hierarchical structuring of design patterns to serve as reference for future design (Borchers, 2001; Gamma, Helm, Johnson, & Vlissides, 1994; Seffah, 2015; van Duyne, Landay, & Hong, 2002). Some have also succeeded in making design pattern libraries living entities, such as UI Patterns (http://ui-patterns.com), where the body of design patterns are expanded on over time.

For the HUMANE design patterns several approaches to systematization are possible. Based in identified implications, the corresponding design patterns may be grouped into five main groups: (a) user motivation and experience, (b) user behaviour and collaboration, (c) innovation and improvement, (d) privacy and trust, as well as (e) the underlying technical infrastructure. When providing the full overview of all initial design patterns suggested as part of the work leading up to this report (Appendix C), the patterns are grouped following this structure.

However, for HCD designers, it may also be useful to have the design patterns grouped according to their functional role, that is, the functions in the HMN to which they correspond. To this end, consider Figure 16 below. Based on a large HMN providing decision support involving different types of human actors with different roles and responsibilities, and different types of interaction between human actors, other human actors, technical components within the network, and between the machines, four main types of interaction can be identified between the edges in the network.

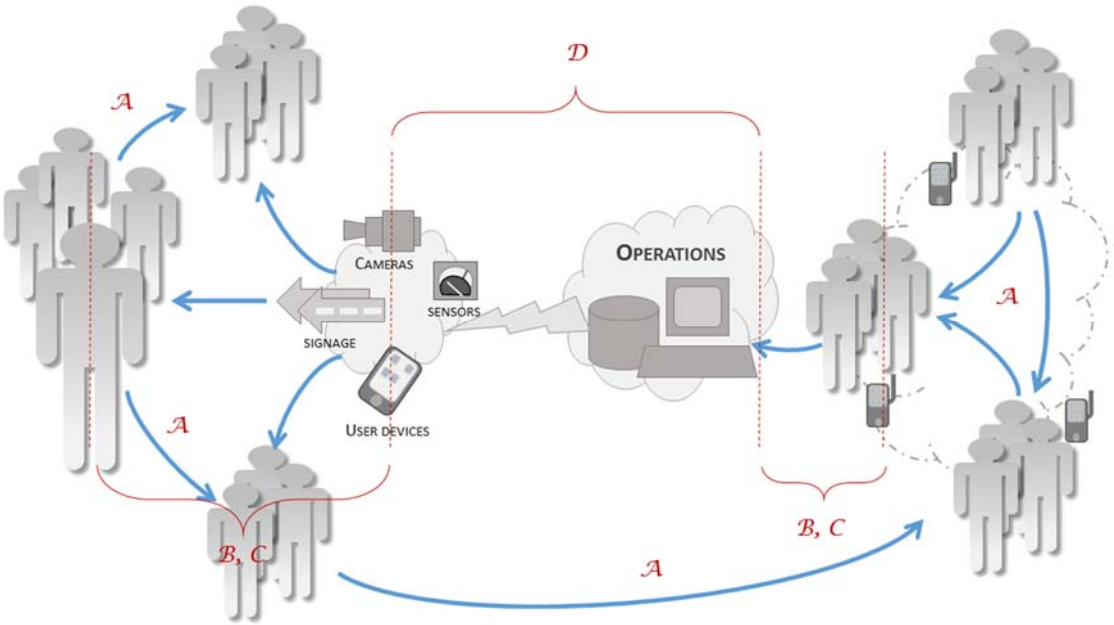



**Figure 16: Design pattern types within HMNs**

As shown in the figure, these interactions may be classified as follows:

A. Interactions between human actors, H2H in Section 8.4.1. The design patterns at this level relate to how the HMN can encourage collaborative behaviours between the human actors
B. Interactions between human and machine actors, H2M in Section 8.4.2. This is the more traditional HCI domain. This is relates not only to ease-of-use and ÌÝ ŜÈÚŃŜÝÌă to trustworthiness. Design patterns here relate to encouraging as well as facilitating interaction: how can I design to help Human agents respond appropriately and provide the input that Machine agents need?
C. Interactions between machines and human actors, M2H in Section 8.4.3. Correspondingly, the machine to human interface may be misconstrued as H2M (see above). But design patterns at this level answer the question: how can I design to help Machine agents respond proactively and be perceived as positive contributors?
D. Interactions between machines, M2M in Section 8.4.4. Traditionally, interaction between machines is usually constrained by standard protocols. Design patterns here would be typically derived from standard reference works. They seek to address: how can machine components be designed to make the most effective contribution to networks?

Each of these interaction types can be illustrated by one or other of the HUMANE use cases, as well as from well-known HMNs. In the following sections, examples are discussed which address specific problems across different parts of the HMN networks considered. As will become clear, these patterns encourage behavioural outcomes in the various networks which turns the focus away from HMN structure towards what the network delivers.

Below, we outline how the identified design patterns may be structured according to the four interaction types. For each of these, we also discuss how this interaction type relates to implications such as (a) motivation and experiences, (b) user behaviour and collaboration, (c) innovation and improvement, and (d) privacy and trust.

### 8.4.1 H2H Design Patterns

The main focus of H2H design patterns is how to encourage productive or constructive interaction between human actors within the HMN. Many of the patterns affect other areas of the HMN and interaction types, which is apparent in the descriptions in the Appendix. However, the patterns here may all contribute to the four main themes we had previously identified (D3.2):

1. **User motivation and experience**: engagement between human actors, irrespective of tie strength, can create a feeling of community or by word-of-mouth promoting the network to others and thereby encourage those actors to engage;
2. **User behaviour and collaboration**: as a result of a motivation to engage, human actors are more likely to participate and collaborate;
3. **Innovation and improvement**: encouraging human actors to engage in the HMN is one factor in promoting the long-term sustainability of that network;
4. **Privacy and trust**: all of the above are predicated on a level of trust between humans in the network; under appropriate circumstances, such interpersonal trust may be transferred and applied to the machine components within a network.

The following table summarises the design patterns which specifically relate to the research question: *K2ø ŏl·y˝ŭKŜ I a b Ŝyŏ2ʤNl·ƎŜ ŏ2ffl·ō2Nl·ŭλØŜ ōŜKl·Øλ2ʤNă ōŜŭøŜŜy˝ŭKŜ KʤYl·y˝l·ŏŭ2Nă*? The columns refer to the Section in Appendix B where the pattern is described, its descriptive title and the phase during which it should be used, i.e., Planning, Design, Redesign, Rollout, and Operation. All of these phases are represented by these patterns.

**Table 5: Design patterns to support H2H interactions**

| PATTERNS WHICH INFLUENCE HUMAN-TO-HUMAN INTERACTIONS IN HMNS | | |
|---|---|---|
| **REF** | **DESCRIPTIVE TITLE** | **WHEN TO USE** |
| 14.1.4.1[11] | Motivating users to contribute content in HMNs | Planning / Operation |
| 14.1.4.3 | Reward users to keep them motivated | Rollout / Operation |
| 14.1.5.1 | Preserving reputation of an individual, company or organization in HMNs | Rollout / Operation |
| 14.2.1.2 | Behavioural change through social motivation | Planning |
| 14.2.2.1 | Collaboration through gamified engagement | Design |
| 14.2.2.3 | Organize social events to increase tie strength | Operation |
| 14.2.3.1 | Apply loyalty ladder to build and maintain a sustainable user base | Planning / Redesign |
| 14.2.4.1 | Encouraging shared responsibility HMNs | Rollout / Operation |
| 14.2.5.1 | Supporting social interaction through strengthening within-platform communication | Planning / Redesign |
| 14.3.2.1 | Use AI to ensure quality | All |
| 14.3.2.2 | Employ automatic quality control | Rollout |
| 14.3.3.1 | Protect new users from bouncing | Operation |
| 14.4.3.1 | Strengthen trust through efficient handling at first point of contact | Design |
| 14.4.3.2 | Strengthen interpersonal trust through rich profiles and recommendations | Planning / Redesign |
| 14.4.3.3 | Supporting trust across HMN interactions | Design / Operation |

The patterns summarised in

[11] The reference number format refers to the appendix heading under which the design pattern is grouped. See Appendix C for details.

Table 5 cover design implications across: Behavioural change; Collaboration; Loyalty; Motivation; Network growth; Product quality; Reputation; Social interaction; and Trust. Further, they apply to all different phases of network design and deployment; and cover both specific aspects of human-to-human contact and interaction as well as machine actor activities in support of those interactions. Both human and machine actors are therefore important in maintaining the value and efficacy of the network.

### 8.4.2 H2M Design Patterns

H2M Patterns relate to interactions between human and machine actors directly in respect of the support needed at the machine level to support human actors. They concern human input and are more typically associated with the User Interface (UI). As such, they relate to technology usability, acceptance and adoption. In regard to the four main themes we had previously identified (D3.2):

1. **User motivation and experience**: at the level of the UI, human actors need to be encouraged to use the interface and to behave in ways that provide the types of input required. This may be associated with the persuasiveness of the interface, though this is not the whole story. Continued use requires efficiency and perceived usefulness as captured in the technology acceptance model and derivatives;
2. **User behaviour and collaboration**: once motivated as hinted at above, human actors can be assumed to engage and make use of the HMN;
3. **Innovation and improvement**: both are then important to be able to maintain continued use and expansion of the network. Patterns addressing the UI component of any machine actors are important therefore for the long-term acceptance and sustainability of the network;
4. **Privacy and trust**: technology acceptance and long-term usage is also dependent on the trust which users have in it. In consequence, patterns which facilitate the development and maintenance of trust in the machine components are significant for the health of the HMN.

The following table summarises the design patterns which specifically relate to the research question: *K2ø ŏI·y˙L ŘŜăλƎy˙ű2 KŜfŁJ I ʤY˙I·y˙I·ƎŜyűă ℕŜăŁJ2yŘ I·LJŁJℕ2ŁJℕλI·űŜfè I·yŘ ŁJℕ2ØλŘŜ űKŜ λy€JdzűűKI·ű a I·ŏKλyŜ I·ƎŜyűă ySŜŘ?*

**Table 6: Design patterns to support H2M interactions**

| PATTERNS WHICH INFLUENCE HUMAN-TO-MACHINE INTERACTIONS IN HMNS | | |
|---|---|---|
| **REF** | **DESCRIPTIVE TITLE** | **WHEN TO USE** |
| 14.1.1.1 | Campaigns, not routine, for attention in small-scale HMNs | Design |
| 14.1.1.2 | Maximising the benefits of affordances | Design / Operation |
| 14.1.4.2 | Attracting and motivating users in content aggregation, curation and recommendation systems | Planning / Operation |
| 14.1.5.1 | Preserving reputation of an individual, company or organization in HMNs | Rollout / Operation |

| | | |
|---|---|---|
| 14.2.1.1 | Making behavioural change a basic premise of the HMN | Planning / Redesign |
| 14.2.4.1 | Encouraging shared responsibility HMNs | Rollout / Operation |
| 14.3.1.1 | Contributors learn to improve by being consumers first | Planning |
| 14.3.3.1 | Protect new users from bouncing | Rollout / Operation |
| 14.3.3.2 | Catering for HMN evolution | Rollout / Operation |
| 14.4.1.1 | Enhancing security in HMNs concerning data aggregation and content curation services | |
| 14.4.1.2 | Managing privacy | |
| 14.4.2.1 | Securing HMNs | Rollout / Operation |
| 14.4.3.2 | Strengthen interpersonal trust through rich profiles and recommendations | Planning / Redesign |
| 14.4.3.3 | Supporting trust across HMN interactions | Design / Planning |
| 14.4.3.4 | Increasing trust of users through transparent algorithms | Rollout / Operation |
| 14.4.3.5 | Increasing trust of users through strict, clear privacy policies | Planning / Design |
| 14.5.1.1 | Designing for flexible configurations of HMNs | Operations |

These patterns (see Table 6) relate to design implications in the following areas: Attention; Behavioural change; Innovation and Improvement; Motivation; Network growth; Reputation; and Trust. Given the relation of H2M patterns with the high-level factors of motivation, participation, sustainability and trust, this is hardly surprising. What they also make clear, though, is that HMNs rely on the interaction not only between human participants, as would be expected in social machines, but also on the relationship and interaction with machine components in the network.

### 8.4.3 M2H Design Patterns

We have made the distinction between H2M and M2H patterns in relation to agency (see Engen, Pickering, & Walland, 2016). H2M patterns as outlinsed above reflect specifically how technology design can affect human interaction: the UI must be acceptable and attractive to encourage engagement. However, there is another significant factor at play: how machines respond to humans and what they do with information and content provided is a rather different issue. This will affect multiple aspects of an operational HMN (see D3.2):

1. **User motivation and experience**: if machines are perceived to behave at least as expected, but preferably in users' best interest in improving service and contributing to network goals, then this may be expected to have a positive effect on motivation: human actors are more likely to engage if they perceive machine actors as collaborators rather than necessary and uninfluential devices;

2. **User behaviour and collaboration**: such motivation could then be expected to have a positive effect on participation in that human actors would be encouraged not only to take part but also to extend usage and even adopt novel and unexpected behaviours in moving the HMN forward;
3. **Innovation and improvement**: with machine actors regarded not only as necessary but also as effective parts of the HMN, this might influence long-term and continued network operation and user participation;
4. **Privacy and trust**: at the same time, an increasing awareness that machine components in the network are playing a contributory and not just passive role will maintain trust in technology and in turn influence technology acceptance.

The following table summarises the design patterns which specifically relate to the research question: *K2ø ŎI·y˝ L ŘŜăλƎy˝ ű2 KŜfLJ a I·ŎKλyŜ I·ƎŜyűă ℕŜăLJ2yŘ LJℕ2I·ŎűλØŜfè I·yŘ ōŜ LJŜℕŎŜλØŜŘ I·ă LJ2ăλűλØŜ Ŏ2yűℕλōdzű2ℕă*?

**Table 7: Design patterns to support M2H interactions**

| PATTERNS WHICH INFLUENCE MACHINE-TO-HUMAN INTERACTIONS IN HMNS | | |
|---|---|---|
| **REF** | **DESCRIPTIVE TITLE** | **WHEN TO USE** |
| 14.1.1.1 | Campaigns, not routine, for attention in small-scale HMNs | Planning / Design |
| 14.1.1.2 | Maximising the benefits of affordances | Design / Operation |
| 14.1.2.1 | Provide what is desired, not just what is known | Planning / Design |
| 14.1.3.1 | Address information overload in HMNs with huge volume of content | Design / Operation |
| 14.1.4.1 | Motivating users to contribute content in HMNs | Planning / Design / Redesign |
| 14.1.4.2 | Attracting and motivating users in content aggregation, curation and recommendation systems | All |
| 14.1.4.3 | Reward users to keep them motivated | All |
| 14.1.5.1 | Preserving reputation of an individual, company or organization in HMNs | Rollout / Operation |
| 14.2.1.1 | Making behavioural change a basic premise of the HMN | Planning / Redesign |
| 14.2.2.1 | Collaboration through gamified engagement | Planning / Design |
| 14.2.2.2 | Consider geography in designing collaboration | All |
| 14.2.2.3 | Organize social events to increase tie strength | Operation |
| 14.2.3.1 | Apply loyalty ladder to build and maintain a sustainable user base | Planning / Redesign |

| | | |
|---|---|---|
| 14.2.4.1 | Encouraging shared responsibility HMNs | Rollout / Operations |
| 14.2.5.1 | Supporting social interaction through strengthening within-platform communication | Planning / Resign |
| 14.3.1.1 | Contributors learn to improve by being consumers first | Planning / Design |
| 14.3.1.2 | Support improvement through showing trends and good examples | Planning / Redesign |
| 14.3.1.3 | Strengthen innovation through infrastructure for informal collaboration | All |
| 14.3.2.1 | Use AI to ensure quality | All |
| 14.3.2.2 | Employ automatic quality control | Rollout |
| 14.3.3.1 | Protect new users from bouncing | Rollout / Operation |
| 14.3.3.2 | Catering for HMN evolution | Rollout / Operation |
| 14.4.1.1 | Enhancing security in HMNs concerning data aggregation and content curation services | Design |
| 14.4.1.2 | Managing privacy | Rollout / Operations |
| 14.4.3.2 | Strengthen interpersonal trust through rich profiles and recommendations | Design |
| 14.4.3.3 | Supporting trust across HMN interactions | Design / Planning |
| 14.4.3.4 | Increasing trust of users through transparent algorithms | Rollout / Operation |
| 14.4.3.5 | Increasing trust of users through strict, clear privacy policies | Planning / Design |
| 14.5.1.1 | Designing for flexible configurations of HMNs | Operations |
| 14.5.2.1 | Include self-healing mechanisms into HMNs | Operations |

The patterns summarised in Table 7 to almost all the implications identified in Section 7, including: Attention, Behavioural change, Collaboration, Experience, Information Overload, Innovation and Improvement, Loyalty, Motivation, Network growth, Privacy, Product quality, Reputation, Social Interaction and Trust. This suggests that successful HMNs rely for their success on a suitably recognised contribution of machine agents. By definition, both socio-technical systems and actor networks are aware of the significance of the machine actors in HMNs; this is not always the case for social machines where the look-n-feel (H2M) and the contribution of machines (M2H) is often overlooked.

### 8.4.4 M2M Design Patterns

The final set of patterns relates specifically to the consequences and therefore activities to be associated with machine-to-machine interactions. It is not enough for human actors to perceive the effectiveness of the machine components they are most clearly involved in (their own computers).

Instead, for the network to be a success, there must also be a correspondingly effective interplay between the machines themselves as effective participants in the HMN. Perceived machine-to-machine interactions could be expected to affect multiple aspects of the HMN (see D3.2):

1. **User motivation and experience**: whether explicitly recognised, or take for granted, effective machine-to-machine operation is essential to avoid de-motivation which could lead to the adoption of alternatives and ultimately the collapse of the network;
2. **User behaviour and collaboration**: continuing to work as part of a network similarly requires some perception of the efficiency and integrity of the machine components;
3. **Innovation and improvement**: further, without effective machine contribution, by definition the network would collapse: all actors in the network must play a role and co-operate appropriately;
4. **Privacy and trust**: although not typically thought of in machine terms, trust is essential for the effective operation of the HMN since technology must be able to work in sync in support of the network rather than in competition.

The following table summarises the design patterns which specifically relate to the research question: *K2ǿ ŏI·y˝ YI·ŏKλyŜ ŏ2YLJ2yŜyűă ōŜ ŘŜăλƎyŜŘ ű2 YI·ʅŜ űKŜ Y2ăű ŜŦŦŜŏűλǾŜ ŏ2yűNλōdzűλ2y˝ű2 ySűǿ2Nʅă?*

**Table 8: Design patterns to support M2M interactions**

| PATTERNS WHICH INFLUENCE MACHINE-TO-MACHINE INTERACTIONS IN HMNS | | |
|---|---|---|
| **REF** | **DESCRIPTIVE TITLE** | **WHEN TO USE** |
| 14.1.2.1 | Provide what is desired, not just what is known | Planning / Design |
| 14.1.3.1 | Address information overload in HMNs with huge volume of content | Design / Operation |
| 14.3.1.3 | Strengthen innovation through infrastructure for informal collaboration | All |
| 14.3.2.1 | Use AI to ensure quality | All |
| 14.3.2.2 | Employ automatic quality control | Rollout |
| 14.3.3.2 | Catering for HMN evolution | Rollout / Operation |
| 14.4.1.1 | Enhancing security in HMNs concerning data aggregation and content curation services | Design |
| 14.4.2.1 | Securing HMNs | Rollout / Operation |
| 14.4.3.2 | Strengthen interpersonal trust through rich profiles and recommendations | Design |
| 14.4.3.5 | Increasing trust of users through strict, clear privacy policies | Planning / Design |
| 14.5.1.1 | Designing for flexible configurations of HMNs | Operations |
| 14.5.2.1 | Include self-healing mechanisms into HMNs | Operations |

Table 8 summarises the patterns specific to machine-to-machine interactions. As well as covering all stages of operation from design to full operation, the patterns relate to the following areas: Experience, Information Overload, Innovation and Improvement, Privacy, Product quality, and Trust. Although machine operation may be regarded as secondary and assumed, especially for social machine type networks, there are significant issues which need to be addressed at this level. The design patterns here may be compared to standard patterns in software engineering (Gamma et al., 1994), but should also be seen in the context of the other patterns outlined in the previous sections.

## 8.5 Concluding remarks on the design pattern approach

In this section, we have summarised a set of design patterns derived from an internal review of implications associated with the various use cases of interest to HUMANE. Grouping these together at interaction level (H2H, H2M, M2H, and M2M) helps identify the specific design experts for whom the design patterns may be relevant. For instance, UX and UI designers are more likely to be interested in H2M and M2H patterns than system architects and platform developers whose focus would be targeted more specifically at M2M interactions and what effect this has on the systems they implement. At the same time though, and especially in the Appendix where all the patterns are listed using a common template, we have provided a behavioural-type grouping which links back to earlier work in WP3 identifying constructs such as trust, motivation and experience, and collaboration.

The design patterns suggested here are established in response to an initial set of implications for the six HUMANE cases. As this set of implications is may be extended in the subsequent case executions (D3.3), in particular through a more comprehensive analysis of selected implications, the set of design patterns may also be extended and thereby provide more comprehensive responses to the implications of particular relevance to the HUMANE cases.

Moving forward, the relevance of the identified design patterns to those directly involved in the development of the network as well as other stakeholders including users and those who represent those users will be investigated through validation of the designs. The purpose of that exercise is twofold: in the first instance, to provide support for what we have done in this deliverable to identify specific challenges for HMNs, their implications for design, and the design patterns themselves which may contribute to a solution for those challenges. But secondly, engagement with stakeholders of our case study networks will help explore the feasibility of the design patterns in terms of guiding development activities.

# 9 Tool support

To support the application of the HUMANE typology and method, we aim to provide an interactive tool to support HMN profiling and transfer of design knowledge and experience in a design pattern format. For this second version of the HUMANE typology and method, the tool has been developed to a fully functional prototype version.

The tool is temporarily available at https://networkprofiler.recordlivinglab.org (but will have the following permanent address https://networkprofiler.humane2020.eu). In this section, we provide an overview of the tool and detail its key features.

## 9.1 Motivation – why do we need tool support

At the heart of the HUMANE method is the profiling process. Here, designers and developers can profile the HMN for which they are designing or developing, and apply the resulting profile for discussion and reflection on implications and design solutions.

Among the findings from the first HUMANE case executions (Lüders et al., 2016), was the need to be able to conduct the profiling quickly and easily, on the one hand, and reliably, on the other. To enable this, adequate tool support is needed.

Furthermore, the HUMANE method assumes the transfer of design knowledge and experiences across HMNs which share profile characteristics. For this to be possible, profiles and design knowledge from a large number of HMNs need to be stored and made available through a common interface.

In the first version of the HUMANE typology and method (Følstad et al., 2015) we provided a template for HMN profiling. This template to some degree provided support for HMN profiling, but no support for transfer of knowledge across HMNs. Hence, in this second version of the typology and method we aim to provide an interactive tool with extended profiling support as well as with support for sharing and transfer of design knowledge and experience.

## 9.2 Tool – overview

The tool, called HUMANE Network Profiler, is an interactive website with an introduction to HMN profiling and features for HMN profiling, sharing and reflecting on design knowledge in the form of design patterns, and browsing of existing HMN profiles and design patterns.

The tool applies Google Material Design[12]. Material design is a design framework with an associated library of components, facilitating consistent design and good user experience across varying devices.

The tool includes the following main parts:

- **Getting started:** An instruction page introducing the concept of HMN and motivating the benefit of profiling HMNs and use the profile for cross-domain transfer of design knowledge and experience.
- **Profile a network:** Here the user can profile a particular HMN. The profiling is conducted as a stepwise process covering the eight HUMANE dimensions.
- **Identify and discuss design patterns:** Each HMN profile serve as location for relevant design patterns. The user can identify relevant design patterns on the basis of profile similarity and

[12] https://material.google.com/

connect these to the HMN profile. Each design pattern has included a discussion thread for sharing of experiences.

- **Share design patterns:** The availability of design patterns require that these are entered. In the HUMANE project, we provide an initial pool of design patterns, drawing on the six HUMANE cases. Users seeing the need for a particular design pattern for a given HMN profile, that is not yet provided, may add this.
- **Browse networks:** Here all HMNs that are profiled in the HUMANE Network Profiler are listed. To see profiles of particular relevance for a particular HMN, the list may be filtered on the basis of scores on one or more of the HUMANE dimensions.
- **Browse patterns:** Here all design patterns that are made available in the HUMANE Network profiler are listed. To see design patterns of particular relevance for a particular HMN, the list may be filtered on the basis of scores on one or more of the HUMANE dimensions.

The content in the tool is openly available for browsing. However, to enter or moderate content the user needs to register or log in.

The "Getting started" page is presented in Figure 17. The features for entering, browsing, and discussing HMN profiles and design patterns are presented in the following subsections. One subsection also details the user access to the tool.

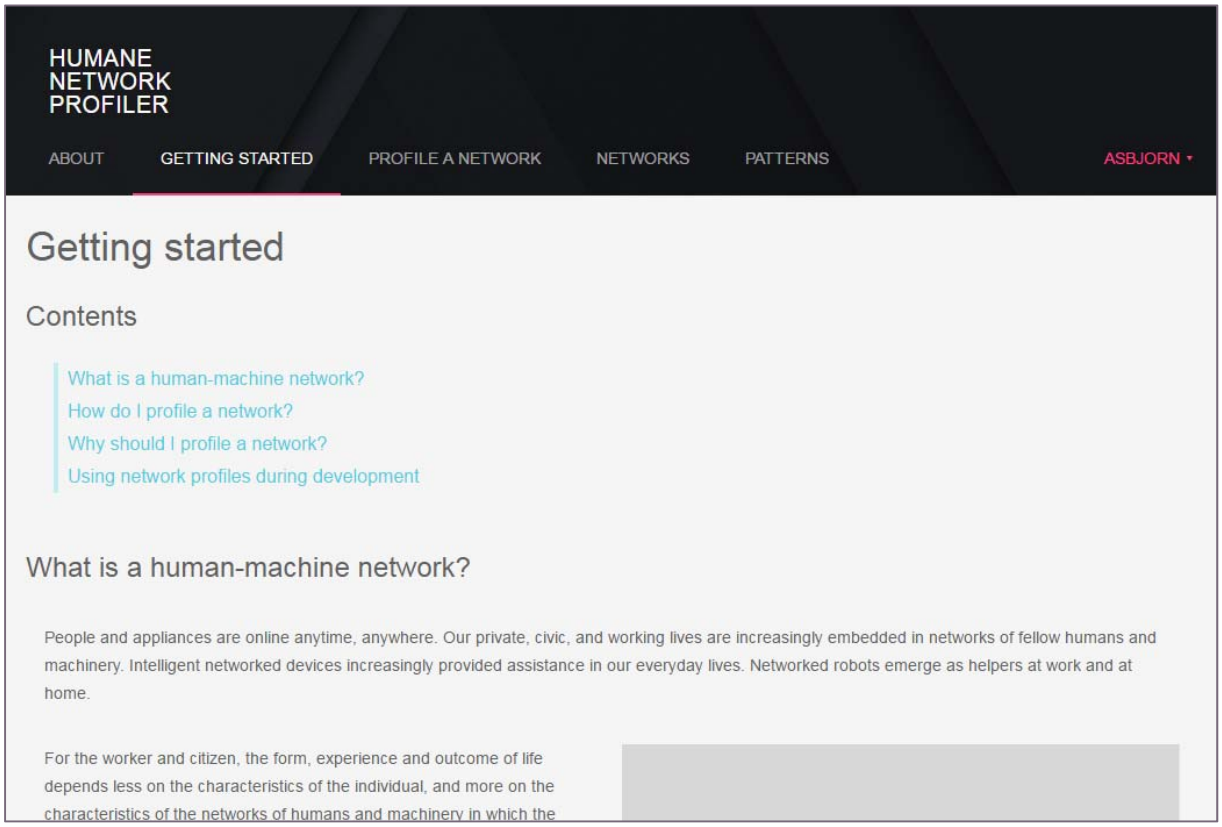



**Figure 17: HUMANE Network Profiler - Getting started (screen dump).**

## 9.3 Profiling a HMN in the tool

The profiling process of the tool aims to make the typology (Section 4) more easily available to designers and developers, and supports profiling a particular HCD in six simple steps.

In the first step, the HMN is given a name and brief description. For additional personalization, an optional HMN logo may be added as well as an optional link to an external website providing more details on the HMN.

In the next four steps, the profile is built through responding to questions for each dimension (see Section 4.1 for an overview of the questions). Each question reflects one of the defining aspects of the dimension, and responses are given in percentage agreement. Each of the four steps corresponds to a HUMANE analytical layer. Hence one step concerns actors (human agency and machine agency), one concerns interactions (social tie strength and H2M interaction strength), one concerns behaviour (workflow interdependence and network organization), and one concerns network (size and geographical space).

In the final step, the profile is consolidated by visualizing the average scores of the questions belonging to each dimension as a spider diagram (See Figure 18).

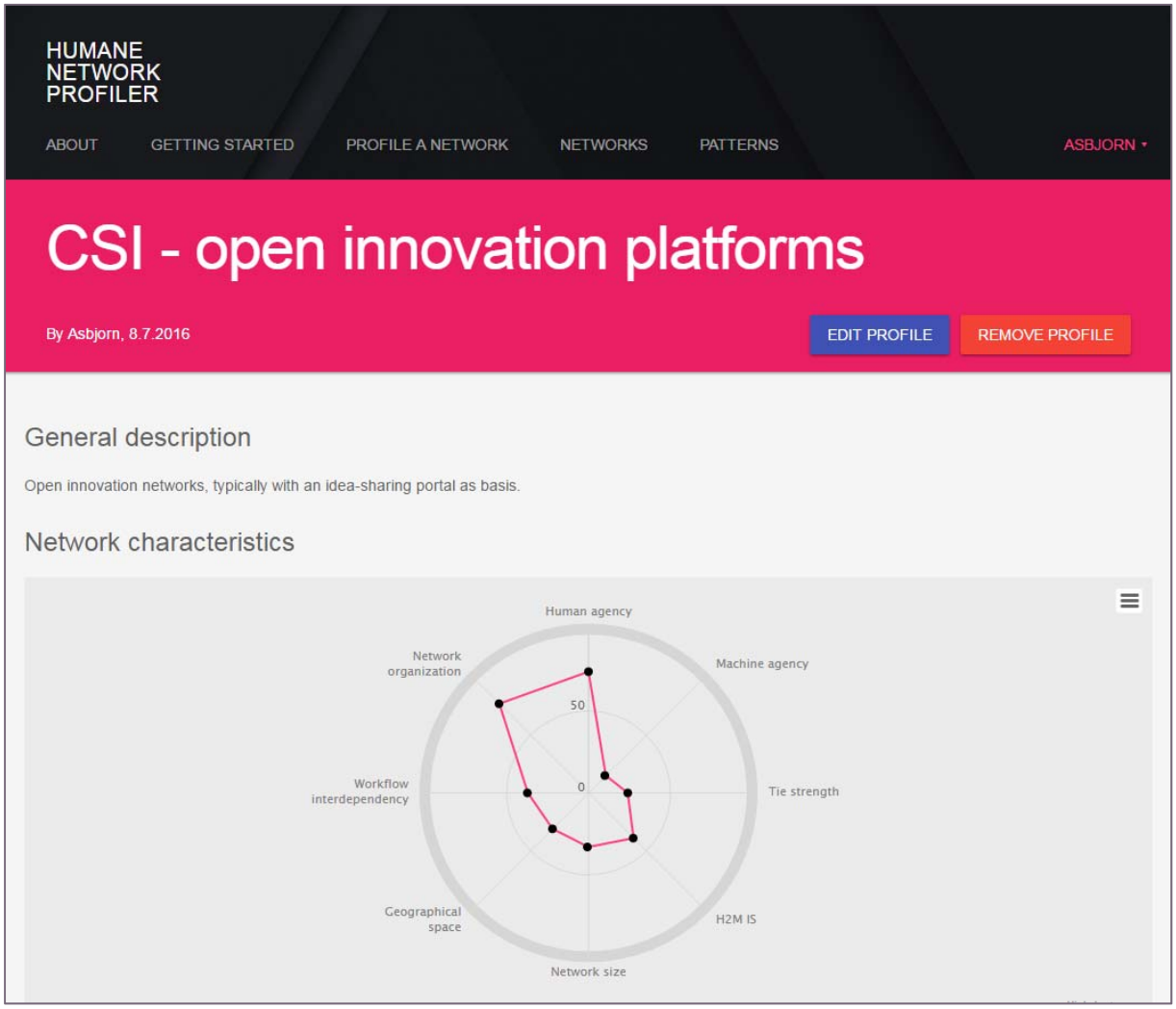



**Figure 18: HUMANE Network Profiler – Consolidated network profile (screen dump)**

When the profile is stored, it is made available for browsing by others and for further reflection on design patterns. Furthermore, the profile includes a list of most similar HMNs as well as an option to include relevant design patterns. The list of most similar HMNs supports reflection on cross-domain similarities among HMNs, which is intended to motivate HCD designers to see HMNs from different domains as relevant sources of design knowledge and experience. The option to include relevant design patterns, makes it possible for the HCD designer to explore design patterns with basis in the HMN profile, and to associate the HMN profile with relevant design patterns.

## 9.4 Reviewing similar HMNs in the tool

The HMN profile is the basis for identifying similar HMN profiles. As part of the HMN profile, other HMNs are listed on the basis of their similarity with the HMN profile in question (see Figure 19).

In this prototype version of the tool, the listing is done on the basis of a preliminary similarity score calculated as the degree of match between the dimension scores for the HMN in question and the matching HMN. A 100% match indicated absolute similarity on all dimension scores. A 0% match indicates maximum theoretical difference on all dimension scores. There is a 10 item limit on the number of similar HMN profiles listed within a given profile. To be included in the list, the similarity value should be minimum 60%- set as a tentative threshold. We refer to the similarity score as preliminary, as it is foreseen a need to update the current approach to calculating similarity and listing HMN profiles on the basis of similarity in later versions of the tool.

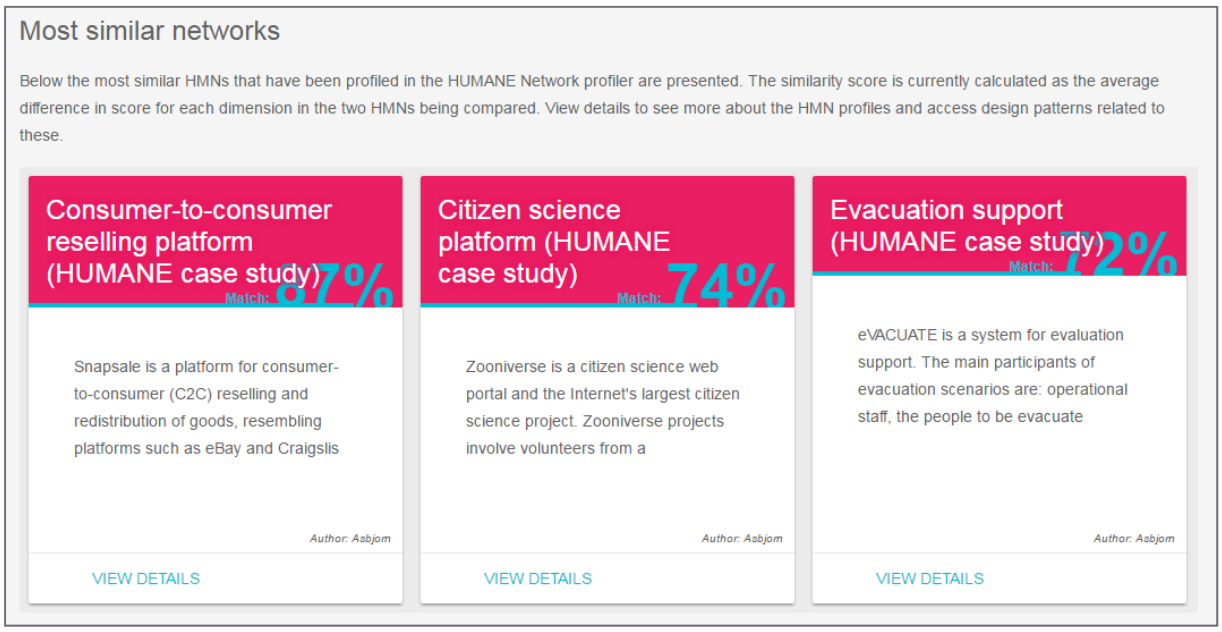



**Figure 19: HUMANE Network Profiler – list of similar profiles in the HMN profile page (screen dump).**

## 9.5 Identifying and sharing design patterns in the tool

The HMN profile is the basis for identifying relevant design patterns. Furthermore, the profile is the basis for sharing design knowledge and experience in the form of design patterns. An example design pattern is presented in Figure 20.

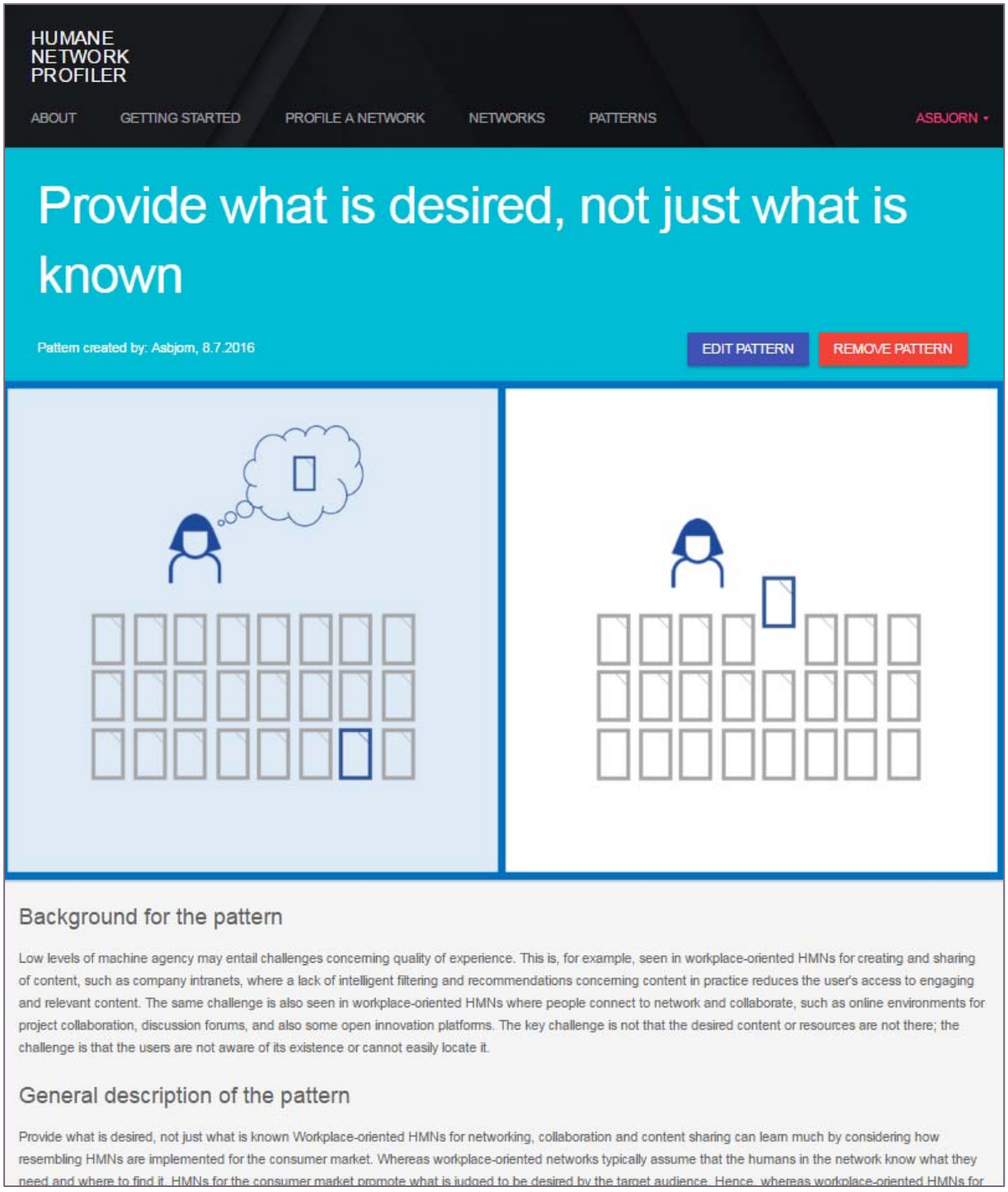



**Figure 20: HUMANE Network Profiler – example design pattern (screen dump)**

At the end of all design patterns, as well as at the end of all HMN profiles a Disqus (http://disqus.com) discussion module is included to facilitate reflections and sharing of experience.

**Identifying relevant design patterns**

To identify relevant design patterns, enter an established HMN profile. In the profile, a section on design patterns is included. To populate the section with relevant design patterns from other HMN profiles, the HCD designer access all available design patterns by clicking "Add design pattern". From here, it is possible to browse either all available patterns, or only "suggested patterns" (see Figure 21). Design patterns are suggested on the basis of profile similarity to the HMN profiles with the design pattern added.

Design patterns identified as relevant can be added to the HMN profile. These pattern then will populate the list of relevant design patterns in the HMN profile.

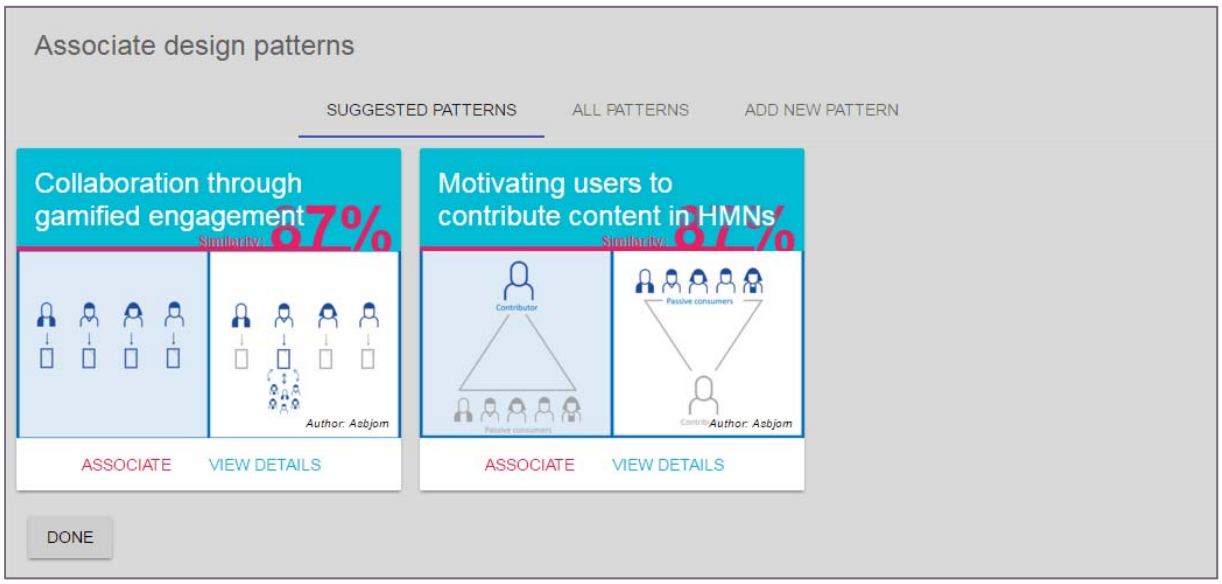



**Figure 21: HUMANE Network Profiler - Adding suggested design patterns in example HMN profile page (screen dump).**

**Adding needed design patterns**

Based on the HMN profile, it is also possible to add needed design patterns that are not already available in the HUMANE Network Profiler. Adding new design patterns is done by selecting "Add new pattern" next to the listing of available design patterns.

Adding a new design pattern is done by entering a pattern title, background, problem, solution, and instructions on how to use. An optional image may also be added.

## 9.6 Browsing HMNs and design patterns in the tool

All HMN profiles and design patterns that have been entered in the HUMANE Network Profiler is readily available for browsing through the menu options "Networks" and "Design patterns".

**Browse HMN profiles**

When entering the page for browsing HMN profiles, all profiles are listed in the order of which they were entered. To facilitate browsing, profiles can be filtered on the basis of the scores on one or more of the profile dimensions (see Figure 22).

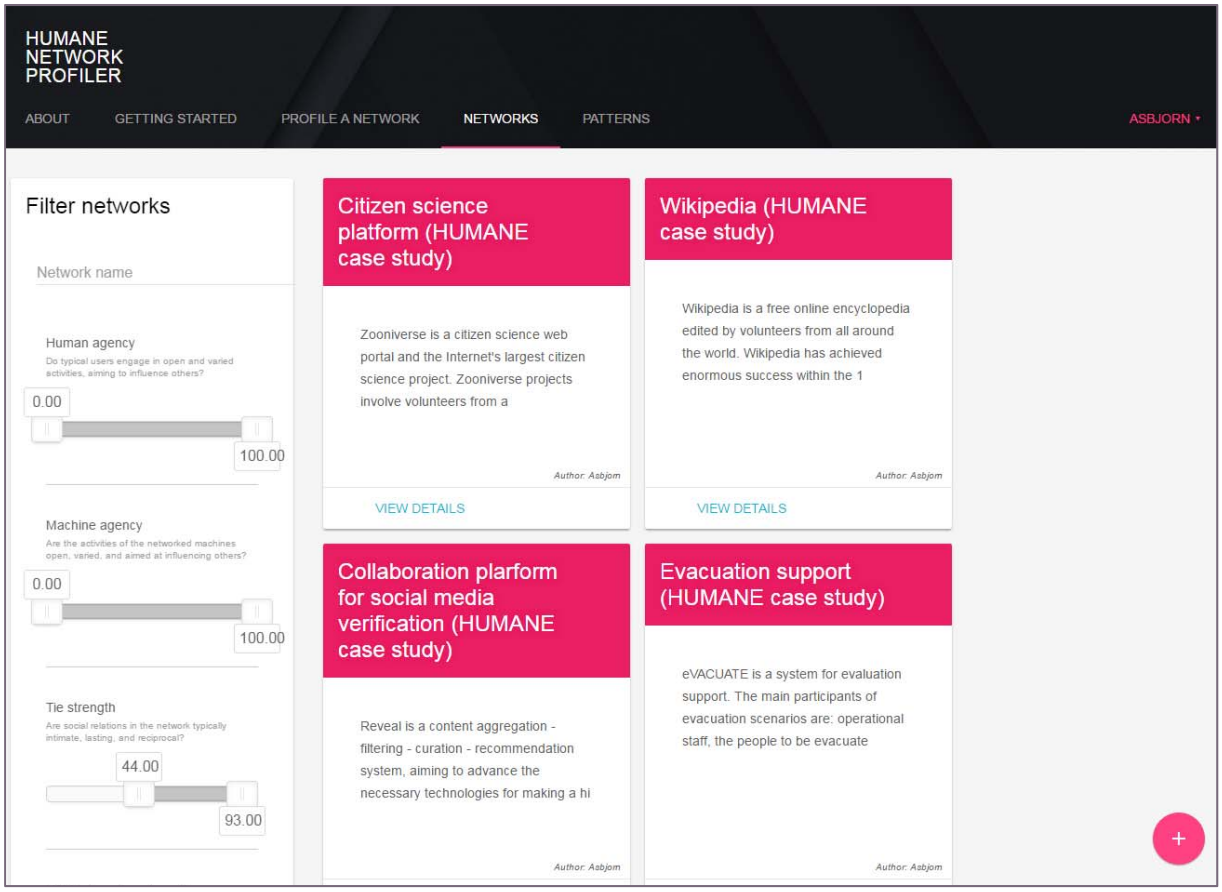



**Figure 22: HUMAN Network Profiler - Browse HMN profiles (screen dump).**

**Browse all design patterns**

The pager for browsing design patterns lists all available design patterns for browsing. The patterns are listed in the order of which they were entered (see Figure 23).

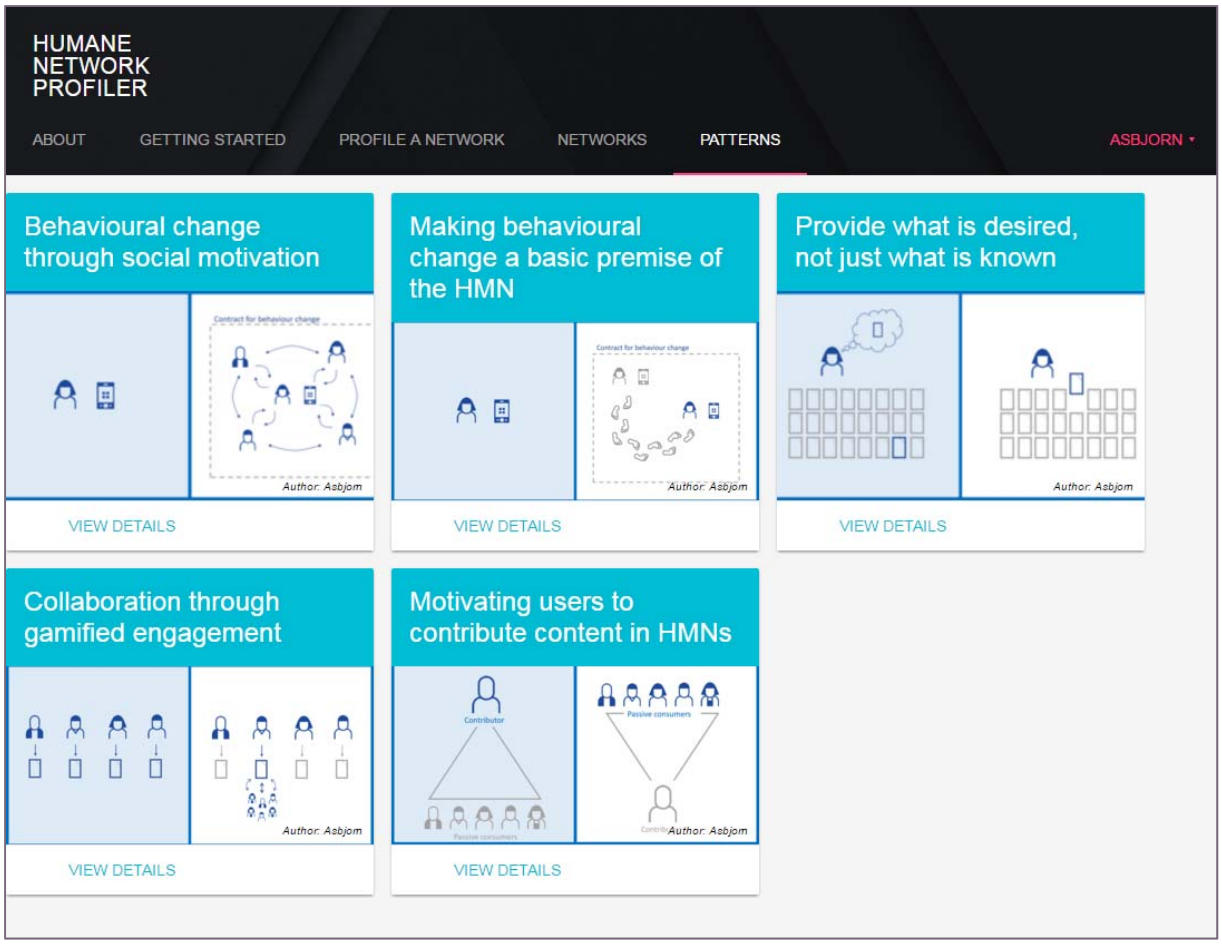



**Figure 23: HUMANE Network Profiler - Browse design patterns (screen dump).**

## 9.7 Access rights

The HUMANE Network Profiler distinguishes between three levels of access: Not logged in, logged in as regular user, and logged in as administrator.

- **Not logged in.** All the content of the HUMANE Network Profiler is openly available to all users, whether logged in or not. Users not logged in can also enter HMN profiles and design patterns, but not make edits or deletions. These patterns and profiles are then marked as "anonymous". Participation in the discussion threads associated with each HMN profile and each design pattern is open to anyone with a Disqus user profile, but does not require to be logged in with a user in the HUMANE Network Profiler.
- **Logged in as regular user.** Any visitor to the HUMANE Network Profiler can register a user. Users can enter new HMN profiles and add design patterns to these, either from the list of existing design patterns or as a new design pattern. Logged in users can also remove or edit HMN profiles or design patterns that they have established themselves.
- **Logged in as administrator.** Administrators have the same access rights as regular users, but may in addition edit or delete HMN profiles or design patterns entered by others.

## 9.8 Application of the tool as part of the HUMANE method

The tool is designed to support the HUMANE method as described in Section 5. In particular, the tool supports Step 2, 3, and 4.

- **Step 2 (HMN profile and network diagram).** The tool supports thoroughly the profiling of the HMN. The user is led through the profiling process in a series of steps corresponding to the HUMANE dimensions. The output of the process is a consolidated HMN profile. The tool does not support drawing a network diagram, only the network profile.
- **Step 3 (Identify similar networks and implication analysis).** The tool supports the identification of similar HMNs, through the listing of HMNs as part of the consolidated profile. The current version of the tool does not support implication analysis.
- **Step 4 (design patterns).** The tool supports identification and sharing of design knowledge and experience through design patterns.

In later versions of the tool, it may possibly be extended to also cover Step 5 of the HUMANE method (evaluation), as well as network diagramming (part of Step 2) and implication analysis (part of Step 3). Decisions as to which additions to prioritize will be decided on the basis of the feedback from the second case executions (D3.3).

Given the prototype nature of the tool, we foresee that the tool will undergo substantial changes. For example, the way identification of similar networks and design patterns are currently presented will be updated. In particular, the subsequent HUMANE case executions will be instrumental to drive these updates with the aim of improving usefulness and ease of use. The version of the tool should however provide an overall impression of how key steps of the HUMANE method may be supported.

# 10 Conclusion and future work

In this report, we have presented the second version of the HUMANE typology and method, as well as a prototype version of an online tool to support the use of the typology and method. The aim of the typology, method and tool is that these should support design for HMNs through analysis of generic characteristics of the HMN and cross-sector access to design knowledge and experiences in the form of design patterns.

The typology, method, and tool are still under development, and we expect these to be substantially refined during the remaining project period. The current version is to be seen as a step towards strengthening our capacity to design for HMNs, though it may not yet be sufficiently refined for unsupported use by HCD practitioners.

The most mature elements are the typology itself as well as the profiling approach (Step 2 of the HUMANE method), as these have been refined on the basis of the first set of the HUMANE case executions. Nevertheless, we foresee developments also of these. The latter steps of the HUMANE method as well as the tool support are assumed to be less mature, as these have not yet been applied in case trials. In particular, we foresee substantial developments of the implication analysis and the design pattern approach following the remaining case executions of the project.

The presented version of the typology, method, and tool will be applied as basis for two strings of future work within HUMANE. One is the validation of the typology and method within the second case executions (T3.3). The other is the work to support future thinking on HMNs; in particular the development of roadmaps for future HMNs.

## 10.1 Validating the typology and method

This version of the HUMANE typology and method will be validated in the second iteration case executions (T3.3). In this validation, we will target the usefulness of the typology, profiling process, implication analysis, and design pattern approach. The requirements and suggestions for these, defined on the basis of the first iteration case executions, are detailed in Section 2.4.

In Table 9, we provide a summary of key validation topics following from these requirements and from the key outcomes of the work presented in this report.

**Table 9: Validation topics for the second iteration case executions.**

| Validation topic | Description |
|---|---|
| The HUMANE typology | The typology should be seen as relevant and useful. This depends on the designers and developers being able to easily grasp the HUMANE framework and apply it to their design and development projects. The typology dimensions should be easily understood and seen as relevant. The profiling process should be fast and easy yielding a basis for relevant insight. The case validations should gather information on designers and developers' perceptions and experiences of the typology. |
| The profiling process | The profiling process should be fast and easy yielding a basis for relevant insight. The case validations should gather experiences from designers and developers with the profiling process. |
| Network diagramming | HMN network diagramming is a view of the HMN which complements the HMN profiling. The network diagramming should be validated in one or more cases to gain insight onto which to base further refinement. |
| The implication analysis | The implication analysis is key to this version of the HUMANE method. The implication analysis is the first step in utilizing the HMN profile for design support, and should help designers and developers gain new perspectives on the implications of the HMN on which they are working. The case validations should gather experiences from designers and developers with the implication analysis, possibly by taking the implications that has already been established as a starting point. |

| Validation topic | Description |
|---|---|
| The design pattern approach | The design pattern approach is at the core of the HUMANE method, and should be seen as relevant by designers and developers. The case validations should provide insight into how the design pattern approach may be taken up by designers and developers and whether the approach supports cross-domain transfer of design experience and knowledge. The case executions should serve to refine and extend the initial set of design patterns. |
| The tool | The case validations should provide feedback on the prototype version of the tool as support for the HUMANE method. |

The validation will be conducted within the HUMANE cases in Q3 of 2016. The validation will provide input to the final development of the typology and method, and also to the refinement of the online tool. The final version of the typology and method will be presented in the HUMANE deliverable 2.3 (due Q1 2017).

## 10.2 Applying the typology and method to support future thinking

Within HUMANE, the typology and method will also be applied to support future thinking on HMNs. Here, the typology should enable the characterization of emerging HMNs within different domains, such as sharing economy, eHealth, eLabour, and citizen participation, and the analysis of implications pertaining to the HMN characteristics.

The analysis of emerging HMNs represents an attempt to go beyond the analysis of existing HMNs to the analysis of future HMNs to allow for strategic discussions and policy developments of relevance to the future design of HMNs. Hence, such analysis represents an opportunity to try out the usefulness of the HUMANE typology and method at the strategic level.

The typology and method may represent a useful support for future thinking and policy making. For example, current and expected near future HMNs may be analysed with regard to their characteristics and related implications. On this basis, one may discuss how the current characteristics needs to change to achieve the desired implications, and how such change may be driven through strategy and policy development.

The work on applying the HUMANE typology and method in support of future thinking will be conducted in the last year of the HUMANE project and will commence in Q1, 2017.

## 10.3 Conclusion

In the second version of the HUMANE typology and method, we present the refined typology and show how its dimensions may be applied as a conceptual framework to analyse and design for

HMNs. The method support is intended to help practitioners apply the typology in design for HMNs and is developed so as to comply with the HCD process.

While the typology and method is not yet in their final versions, we hope the presented work can motivate researchers and practitioners working with the design and development of ICT to reflect on how the characteristics of HMNs affect aspects such as motivation, collaboration, innovation and trust, and how to design for HMNs so as to achieve the desired effects.

# 11 References


Adler, B. T., De Alfaro, L., Mola-Velasco, S. M., Rosso, P., & West, A. G. (2011). Wikipedia vandalism detection: Combining natural language, metadata, and reputation features. In *Lecture Notes in Computer Science* (pp. 277–288). Springer. Retrieved from http://link.springer.com/chapter/10.1007/978-3-642-19437-5_23

Alexander, C., Ishikawa, S., & Silverstein, M. (1977). *A Pattern Language: Towns, Buildings, Construction*. New York, New York, USA: Oxford University Press.

Allahbakhsh, M., Benatallah, B., Ignjatovic, A., Motahari-Nezhad, H. R., Bertino, E., & Dustdar, S. (2013). Quality Control in Crowdsourcing Systems: Issues and Directions. *IEEE Internet Computing*, *17*(2), 76–81. http://doi.org/10.1109/MIC.2013.20

Anderson, A., Huttenlocher, D., Kleinberg, J., & Leskovec, J. (2013). Steering user behavior with badges. In *Proceedings of the 22nd International Conference on World Wide Web* (pp. 95–106). New York: ACM Press.

Baxter, G., & Sommerville, I. (2011). Socio-technical systems: From design methods to systems engineering. *Interacting with Computers*, *23*(1), 4–17. http://doi.org/10.1016/j.intcom.2010.07.003

Boehm, B. (2000). Requirements that handle IKIWISI, COTS, and rapid change. *Computer*, *33*(7), 99–102.

Borchers, J. O. (2001). A pattern approach to interaction design. *AI & Society*, *15*(4), 359–376. http://doi.org/10.1007/BF01206115

Brandes, U., Kenis, P., & Lerner, J. (2009). Network analysis of collaboration structure in Wikipedia. *Proceedings of the 18th International Conference on World Wide Web*, 731–740. Retrieved from http://dl.acm.org/citation.cfm?id=1526808

Broekens, J., Heerink, M., & Rosendal, H. (2009). Assistive social robots in elderly care: a review. *Gerontechnology*, *8*(2), 94–103.

Cusinato, A., Della Mea, V., Di Salvatore, F., & Mizzaro, S. (2009). QuWi: quality control in Wikipedia. In *Proceedings of the 3rd Workshop on Collaborative Web Tagging* (pp. 27–34). New York: ACM.

Dixon, M., Freeman, K., & Toman, N. (2010). Stop trying to delight your customers. *Harvard Business Review*, *88*(7/8), 116–122.

Eide, A. W., Pickering, J. B., Yasseri, T., Bravos, G., Følstad, A., Engen, V., … Tsvetkova, M. (2016). Human-Machine Networks: Towards a Typology and Profiling Framework. In *Lecture Notes in Computer Science*. Toronto, Canada: Springer.

Engen, V., Pickering, J. B., & Walland, P. (2016). Machine Agency in Human-Machine Networks; Impacts and Trust Implications. In *Lecture Notes in Computer Science*. Toronto, Canada: Springer.

Følstad, A., Eide, A. W., Pickering, J. B., Tsvetkova, M., Gavilanes, R. G., Yasseri, T., & Engen, V. (2015). *SHAPE Deliverable D2.1 Typology and method*.

Gamma, E., Helm, R., Johnson, R., & Vlissides, J. (1994). *Design Patterns: Elements of Reusable Object-Oriented Software*. Pearson Education.

Gay, P. L., Brown, S., Huang, A. D., Lehan, C., & Team, M. Z. (2010). Behaviors and Motivations observed in the Zooniverse. In *AAS Meeting Abstracts*.

Geiger, R. S., & Halfaker, A. (2013). When the levee breaks. In *Proceedings of the 9th International Symposium on Open Collaboration*

{ëYLJ2ăλdzY 2y hLJŜy /2ftI·ō2NI·ůλ2y π ² λ]λ{ëY ⓛmo (pp. 1–6). New York, New York, USA: ACM Press. http://doi.org/10.1145/2491055.2491061

Granovetter, M. S. (1973). The Strength of Weak Ties. ¢KŜ ! YˆŜNλŏI·yˆW2dzNyl·f 2ŦˆŜ{2ŏλ2f2∃ë, my(6), 1360–1380. Retrieved from http://www.jstor.org/view/00029602/dm992612/99p02603/0

Guerrieri, P., & Bentivegna, S. (Eds.). (2011). ¢KŜ Ŝŏ2y2YλŏˆλYLJI·ŏů 2Ŧ Řλ∃λůI·f ůŜŏKy2f2∃λŜăY a ŜI·ădzNλy∃ λyŏtdzăλ2yˆI·yŘ ŘλŦŦdzăλ2yˆλy9dzN2LJŜ. Edward Elgar Publishing.

Halfaker, A., Geiger, R. S., Morgan, J. T., & Riedl, J. (2012). The Rise and Decline of an Open Collaboration System: How Wikipedia's Reaction to Popularity Is Causing Its Decline. ! YˆŜNλŏI·yˆ . ŜKI·ŐλI2NI·f {ŏλŜyůλăű, pm(5), 664–688. Retrieved from http://abs.sagepub.com/content/early/2012/12/26/0002764212469365.abstract

Haugstveit, I. M., Halvorsrud, R., & Karahasanovic, A. (2016). Supporting Redesign of C2C Services through Customer Journey Mapping. In tN2ŏŜŜŘλy∃ă 2Ŧ ůKŜ {ŜNØ5Ŝăнлмс /2yŦŜNŜyŐŜ (pp. 215–227). Linköping University Electronic Press.

Heskett, J. L., & Schlesinger, L. A. (1994). Putting the service-profit chain to work. I I·NØI·NŘ . dzăλySăă wŜØλŜø, mн(2), 164–174.

Hristova, D., Quattrone, G., Mashhadi, A., & Capra, L. (2013). The Life of the Party: Impact of Social Mapping in OpenStreetMap. In L/ ² { a . Retrieved from http://www.aaai.org/ocs/index.php/ICWSM/ICWSM13/paper/viewFile/6098Desislava/6362

ISO. (2010). 9N∃2y2YλŏăˆŦ KdzYl·yçäëăűŜY λyůŜNI·ŏűλ2yˆ τ tI·Nű нмлY I dzYl·yπŐŜyúNŜŘ ŘŜăλ∃yˆŦ2N λyűŜNI·ŏűλØŜ ăëăűŜYă. Geneva, Switzerland: International Organization for Standardization.

Kittur, A., Nickerson, J. V., Bernstein, M., Gerber, E., Shaw, A., Zimmerman, J., … Horton, J. (2013). The future of crowd work. In tN2ŏŜŜŘλy∃ă 2Ŧ ůKŜ нлмо Ŏ2yŦŜNŜyŐŜ 2yˆ/2YˆLJdzűŜN ădzLJLJ2NűŜŘ Ŏ22LJŜNI·ůλØŜ ø2N] π /{/ ² ⓛmo (p. 1301). New York, New York, USA: ACM Press. http://doi.org/10.1145/2441776.2441923

Kriplean, T., Beschastnikh, I., & McDonald, D. W. (2008). Articulations of wikiwork: uncovering valued work in Wikipedia through barnstars. In tN2ŏŜŜŘλy∃ă 2Ŧ ůKŜ нллу ! / a /2yŦŜNŜyŐŜ 2yˆ/2YˆLJdzűŜN {dzLJLJ2NűŜŘ /22LJŜNI·ůλØŜ ² 2N] (pp. 47–56). New York: ACM Press.

Law, J. (1992). Notes on the Theory of the Actor-Network: Ordering, Strategy, and Heterogeneity. {ëăűŜYă tNI·ŐűλŐŜ, p(4), 379–393.

Leonardi, P. M. (2012). Materiality, Sociomateriality, and Socio-Technical Systems: What Do These Terms Mean? How Are They Related? Do We Need Them? In P. M. Leonardi, B. A. Nardi, & J. Kallinikos (Eds.), a I·ůŜNλI·flůë I·yŘ hN∃I·yλÎλy∃Y {2ŏλI·f LyűŜNI·Őűλ2yˆλyˆI· ¢ŜŏKy2f2∃λŏI·f ² 2NfŘ (pp. 25–48). Oxford: Oxford University Press. Retrieved from http://papers.ssrn.com/sol3/Papers.cfm?abstract_id=2129878

Lüders, M. (2013). Networking and notworking in social intranets: User archetypes and participatory divides. CλNăű a2yŘI·ë, my(8). http://doi.org/10.5210/fm.v18i8.4693

Lüders, M. (2016). Innovating with users online? How network-characteristics affect collaboration for innovation. W2dzNyl·f 2Ŧ a ŜŘλI· LyŷŶ2ØI·ůλ2yã, o(1), 4–22.

Lüders, M., Pickering, J. B., Engen, V., Bravos, G., Yasseri, T., & Tsvetkova, M. (2016). 5o©н wŜLJ2Nű 2Ŧ ŦλNăű ăŜű 2Ŧ ŏI·ăŜπăűdzŘλŜă.

Maguire, M. (2001). Methods to support human-centred design. LyűŜNyl·ůλ2yl·f W2dzNyl·f 2Ŧ I dzYl·yπ /2YˆLJdzűŜN {űdzŘλŜă, pp(4), 587–634.

Nass, C. I., Lombard, M., Henriksen, L., & Steuer, J. (1995). Anthropocentrism and computers. *. ŜKI·ØĺƨdzŊ ƻ LyŦƨŊYI·űĺƨyʃ¢ŜŎKyƨtƨƎè, мп*(4), 229–238. http://doi.org/10.1080/01449299508914636

Niederer, S., & van Dijck, J. (2010). Wisdom of the crowd or technicity of content? Wikipedia as a sociotechnical system. *bŜø aŜŘĺI· ƻ {ƨŎĺŜűè, мн*(8), 1368–1387. http://doi.org/10.1177/1461444810365297

Nuseibeh, B. (2001). Weaving together requirements and architectures. */ƨYLJdzűŜŊ, оп*(3), 115–117. http://doi.org/10.1109/2.910904

Payne, A. (1994). Relationship marketing - making the customer count. *a I·yI·ƎĺyƎ {ŜŊØĺŎŜ vdzI·tűëY !yʃ LyűŜŊyI·űĺƨyI·t Ŵƨdzŋ yI·t*, *п*(6), 29–31.

Pentland, A. (2014). *{ƨŎĺI·t LJKèăĺŎăY I ƨø Ǝ22Ř ĺŘŜI·ă ăLJŊŜI·ŘπűKŜ tŜăăƨyã ŦŊƨY I· ySø ăŎĺŜyŎŜ*. Penguin.

Porter, J. (2010). *5ŜăĺƎyĺyƎ ŦƨŊ űKŜ {ƨŎĺI·t ² Ŝō*. Peachpit Press.

Potthast, M., Stein, B., & Gerling, R. (2008). Automatic vandalism detection in Wikipedia. *!ŘØI·yŎŜă ĺyʃ LyŦƨŊYI·űĺƨyʃwŜűŊĺŜØI·t*. Retrieved from http://link.springer.com/chapter/10.1007/978-3-540-78646-7_75

Quinn, A. J., & Bederson, B. B. (2011). Human computation: a survey and taxonomy of a growing field. In *tŊƨŎŜŜŘĺyƎă 2Ŧ űKŜ нлмм I·yŷdzI·t Ŏ2yŦŜŊŜyŎŜ 2yʃ I dzYI·yʃŦI·ŎűƨŊă ĺyʃŎ2YLJdzűĺyƎ ăëăűŜYă π / I L Ωмм* (p. 1403). New York, New York, USA: ACM Press. http://doi.org/10.1145/1978942.1979148

Rose, J., & Jones, M. (2005). The Double Dance of Agency: A Socio-Theoretic Account of How Machines and Humans Interact. *{èăűŜYăΣ {ƛƎyã ƻ !Ŏűĺƨyã, м*(1), 19–37.

Rowe, M., Fernandez, M., Alani, H., Ronen, I., Hayes, C., & Karnstedt, M. (2012). Behaviour analysis across different types of enterprise online communities. In *² Ŝō{ŎĺΩмнY tŊƨŎŜŜŘĺyƎă 2Ŧ űKŜ пűK !yŷdzI·t ! / a ² Ŝō {ŎĺŜyŎŜ /ƨyŦŜŊŜyŎŜ* (pp. 255–264). ACM Request Permissions. http://doi.org/10.1145/2380718.2380752

Ryan, R. M., & Deci, E. L. (2000). Intrinsic and extrinsic motivations: Classic definitions and new directions. */ƨyűŜYLJƨŊI·Nè 9ŘdzŎI·űĺƨyI·t tăèŎK2tƨƎè, нр*(1), 54–67.

Seffah, A. (2015). *¢KŜ tI·űűŜŊyã 2Ŧ I /L 5ŜăĺƎyY hNĺƎĺyΣ tŜŊŎŜLJűĺƨyãΣ I·yŘ aĺăŎ2yŎŜLJűĺƨyã*. Springer International Publishing.

Steiner, T. (2014). Bots vs. Wikipedians, Anons vs. Logged-Ins (Redux). In *tŊƨŎŜŜŘĺyƎă 2Ŧ ¢KŜ LyűŜŊyI·űĺƨyI·t {èYLJƨăĺdzY 2yʃhLJŜyʃ/2ffI·ō2ŊI·űĺƨyʃπ hLJŜy{èY Ωмп* (pp. 1–7). New York, New York, USA: ACM Press. http://doi.org/10.1145/2641580.2641613

Sumi, R., Yasseri, T., Rung, A., Kornai, A., & Kertész, J. (2011). Characterization and prediction of Wikipedia edit wars. In *tŊƨŎŜŜŘĺyƎă 2Ŧ űKŜ ! / a ² Ŝō{Ŏĺ Ωмм* (pp. 1–3). Koblenz, Germany. Retrieved from http://journal.webscience.org/523/

Tsvetkova, M., García-Gavilanes, R., & Yasseri, T. (2016a). */fI·ăK 2Ŧ . 2űă*.

Tsvetkova, M., García-Gavilanes, R., & Yasseri, T. (2016b). Dynamics of Disagreement: Large-Scale Temporal Network Analysis Reveals Negative Interactions in Online Collaboration. Computers and Society; Physics and Society. Retrieved from http://arxiv.org/abs/1602.01652

Tsvetkova, M., Pickering, B., Yasseri, T., Walland, P., Lüders, M., & Engen, V. (2015). *5мфм {ëăűŜYI·űĺŎ [ĺűŜŊI·űdzŊŜ wŜØĺŜø*.

van Duyne, D. K., Landay, J., & Hong, J. I. (2002). *¢KŜ ŘŜăĺƎyʃ2Ŧ ălűŜăY LJI·űűŜŊyãΣ LJŊĺyŎĺLJtŜăΣ I·yŘ*

LJNN2ŎŜăăŜă ŦŻN ŎNI·ŦűλyE I· ŎdzăűŻYˆŜNπŎŜýűŜNNŜŘ ² Ŝō ŜĖLJŜNNŜyŎŜ. Boston, MA: Addison-Wesley Longman Publishing.

West, A. G., Kannan, S., & Lee, I. (2010). Detecting Wikipedia vandalism via spatio-temporal analysis of revision metadata? In tN2ŎŜŜŘλyEă 2Ŧ űKŜ ¢KNŘ 9dzN2LJŜI·yˆ ² 2N}ăK2LJ 2yˆ{èăűŜYˆ {ŜŎdzNNúë π 9¦whf{9/ ⍰мл (pp. 22–28). New York, New York, USA: ACM Press. http://doi.org/10.1145/1752046.1752050

# 12 Appendix A – Summary of focus group following initial cases

Following the initial case executions, a session of feedback interviews in the form of a focus-group involving the HUMANE project participants was conducted at project plenary meeting, January 12-13, 2016. This activity served as an efficient way to summarize key learnings and recommendations for the HUMANE typology and method, following the experiences with the initial typology and method from the six HUMANE cases.

Prior to the focus group, each of the six HUMANE use cases had presented experiences with the typology within the specific use case. As we refer extensively to the cases in the tables which summarizing the learnings and recommendations from this activity, we list these here for easy reference (use of typology or dimensions in parentheses):

- Case 1 – innovation platforms (Experiences with typology dimensions as a dialogue tool during stakeholder interviews)
- Case 2 – C2C reselling platform (Experiences with typology dimensions applied as analytical framework for analysis of user and stakeholder interview data)
- Case 3 – eVACUATE / OPERANDO (Typology dimensions used for profiling of human-machine networks in interviews with development team representatives)
- Case 4 – social media verification, Reveal (Dimensions and typology validated through questionnaire for ICT project leaders)
- Case 5 – Wikipedia. (Separate dimensions analysed through aggregated usage and log data.)
- Case 6 – Zooniverse. (Separate dimensions analysed through aggregated usage and log data.)

**Table 10: Useful aspects of the HMN typology**

| # | Useful aspects | Description |
|---|---|---|
| 1 | Profiling a HMN may be engaging | In Case 1, using the typology as part of stakeholder interviews were found to create an interest for the participants in the Min Ide case; the participants found it to be engaging and fun to map out the network. Likewise, in Case 4, the participants in the REVEAL study found it interesting to depict the network in a graph (spider diagram). |
| 2 | The typology and network visualizations may strengthen cross-disciplinary communication | In Case 3, where the typology was used for characterizing and visualizing of human-machine networks in interviews with development team representatives, it was found that the typology may serve to bring in to the discussion aspects of relevance to user-centred design which might not otherwise have received sufficient attention. Hence, the typology seems to have the potential to bring together technical personnel and human factor specialists and enable them to communicate with each other. This indicates that the typology may be used as a communication tool between different participants in software development teams. |
| 3 | The typology may strengthen requirements specification | In Case 3, it was also suggested that the typology could be beneficial during requirements specification to identify and communicate non-technical requirements. As such, the typology would support the user-centred design process, in particular the formulation of user requirements. |
| 4 | The typology | During the workshop it was argued that the typology is capable of structuring how you |

| # | Useful aspects | Description |
|---|---|---|
| | may strengthen the design process | can approach a human machine network and how you can design successfully for it. It shows important aspects that one needs to take into account and think about. |
| 5 | The typology may bring in new perspectives | The typology and profiling framework may motivate researchers and practitioners to view the HMN differently. This was seen in three of the cases:<br>Case 1: The importance of machine agency, and the relation between network size and need for increased machine agency constituted an important insight.<br>Case 3: The typology and associated network visualization was considered as helpful in providing a new and human/organization-oriented perspective for non-HCD personnel, especially as roles, responsibilities and interactions of agents were more clear.<br>Case 5: The typology could influence research ideas In particular by identifying gaps in the research. Furthermore, the typology and profiling could provide insight into that there are several ways to build a successful solution. |
| 6 | The dimensions are relevant | The participants in cases 1, 3, and 4 found the dimensions to be relevant. Some of the dimensions, but not all, were also found reasonably easy to understand. (Exceptions to this were *Iнa ƛyűŜℕI·ŏűƛ2y˙ăúℕŜyƎűK, ǿ2ℕ}₹f2ǿ ƛyűŜℕŘŜLJŜyŘŜyŐŜΣ* and *Kdz˙YI·y˙I·ƎŜyŐè*. There were also interpretational issues concerning the scales. For these limitations, see */KI·ffŜyƎŜă I·yŘ tƛY˙ƛűI·űƛ2yã* below) |
| 7 | Typology useful as analysis framework | The typology was applied as an analytical framework in Case2, and also as a perspective for data analysis in Cases 5 and 6. Experiences from these cases indicate that the typology may be useful for this approach, both as a means to structure the analysis and as a means of including new perspectives. |
| 8 | Typology potentially useful for theoretical purposes | During the discussions it was suggested that the typology could be useful for scholars and academics to map out human machine networks. That is, the typology may be useful as a means to increase our theoretical understanding of human-machine networks, and not just as an approach to strengthen the design of ICT for human-machine networks. |

**Table 11: Challenges and limitations of the typology**

| # | Challenges | Description |
|---|---|---|
| 1 | Unclear relation between typology and trust, privacy, shared responsibility and motivation | The link between the typology and consequences for trust, privacy, shared responsibility and motivation is not sufficiently explicated. Such consequences are important to HUMANE, and were also treated in some of the cases. For example trust was thoroughly treated in Case 1 and 2. However, the relation between the typology dimensions and these consequences were only implied. In future versions of the typology, it is required that we detail how different configurations and designs of HMNs affect consequences such as trust, privacy, shared responsibility, and motivation. Such consequences may, for example, be considered as implications of the identified HMN types. |

| # | Challenges | Description |
|---|---|---|
| 2 | Typology completeness may be challenged | Whereas the participants in some of the cases (e.g. Case 4) seemed to become familiar with the dimensions easily and did not feel that additional/new dimensions should be included, the participants in other cases reported the need for additional dimensions. In particular, the participants in Case 3 argued, from an engineering point of view, that the lack in coverage for machine-to-machine interactions is a significant gap in the current typology. Engineers need to make decisions about these types of interactions and thus they are important for them. |
| 3 | The typology is not sufficiently validated | The typology is in need of validation at two levels.<br>(a) Does the typology include the needed dimensions? Such validation could be conducted by profiling larger samples of HMNs and clustering these.<br>(b) Does the profiling add value to the design process? Such validation could be conducted by following the profiling and subsequent development in design processes. |
| 4 | The typology does not capture how HMN change or evolve | HMNs change or evolve across its lifecycle. Such change may be due to the growth of the network, and change in one network dimension, e.g. network size, may drive change in other dimensions, e.g. machine agency. Change is not represented in the typology, except for the opportunity to profile different states of the HMN (as in the eVACUATE profile). We need to consider ways to represent time and change across time. There was a dimension related to time at some point but we got rid of it. This could help show how a network should change in the future. You might also need to see how the relationships between dimensions changes over time. |
| 5 | The link to the HCD process is insufficiently clarified | The typology and framework is developed to fit the HCD process. However, as of now the link to the HCD process is not made sufficiently clear. For example, should the profiling activity be regarded as part of context analysis, requirements, or design. This needs to be clarified in later versions. |
| 6 | Three dimensions may be difficult or counter-intuitive | The dimensions H2M interaction strength, workflow interdependence, and human agency were seen as somewhat challenging.<br>The scaling of H2M interaction strength, while seen as theoretically sound, was argued to be hard to remember and apply.<br>The direction of the dimension workflow interdependence in the visual layout of the spider diagram was seen as counter-intuitive.<br>The human agency dimension was pointed out as needing a better definition. |
| 7 | Scale reliability | The scales were argued to be difficult to interpret, and contextual aspects may affect the interpretation. For example, may a network of 1000 nodes in crisis management be considered large, while a network of the same size in e.g. peer-to-peer reselling may be considered small. This interpretational issue may be seen from two perspectives:<br>(a) If the scales are to be used to compare HMNs, the scales are currently not sufficiently reliable. This may be improved through an iterative process of adjustments and tests of inter-rater agreement.<br>(b) If the scales are to be used for cross-disciplinary dialogue and requirements specification, the reliability issues are less important. |

| # | Challenges | Description |
|---|---|---|
| 8 | Scale scoring depending on role or perspective | The scoring on the different scales may vary depending on the roles or perspective that is foreseen by the scorer. For example, social ties in Wikipedia may mostly be non-existent or latent, but for a small group of key actors this dimension should be scored as weak or strong. This issue is strongly related to the issue of scale reliability above. Currently, there is no way to express this variation across roles or perspectives in the typology. In the typology we aim for characterizing the HMN as a whole. At the same time, it may be necessary to represent different roles or perspectives within the HMN. |
| 9 | Using the typology requires HCD competency | In Cases 1, 3 and 4, participants that were not trained in HCD were asked to apply the typology. In all cases researchers trained in HCD were present. However, in Cases 3 and 4 the participants did not appear to fully understand the purpose of the typology. For example, in Case 3 it was clear that the participants in some cases did not have a complete understanding of what they were supposed to accomplish when using the typology. This was expected, as it was not realistic that participants could get a full understanding from a short description and with the time-limitations. However, it is also likely that the typology and framework, while potentially supporting cross-disciplinary collaboration, may require the process leader to hold HCD competency. |
| 10 | Implications from profiled networks or types have not yet been made fully evident | The current applications of the typology and profiling framework have not yet been taken to a stage where we draw design implications from type identifications. There is a need to understand what the overall shape of the spider diagram can tell about a network. This needs to be highlighted in the next version of the typology. |
| 11 | The typology only used for profiling, not for identifying similar HMNs or design implications | In none of the cases, the typology was used to identify similar HMNs (step 3 of the profiling framework) or for eliciting design implications (step 4 of the profiling framework). This was as expected, as we in the first set of case trials were to target context analysis. However, this needs to be included in later case trials. |
| 12 | The current cases concern HMNs that are established or about to be established, not HMNs only at a conceptual stage of development | The current case studies may not provide sufficient feedback from those who are building new HMNs. We need to see how the typology works from the perspective of the very start-up of designing for HMNs, and may therefore need to approach projects that are in the starting phase. One suggestion is to apply the typology and method to NextGenDST which is a SEP project at SINTEF. |

**Table 12: Recommendations for the second version of the typology and method**

| # | Recommendations | Description |
|---|---|---|
| 1 | Show how the dimensions and typology has consequences for trust, privacy, shared responsibility, and motivation | The consequences of the dimensions and typology for trust, privacy, shared responsibility, and motivation is not made sufficiently clear. In the second version of the typology, we should explicitly address how different states of the typology dimensions, or different HMN types, affect these consequences. |

| # | Recommendations | Description |
|---|---|---|
| 2 | Reduce ambiguity in scales | Effort needs to be made to reduce the ambiguity in the dimension scales, to a point where we reach adequate inter-rater reliability when profiling the same HMN with different analysts that all know the HMN well. |
| 3 | Update dimensions | The current set of dimensions needs to be updated. The current dimensions may be kept, but dimensions that are difficult to understand or apply should be clarified and adapted. |
| 4 | Provide support to identify types | The current support to identify HMN type following profiling is weak. This needs to be strengthened in the second version of the typology. One approach to achieve this could be to profile a large number of HMNs and identify types on the basis of cluster analysis. |
| 5 | Provide support to elicit and access design implications | In the second version of the typology, we also need to move closer to actually getting detailed design implications from the profiling. This is according to what is already described in the DOA. |
| 6 | Validate the typology | The typology needs to be validated on two levels. Firstly, we need to validate the completeness of the typology; are all key dimensions included? Secondly, we need to validate the value of the typology and profiling framework in the context of concrete design processes. |
| 7 | Clarify the role of the typology in the HCD process | The typology is intended as support in HCD. As of now the link to the HCD process is insufficiently clarified. We need to make this clarification in v2 of the typology. |

**Table 13: Suggestions for the second version of the typology and method**

| # | Suggestion | Description |
|---|---|---|
| 1 | A profiling game? | Profiling a HMN you know well may be engaging and provide new perspectives. Furthermore, it will be beneficial to have a large pool of profiled HMNs available to further develop types on the basis of profiles. It was suggested to make a profiling game, where practitioners or researchers profile their HMN at a website, e.g. to benchmark against others, to find out which HMNs that are similar to theirs, or to get access to design implications.<br>Another version of such a game could be to show participants profiles and have them suggest HMNs that fit the profile. |
| 2 | A dialogue tool? | The typology and profiling framework may support cross-disciplinary communication and dialogue. It may be considered to pursue this potential use of the typology, for example by developing a dialogue tool on the basis of the profiling framework. Such a tool would likely require a HCD-person as moderator. |
| 3 | Support for requirements specification? | An extension of the above dialogue tool, could be to apply the profiling framework for specification purposes. The aim of this would be to introduce HMN perspectives into the requirements specification. For example as a supplement to specifications based on UML. |

| # | Suggestion | Description |
|---|---|---|
| 4 | Study and visualize change? | Currently, the typology is used to profile HMNs at a given point in time. It may be worth considering whether the typology could also be used to study and visualize change.<br>A study of change could, for example, be done on historical data for a particular HMN (Wikipedia was mentioned), to gain insight into how the dimensions of the typology co-vary and also, if possible, to see the effects of changes in the profile and consequences such a trust, privacy, shared responsibility and motivation.<br>Visualizations of change could take the form of animations, to show e.g. how change in some dimensions affect change in others. Such visualizations could possibly be based on empirical data from studies of change in HMNs. Such visualizations could among other things be useful to understand how changes in different dimensions of a HMN affect others.<br>A minimalistic version of change visualizations could be to visualize the starting point and the desired future state for a HMN. |
| 5 | Visualize distributions along dimension? | Currently, dimensions are scored as a fixed value. Possibly, this could be changed to accommodate for representing the prevalence of different values for a dimension within a network. For example, for social ties, scoring could be made by showing the estimated distribution of tie classes within the network. |

# 13 Appendix B – output from initial implication analyses

Here we present the full output from the initial implication analyses for each of the six HUMANE cases. For each case, we first provide a brief overview of the purpose of the case HMN and its profile before presenting the identified implications.

## Case 1 (open innovation platforms, CSI) – initial implication analysis

Case 1 is an open innovation platform, that is, a platform intended to support crowd-sourced idea-gathering as well as the innovation process beyond. Here, external or internal users may contribute ideas for innovations through an online interface. Furthermore, users may read, rate, and add to others comments.

When profiling the open innovation platform following the HUMANE approach, we get a HMN profile as presented in Figure 24. This profile, as are the following case profiles, is taken from D2.1.

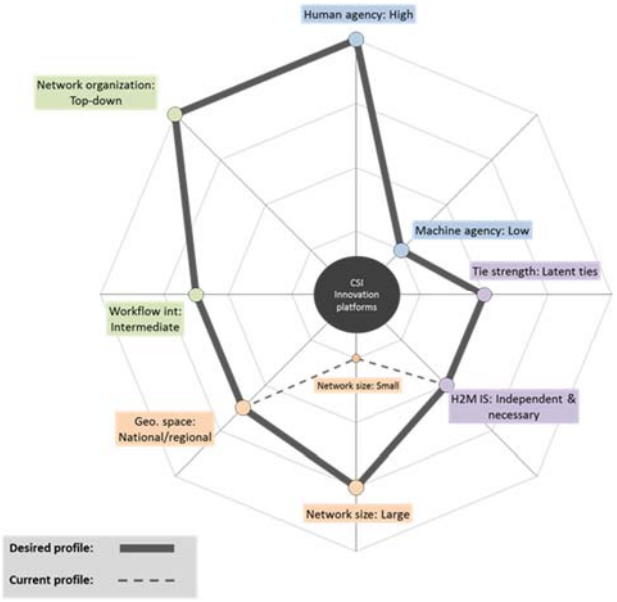
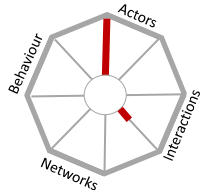
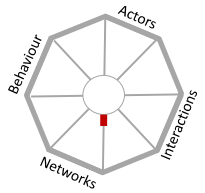


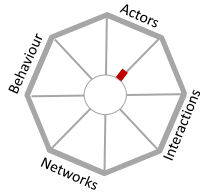
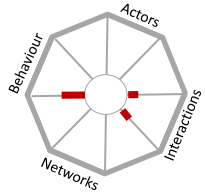

**Figure 24: Case 1 - open innovation – initial profile**

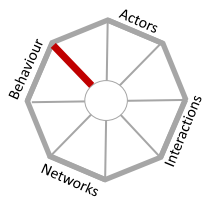
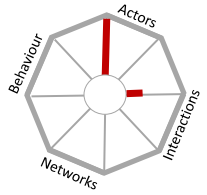
- Human actors are encouraged to provide ideas or proposals of a wide variety. The human agents have high degrees of freedom in terms of content; creativity is encouraged.
- Machine agency is limited to providing structure for processing contributed ideas or suggestions, e.g. to notify participants and stakeholders of new content.
- Contributors are not required to, and typically do not have existing social relations. However, contributors with promising ideas may be involved in the subsequent process to refine and develop ideas which may lead to moving beyond weak ties.
- Human actors can choose whether they want to use the platform or whether they want to contribute ideas through other channels.

- bŜűø2ℕ ǎλÎŜ ς f2ø óλyˆλyűûλI·f LJKI·ǎŜǎΣ ŘŜǎλℕŜ ű2 õŜ fI·ℕ∃ŜúY For open innovation platforms to be effective, a relatively large volume of contributors are needed. Recruitment is a challenge.
- DŜ2∃ℕI·LJKλǑI·f ǎLJI·ǑŜ ς λyűŜℕYˆŜŘλI·űŜ óℕŜ∃λ2yI·fúY The open innovation platforms in Case 1 typically concern a regional geographical space, e.g. a health region, municipality, or a geographically distributed enterprise.
- ² 2ℕ ł f f2ø λyűŜℕŘŜLJŜyŘŜyǑŜ π λyűŜℕYˆŜŘλI·űŜY Ideas or proposals typically are submitted in a pooled fashion. However, as soon as an idea or proposal is submitted, this moves into a sequential process for refinement and development including a number of predefined steps.
- bŜűø2ℕ ł 2ℕ∃I·yλÎI·ű2yˆς Kλ∃K óű2LJπŘ2øyűY Being a crowdsourcing platform where ideas or proposals are submitted and pooled following a specific format, and then processed in a predefined process with explicated roles and responsibilities, the network organization is considered as fairly top-down.

This HMN profile gives rise to a number of implications. The following are particularly noteworthy:

| | |
|---|---|
|  <br>IdzYI·yI·∃ŜyǑè Kλ∃Kφ<br><br>Iнa λyűŜℕI·Ǒűλ2yˆ ǎűℕŜy∃úK f2øφ | **Implications for Motivation:** In the CSI open innovation platform, KdzYI·yˆ I·∃ŜyǑè is high, that is, human contributors to the open innovation platforms are expected to contribute to goal setting, display creativity and self-expression, with self-decided and open tasks. At the same time, Iнa λyűŜℕI·Ǒűλ2yˆǎűℕŜy∃úK is low, meaning that the human contributors not have particularly strong dependency, reliance and trust in the machine components of the networks.<br><br>This HMN profile has important implications for motivation. Contributing in tasks characterized by flexibility in goal setting, creativity, and self-expression require relatively high levels of effort and attention. This requires high levels of motivation in the contributor. Without such motivation, the contributor may just opt out. In particular, when the interaction strength between the contributors and the machine components is low, and the contributions are not made as part of an established routine or behaviour pattern.<br><br>In the literature, it is argued that tasks requiring independent goal setting and creativity benefit from λyűℕλyǎλǑ Yˆ2űλØI·űλ2yˆ (Ryan & Deci, 2000)φ Hence, to establish the needed motivation the HMN needs to trigger intrinsic motivation in the individual contributor, for example, through providing the sense of contributing to a social collective of fellow contributors. |
|  <br>bŜűø2ℕ ǎλÎŜ f2øφ | **Implications for Attention:** In the CSI open innovation platform, yŜűø2ℕ ǎλÎŜ often is low. In particular, during the start-up phases of an innovation platform, the number of involved contributors is small. For some open innovation portals, the aim is to grow in network size, and a few indeed succeed. However, many portals innovation platforms remain small size.<br><br>Small network size may strongly affect the attention that the open innovation |

| | |
|---|---|
| | portal may get. When the number of involved humans is small, then the activity in the innovation portal over time will tend to remain limited. Hence, the attention that the portal get in users every-day life will be reduced, leading to a vicious circle where a lack of attention leads to lack in activity, which again leads to lack in attention (Porter, 2010). Hence, while a small network size in itself may not be seen as challenging, it may severely affect the attention which the open innovation platform gets from its users. |
|  *a I·ŏKλyŜ I·ƎŜyŎë t2ø℗* | **Implications for Experience**: In the CSI open innovation platform, *YI·ŏKλyŜ I·ƎŜyŎë* is low, that is, the machine components of the systems does not strongly influence the actions and intentions of the contributors, does not conduct actions reflecting intelligence, and is not perceived by the user as having agency.<br><br>HMNs with low machine agency may entail challenges concerning «quality of experience». This is particularly seen in HMNs concerning sharing and consume of content*. With low levels of machine agency, the users are typically exposed to the full set of contributions, with little aid for identifying content that is particularly relevant or engaging for them. Examples of this is Twitter's exposure of all content from people you follow in the streams, or collaboration systems that by default notify users on all updates that have occurred recently. In open innovation platforms, low levels of machine agency implies that users will get little support in finding interesting ideas that others have contributed, or little support in finding fellow users with which it may be interesting to collaborate.<br><br>*) For HMNs not concerning the sharing and consumption of content, low machine agency may possibly be beneficial for experiential purposes if the aim is to provide a raw, authentic, or engaging flow-like experience. This is, in particular, seen in systems where the user controls or monitors a flow of events. Here, high levels of machine-agency in the form of automation may challenge the quality of experience and reduce user awareness. |
|  *{2ŏλI·t úλŜ ăűŃŜyƎűK t2ø ótI·üŜyúú℗*<br><br>*I н a λyűŜŃI·ŏűλ2y ăűŃŜyƎűK t2ø*<br><br>*² 2Ń⌊ŦŦ2ø λyűŜŃŘŜLJŜyŘŜyŎŜ* | **Implications for Collaboration:** In the CSI open innovation platforms, social ties typically are non-existent or latent; that is, the users typically do not have an existing social relation. The exception to this is when the innovation platform is used for company-internal idea gathering. Here, however, the users typically also have other means of contributing their ideas or suggestions (indicated by H2M interaction strength being low. Finally, workflow interdependence is at best intermediate. Collaboration on ideas is possible, but ideas often is submitted to the platform without any coordination or collaboration with others.<br><br>Hence, while the open innovation process would strongly benefit from high levels of interaction within the HMN, users are typically not interacting as much as desirable (Lüders, 2016). The default mode of participation for most |

| | |
|---|---|
| λyűŜℕYŜŘλI·űŜ◊ | users is by submitting ideas, with only limited incentives to collaborate on improving or strengthening the ideas. Or by browsing other users ideas, but without engaging. Interaction within the HMN hence typically needs strengthening, while the HMN profile suggests that this may be challenging as low social ties, low H2M interaction strength and low to intermediate workflow interdependence do not strongly encourage such interaction. |
|  bŜűǿ2ℕ⟅ 2ℕ∃I·yλÎI·űλ2yϒKλ∃K óű2LJπŘ2ǿyϋ | **Implications for Innovation and improvement:** Open innovation platforms typically have a top-down organization, implying centralized control, and low levels of adaptability. The structure of the platform and the process for contributing and refining content is typically decided by company policy.<br>This has important implications for the innovation platform to innovate and improve itself. The contributors are typically invited to contribute ideas on other fields of interest than the platform itself, and users typically are highly restricted in their ability to affect the idea contribution and innovation process of which they are part. Hence, innovation platforms may lack the ability to improve itself that is needed for a HMN to fit rapidly changing contexts. Practices for renewing implemented innovation platforms may hence be a critical challenge. |
|  I ʤYI·yϒI·∃ŜyŎë Kλ∃K<br>{2ŎλI·f űλŜ ăűℕŜy∃űK f2ǿ ótI·űŜyϋϋ | **Implications for Trust:** In open innovation platforms, KʤYI·yϒI·∃ŜyŎë needs to be high; that is, the contributions to the open innovation platforms typically should represent acts of formulating an experienced need and creatively considering how to meet this need. Such an act of creative expression require work and dedication, which in turn require trust in the platform owner's capability for treating the contributions in a respectful and fair manner. In particular, contributors are concerned that their contributions are listened and responded to (Lüders, 2016). However, due to weak or non-existing social ties such trust in the platform owner will need to be earned.<br>Treating contributions in a way that corresponds to this trust need, however, implies a substantial workload for the platform owner in the form of responding to contributions, assigning promising contributions to an internal innovation process, and refining promising contributions into actual innovations. Often it may be challenging for the owner to respond to contributions, but even more so to assign contributed ideas to internal personnel which could bring these forward in the innovation process. Hence, prioritizing and respectful handling of contributions becomes a key trust challenge for open innovation platform owners. |

## Case 2 (C2C reselling platform, Snapsale) – initial implication analysis

Case 2 is Snapsale, a platform for consumer-to-consumer (C2C) reselling and redistribution of goods, resembling platforms such as eBay and Craigslist, but developed mainly for use on mobile devices. Here, the threshold for posting classified ads are made as low as possible, having the users only to take a picture and add a brief text. On the basis of automatic analyses, ads are categorized and filtered. Buyers browse ads on the basis of thematic and geographical filtering.

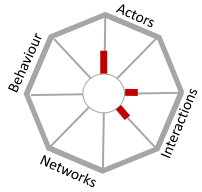
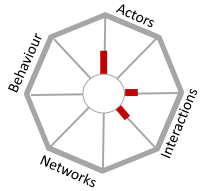
When profiling the open innovation platform following the HUMANE approach, we get a HMN profile as presented in Figure 24.

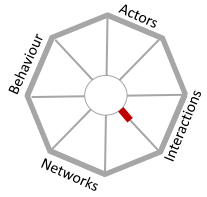
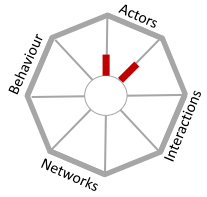
**Figure 25: Case 2 - C2C reselling – initial profile**

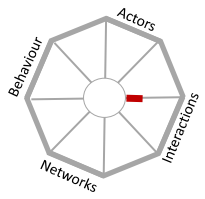
- Compared to typical C2C reselling platforms, Snapsale aims to make the workload on the users as low as possible. For example, when users upload ads, the input is restricted to a picture and a very brief text.
- The Snapsale platform performs a set automatic functions which influences user-experience. In particular for automatic categorization and dynamic filtering of ads, as well as support for discovering and following peers.
- Users are not required to, and typically do not have existing social relations. However, users may follow each other which may lead to establishing weak ties.
- Human actors can choose whether they want to use the platform or whether they want to sell their goods through other channels.
- For C2C platforms to be effective, a relatively large volume of users are needed. Recruitment is a challenge.

- DŜ2ƎℕI·LJKλŎI·f ăLJI·ŎŜ f2ǿ ǿf2ŎI·f λƴƛλűλI·f LJKI·ăŜăΣ ŘŜăƛℕŜ ű2 ōŜ Ǝf2ōI·fúϒ Snapsale aims to support local C2C reselling. However, to get sufficient volume e.g. to be commercially viable, a large geographical distribution is needed.
- ² 2ℕ⟅Ŧfǿǿ λƴűŜℕŘŜLJŜƴŘŜƴŎŜ π λƴűŜℕYŜŘλI·űŜϒ Ads are submitted by users in a pooled fashion. Hence, content production happens without any needs for coordination. However, for a sale to take place, coordination between seller and buyer is needed, much of which takes place outside the Snapsale platform (e.g. through SMS, email, and physical meetings).
- bŜűǿ2ℕ⟅ 2ℕƎI·yƛÎI·ű2Yς KλƎK óű2LJπŘ2ǿyúϒ The organization of Snapsale is top-down, where functionality, features, forms of content, and modes of interaction are determined through centralized decisions and policies. However, some characteristics of the HMN still emerge bottom up, e.g. the group of users which take up Snapsale depends on which segments in which this platforms gain traction.

This HMN profile gives rise to a number of implications. The following are particularly noteworthy:

| | |
|---|---|
|  <br>I dzYI·yI·ƎŜyŎë λƴűŜℕYŜŘλI·űŜ 2ℕ f2ǿф<br>{2ŎλI·f űλŜă f2ǿ ófI·űŜƴúϕ<br>I н a λƴűŜℕI·Ŏűλ2Y ăűℕŜyƎűK f2ǿф | **Implications for Loyalty:** In Snapsale, KdzYI·yI·ƎŜyŎë is currently assessed as intermediate, and then ambition is to lower the need for human agency further. That is, human contributors should be able to set up ads and conduct transactions with as little effort as possible. At the same time, social ties and H2M interaction strength are low, implying that neither particular human-human or human-machine relations tie the user to the platform.<br><br>This HMN profile has important implications for loyalty. For Snapsale that is a relative newcomer in the C2C market, it is critical to establish a loyal user base. At the same time, building loyalty require the user to invest attention and time in the relation (Heskett & Schlesinger, 1994), something that may be hampered with weak or non-existent relational ties. This challenge is likely faced by any newcomer HMN with relatively low human agency, low social ties, and low H2M interaction strength. |
|  <br>I dzYI·yI·ƎŜyŎë λƴűŜℕYŜŘλI·űŜ 2ℕ f2ǿф<br>{2ŎλI·f űλŜă f2ǿ ófI·űŜƴúϕ<br>I н a λƴűŜℕI·Ŏűλ2Y | Implications for **Behavioural change**: In Snapsale, KdzYI·yI·ƎŜyŎë is currently assessed as intermediate, and then ambition is to lower the need for human agency further. At the same time, social ties and H2M interaction strength are low.<br><br>C2C reselling platforms are key to making the sharing economy a vehicle for sustainability, through reduced waste and consumption of goods. However, such turning towards more sustainable behaviour require substantial behavioural change among consumers. If the default mode of shopping should be shopping for used goods, then our response when we need some cannot be to buy something new. And vice versa, the default mode of handing off used goods needs to become reselling, not storing or throwing away. Enabling such a behavioural shift is challenging. When knowing that some of the most efficient mechanisms for behavioural change is long term |

| | |
|---|---|
| ăűŃŜyƎűK f2ǿΦ | exposure and social motivation (Pentland, 2014), then a HMN where social ties and H2M interaction strength is low may be challenged to drive the needed behavioural change. |
|  <br>Iнa ƛyűŜŃI·ŎűƛƧƴ ăűŃŜyƎűK f2ǿ | **Implications for Collaboration**: For Snapsale, Iнa ƛyűŜŃI·ŎűƛƧƴ ăűŃŜyƎűK is low, meaning that the human contributors not have particularly strong dependency and reliance in the machine components of the networks. This implies that customers and sellers may well use other means of contact that the dialogue features provided by Snapsale.<br><br>This has implications for social interaction, as the interaction between users of Snapsale is fragmented across the platform itself, sms, phone, email, and face-to-face meetings. This may be beneficial in the short term, as it allows the users to find an approach to communication that suits them. At the same time, it makes it difficult for the platform owners to monitor and optimize social interaction – as is seen also in other C2C reselling platforms (Haugstveit, Halvorsrud, & Karahasanovic, 2016). Hence, it may, for example be difficult to find solutions to the challenge pertaining to buyers or sellers quitting the dialogue without concluding it, something that challenges the user experience of the remaining part. |
|  <br>Idz YI·ƴI·ƎŜyŎè ƛyűŜŃYŜŘƛI·űŜ<br><br>aI·ŎKƛyŜ I·ƎŜyŎè ƛyűŜŃYŜŘƛI·űŜ ó2Ń f2ǿú | **Innovation and improvement:** In Snapsale, YI·ŎKƛyŜ I·ƎŜyŎè is assessed as intermediate, that is, the platform includes some features reflecting machine intelligence such as intelligent filtering of content. However, more such features are possible.<br><br>In C2C-platforms for reselling of goods, the motivation and loyalty of sellers depend on getting the offered goods sold. Hence it is important for sellers to present goods for sale in a manner that is attractive to buyers. However, given the low volume of adds an individual seller typically has, it is difficult to learn which ads that work and which does not. Hence, sellers are limited in their ability to improve and innovate on presenting the goods for sale. Increased, or different, machine agency may be required to support sellers in learning how to improve on the provided ads, in particular how to learn from good examples.<br><br>What constitute good examples may not always be intuitive. In the case work on Snapsale presented in HUMANE D3.2 (Lüders et al., 2016), it was found that image quality was inversely associated with the level interest in Snapsale adds. |

| | |
|---|---|
|  <br>{ž2ŏλl·f űλŜă tž2ø<br>ófl·űŜýűú | **Implications for Trust:** In Snapsale social ties are typically non-existent, though there is an opportunity to establish ties through following.<br><br>The absence of social ties has potential implications for trust. In C2C reselling platforms, it is necessary for sellers and buyers to trust each other; the absence of social ties may make reduce the parties initial trust levels towards each other. Hence, mechanisms are needed to establish the needed trust in a context where the involved parties has have low social ties. |

## Case 3 (evacuation support, eVACUATE) – initial implication analysis

The eVACUATE case is unusual for a number of reasons, not least because the specific profile derived from the network depends very much on the type of activity supported by the HMN at any one time. Typically, we have distinguished two states: monitoring, when the central decision-support system is simply responding to sensor input and checking that all is running smoothly; and evacuation when the network must support the real-time effective management of human participants as they leave a given venue or event. A further complication arises, though, in that different dimensions involve different network elements at different times and with different roles. Human agency for instance changes depending on which group of participants in the network seem most salient. In this section, therefore, we will consider different aspects of these types of dynamism: initially in terms of network state, but then subsequently as relates to changing roles and participants involved in the network as a whole .

### Network changes state

When we discuss implications of changes in state for the HMN, we need to consider both the implications of each state independently as well as the transition between them. That is, in eVACUATE we have two distinct states: monitoring vs evacuation. Each state changes the profile of the HMN significantly, as seen below in Figure 26. There are two transitions; first when the HMN transitions from monitoring under normal conditions to a disaster occurring leading to evacuation taking place; the second transition being a return to normal monitoring.

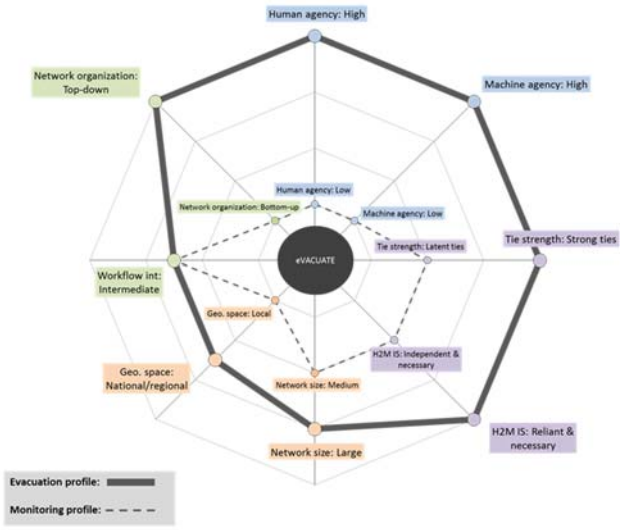



**Figure 26: Case 3 - eVACUATE – initial profile**

There may be different implications to state changes, such as for the technical architecture that is used to support the HMN. If increases in *bŜűǿƨℕ⟆ ƨℕƎI·yϧÎI·ű϶yɀ aI·ŎKϧyŜ !ƎŜyŎè* and *bŜűǿƨℕ⟆ ăϧÎŜ* imply increased capacity, then there may be a need for elasticity: unscheduled expansion of resource use, as provided by a cloud infrastructure. On the other hand, if they imply an increase in the nature and scope of operations required, peer-to-peer configurations may no longer be efficient enough, introducing potential bottlenecks. Instead we may need to consider a SOA design, with individual function connected by a dedicated and high-speed ESB. Therefore, we distinguish here between the following key characteristics of HMNs associated with state change: size, complexity or both.

To assess the complexity of the state change, the network profile may be analysed in terms of which dimensions change and how. If it is only the network size dimension that changes, then we naturally do not consider it a change in complexity. However, if dimensions such as workflow interdependence and agency changes, this may indeed indicate a significant change in complexity that needs to be supported. Moreover, there may be relationships between the dimensions that change, which indicate significant implications that need to be considered.

As noted above, the transitions are important to consider as well. Firstly, one may need to consider monitoring for indications of state changes, as conceptualised in MAPE-K for autonomic computing for instance. Whilst the decision-support system continues to monitor the crowd, the self-healing paradigm of MAPE would need to identify which resources need to be protected and maintained at current performance levels or to be switched to different infrastructure. Secondly, one must consider the speed and nature of the transition. For example, if it is very quick then being able to respond quickly is important: this has implications for the HMN – possibly for both human and machine agents. This is the case in eVACUATE. Technology needs to adapt quickly to collect, process and present data to operational staff, for example, in order to provide timely decision support. While, at the same time, the operational staff must rapidly organise themselves to aid the safe evacuation of the public. This may include emergency and special services, who extend the HMN accordingly.

Inclusion of additional stakeholders in a HMN state change may indicate a need for additional interfaces. In eVACUATE, this may involve simply allowing emergency and special services to gain access to information about the status of the venue and evacuation plans. However, this would have to be via robust and protected connection which may need to involve priority access to one or other group.

On an architectural level, therefore, there are a number of different knock-on effects which relate specifically to the dynamic property of the eVACUATE HMN. Network profile changes should not simply be assumed to require additional resource. There may be software architectural changes, as well as security implications which would need to be addressed in this sort of network. In respect of design patterns, we would be looking for:

- Self-monitoring / self-healing capabilities
- Support for elasticity
- Integration flexibility

These will be considered below.

### Human-centric aspects of network design

One of the most striking features of this HMN relates to the changing levels of agency and participation among the many actors in the network. During normal monitoring, the evacuees themselves are passive participants, being observed by the Operational staff with a view to ensuring that no specific problem arise. As such, they may not know each other, and have no intention of collaborating with let alone relying completely on one another. However, in the case of an emergency situation when they must be safely guided out of a given location or venue, reliance is not only Operational staff or technology components such as signage and the individual devices with a smart space, but in many cases they will have to engage with each other to maximise chances of successful escape. The table below looks at some of the interactions between dimensions under evacuation circumstances and considers some of the implications. In each of the illustrative cases presented, we consider aspects of human-to-human, human-to-machine, machine-to-human and machine-to-machine interactions as they are affected by the specific characteristic: trust, collaboration and shared responsibility.

**Concluding remarks on Case 3**

Not least in ICT, design and design principles tend to be predicated on a set of immutable steps often involving fairly rigid models (of the typical user, rather than the specific user under specific circumstances) and pre-set immovable constraints (of technology design and responsiveness). However, considering this case – advanced decision support in emergency crisis situations – highlights a need for a more flexible approach to design which on the one hand takes account of contextual influence (humans under stress may revert to basic schemata) as well as different approach to protocol implementation and design (machines must allow negotiation and accommodate imperfect responses). Underlying all of this is a call for adaptive design where the machine elements in the network go beyond the self-healing of autonomic computing to responsive interactive systems which react in support of the human agents rather than in spite of them. Effective socio-technical systems depend on the flexibility of the technical design as much as on encouraging trust and participation among the human actors.

| | |
|---|---|
| <br>Network size: Modest<br>Geographical space: Modest<br>Human and Machine agency High<br>Human to Machine interaction strength: High | **Implications for Trust:** the eVACUATE network supports two operational states: during monitoring, to check that there are no potentially dangerous situations detected; and during emergency situations where evacuees must be helped to leave a given venue safely. Considering this latter situation – namely during an emergency evacuation – the network size and geographical distribution remain modest, confined to the devices and individuals associated directly with the evacuation, but may include additional human actors (such as emergency services and possible special services, such as anti-terrorist units) as well as additional technical components (the devices which emergency workers or special forces use). Interestingly, the evacuees have now become direct participants rather than passive objects to be monitored.<br><br>At the same time, however, both Human and Machine agency increase significantly as the human actors in the network must act and interact to effect a successful and effective evacuation; further, existing devices (the main decision support system) must now operate at the highest level of efficiency and speed. Sensors and signage must, if possible, now respond to specific requests for information from the decision support system; further, additional devices may become active parts of the network (such as those from the emergency services at a collaborative level; of the special services, on a request-for-information basis only; and even potentially any smart devices like 'phones owned and used by the evacuees).<br><br>As the HMN shifts into emergency mode and not least on account of the changing responsibilities of components and individuals, potentially bringing new devices into the network, each and every level of interaction relies increasingly on trust: |

| | |
|---|---|
| | ¢ The Human actors must be able to trust and rely on one another, including evacuees on the guidance from operational staff, and both groups on the emergency services as well as optionally on Special Forces. This may depend on defined protocols and procedures; but may, as would be the case between evacuees themselves, depend on latent tie strength shifting to strong tie strength. This means that the network must be designed to encourage human-to-human trust: design patterns must facilitate increasing Tie strength.<br>¢ Human actors must also trust the information provided by the various technology elements: operational staff on the decision support system, and evacuees on signage and any smart devices programmed or activated to pass supportive information or direction. HCD design patterns must focus on ease-of-use, providing intuitive and focused interfaces allowing automatic and intuitively obvious responses.<br>¢ Machine actors must cater for human override, for ethical as well as technical reasons, which may involve re-starting decision modules with new, hybrid inputs. This requires design patterns which support flexibility and cyclical operation of modules.<br>¢ Machine actors must also provide secure and robust interfaces between themselves: the data passed via these interfaces must be reliable, so their integrity must be guaranteed as well as the physical connection remaining operative. Design patterns related to security are important, but also include flexibility and ease of integration.<br><br>Trust assumes a willingness to accept vulnerability; that is an exposure to some level of risk. This implies a level of non-determinism which is not normally catered for in design. Looking at different types of interaction across the network, introducing a willingness to accommodate risk relies on all of these elements to a greater and lesser extent. Design patterns must therefore work in tandem to support the overall effective operation of the HMN. |
| <br>bŜűǿ2ℕ‘<br>2ℕ∃I·yʎÎI·űʎ2ƴ Iʎ∃K<br>a I·ŏKʎyŜ I·∃ŜyŏèIʎ∃K<br>I ȸYI·ƴű2 | Implications for Collaboration: Looking again at the emergency mode of the eVACUATE network, along with the highest levels of Machine agency and Human to machine interaction, Network organization increases markedly as well. All actors within the network are therefore assumed to operate predictably and reliably such that the evacuation is successful. All components within the network must work collaboratively and effectively together to ensure that the overall goal of the HMN is achieved.<br><br>There are clear architectural implications here, some of which were discussed in the previous section. For instance, some form of autonomic self-monitoring and self-healing capability should be in place to facilitate the continued and |

| | |
|---|---|
| a l·ŎKλyŜ λyűŜWl·ŎűA2y ăűWŜyƎűK l λƎK | effective operation of the network. However, what is more important here is to consider how the network may be designed to cater for effective and ongoing collaborative effort across actors.<br><br>For the Human actors in the network, overall network organization must be predicated on a collaborative and unified effort across all human actors. One way to design for this might be to open up additional H2H communication channels to promote a common understanding between all parties as a crisis is managed through.<br><br>¢ Part of the design for collaborative interaction at the Human to Machine interaction level depends not simply on intuitive interface design, the typical province of HCI and illustrated frequently on the basis of wizards and dialogue boxes breaking down interactions to simple and intuitive levels. The more significant part though takes 'intuitive interfaces' to another level: it has been attested in post hoc reports of evacuations that under extreme circumstances and lacking other input, evacuees will revert to schema-based strategies for escape. That being so, H2M design must exploit automatic responses wherever possible, taking affordances to a basic level where purpose rather than aesthetics is the primary goal.<br>¢ To encourage collaborative engagement between actors in support of high levels of Network organization and Machine agency, Machine actors must be designed to tolerate incomplete input. This is a tall order, of course; but a machine actor or component which employs fuzzy logic to attempt to make sense of input is more likely to encourage ongoing collaborative (and trusting) behaviours in Human agents than re-prompting for input, along with helpful examples.<br>¢ Most machine-to-machine interaction depends on strict protocols and negotiated access rights. This works well in many situations, but fails to provide enough flexibility again. Design to encourage collaboration at a machine level must instead provide flexibility and ongoing negotiation around severity and significance of the information and/or command(s) being exchanged.<br><br>Collaboration is about facilitating negotiation and dynamic adaptation to differing interaction 'rules' requires a different approach to design encouraging flexibility and a best-can-do attitude not typically regarded as a reasonable goal. But where networks must be highly organised and at the same time rely on a high degree of Machine agency and Human-Machine interaction, then such flexibility may be an essential underpinning to ensure collaborative engagement and network success. |

*I ʤY I·y ! ∃Ŝyǒè I ƛ∃K*

*{ƨǒƛI·f ¢ƛŜ {ǘŃŜy∃ǘK I ƛ∃K*

Implications for Shared Responsibility: In the previous section, we considered the increased level of Network organization and an attendant increase in Machine agency and Human to machine interaction. The eVACUATE HMN also shows the highest level of Human agency and Tie strength in emergency situations. Focusing here solely on human to human interactions and dimensions is a clear abstraction which should be understood in the context of the other dimensions in the previous sections of this table. However, these dimensions highlight some specific and unique features in this type of network.

One of the challenges associated with profiling the eVACUATE HMN is the changing roles and numbers of human actors. In monitoring mode, potential evacuees are simply passive objects for observation; they may not even be aware or agree that they are part of the HMN. During an evacuation, they become active participants with some responsibility for their own safety. Further, depending on the situation, emergency forces as well as special services may be called in to assist. Tensions may arise between operational staff and outside agencies, whom they perceive as a threat to their autonomy; and according to many modellers misinterpreting Le Bon, the evacuees themselves panic and revert to an every-man-for-himself mentality.

This is counterproductive, on the one hand, and simply untrue on the other. The important point though is that one way to encourage collaboration among disparate groups and individuals (see above) is to instil a feeling of shared responsibility among all actors in the network: boost Tie strength towards strong and encourage Human agency towards social facilitation, social identification and the breakdown of perceived ingroup-outgroup barriers.

- For the Human actors in the network, direct interaction between different groups (emergency services, evacuees, operational staff, etc.) should be enabled via technology connectivity and communication channels in support of or as an alternative if necessary to direct human-to-human interaction. Getting to know the outgroup and developing shared goals mitigates against aggression, panic and unhelpful behaviours.
- H2M design should include not only traditional collaborative tooling such as instant message, but also provide matchmaking between groups and individuals with similar focus. For instance, the technology should encourage speech-enabled interfaces, and provide language-based sentiment analysis to encourage mutual support.
- To complement the H2M interaction, M2H interactions should be based on attentional focus: encourage information highlighting based on importance to the recipient, but also about those the recipient is connected with.
- Finally, machine-to-machine interaction should introduce a communicative element where connection between machines is made wherever possible

| | |
|---|---|
| | to provide continued and appropriate contact and information sharing to encourage informed decision making along with a sense of personal and group responsibility.<br><br>The transition between social loafing – a specialised bystander effect where responsibility is assumed to rest with others – and facilitation encouraging active and responsible participation depends on the communicative and also the information and data mining capabilities of the machine elements within the network. This is part of the reason that increase Human agency and Tie strength in the eVACUATE HMN is accompanied by increased Machine agency and Human to machine interaction. In encouraging a sense of shared responsibility in the management of the crisis, the network shifts from socio-technical system to actor network where each and every element within the HMN contributes in a complex and integrated way to the overall successful functioning of the network. |

## Case 4 (collaboration platform for social media verification, Reveal) – initial implication analysis

Case 4 is a content aggregation - filtering - curation - recommendation system, aiming to advance the necessary technologies for making a higher level analysis of social media possible, thus enabling users to reveal hidden 'modalities' such as reputation, influence or credibility of information. Here, journalists interact with sources, the public and other journalists, and use the tools provided by the project case study for revealing information with respect to social media contributors (source of the information), content (the information itself) and context.

When profiling the REVEAL platform following the HUMANE approach, we get a HMN profile as presented in Figure 27. The profile of the REVEAL platform has been updated since D2.1, due to changes in REVEAL and a renewed understanding of the profile dimensions.

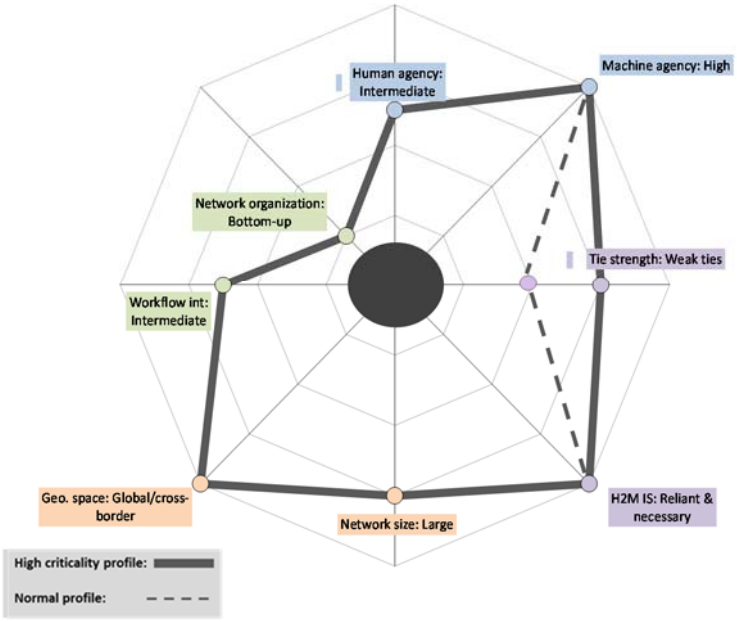



**Figure 27: Case 4 - REVEAL – initial profile**

- Human actors are the end-users, who are using the REVEAL tools to search for credible information in social media. These tools can be used to examine the credibility of a specific message, based on metrics regarding the contributor, content and context of the message.
- Machine actors are software agents that retrieve and analyze social media messages, and store the results of this analysis. The credibility module performs an elaborate analysis of posts in each category using social media quantitative metrics.
- Human actors can interact with each other by providing comments and recommendations on the same content, as well as on the credibility assessment. These interactions are rare, since users are mostly viewers of content, implicit (through the machine and not directly to each other) and are not expected to last long.
- Human actors have a constant interaction with the machine part of the system for setting preferences and content filters, creating topics, browsing the presented results, and providing feedback. Furthermore, the system can function without any human input (apart from initial registering of a user), whereas humans are highly dependent on the machine output.
- The REVEAL tools currently work for the two most important social media with worldwide users Facebook (with 1.65 billion monthly active users) and Twitter (with 332 million active users in January 2016). REVEAL acts as a third-party which collects content from these primary social media (Facebook, Twitter), and further exposes it to a larger audience.

- DŜ2∃ℕI·LJKλŎI·f ăLJI·ŎŜ π Kλ∃K ófI·ℕ∃ŜúY The tremendous popularity of REVEAL tools guarantees that a huge number of topics can be monitored, practically about all aspects of human activities, all over the globe.
- ² 2ℕ]ŦfŁ2ǿ λyűŜℕŘŜLJŜyŘŜyŎŜ π λyűŜℕYŜŘλI·űŜY Each incident in REVEAL triggers specific activities within the network, which lead to journalists taking decisions and evaluating the trustworthiness of each source.
- bŜűǿ2ℕ] 2ℕ∃I·yλÎI·űλ2y´ç fŁǿ óŌ2űű2YπdzLJúY The network organization is bottom-up, meaning that the network's operation is triggered from the "bottom", based on an incident that is published through a channel , and after that the network is organized dynamically according to additional contributions.

| | |
|---|---|
| <br>I dzYI·y´I·∃ŜyŎè λyűŜℕYŜŘλI·űŜφ<br>¢λŜ ăűℕŜy∃űK fI·űŜyű 2ℕ ǿŜI·]φ | **Implications for Motivation:** While the output greatly depends on user generated content and user interactions in the original social media, the REVEAL user is rather a viewer of content, not an active contributor. Thus, the REVEAL tools process information that is already available on social media, and thus does not bear requirements such as a sufficient number of users actively contributing to content, as a prerequisite for its uptake. However, a number of components of the system (such as the modules to provide feedback, approve or disapprove the content and provide comments to justify their decision) depends on the active participation of the users, leading to a similar "sufficient number" requirement (albeit much smaller than the number of social network users). Furthermore, just like any commercial product, its uptake by the end-users is necessary for its economic sustainability.<br><br>Moreover, tie strength is weak and users are mainly incited by the machine output and not by the social interactions between each other.<br><br>This HMN profile has important implications for motivation. There is significant room for human actors to find the content that interests them, but this depends on how the machine presents the content and by how accurately and precisely it retrieves the content the users are interested in. Despite that tie strength between human actors is weak in REVEAL, this is alleviated by the fact that there are strong ties between human actors in the underlying social networks and by the possibility for REVEAL users to share content on the original social network. |
| <br>bŜűǿ2ℕ] ăλÎŜ fI·ℕ∃Ŝ | **Implications for Information Overload:** In REVEAL, the problem of information overload is managed by advanced filtering functionality, which allows viewing social media content based on individual needs and interests. Besides filtering based on topics and keywords, the user has the possibility to filter content based on time period, contributors, location, recency, popularity, and credibility. This reduces significantly the volume of messages that are finally delivered to the end-users. Nevertheless, this carries the risk of excessive |

| | |
|---|---|
| | filtering, in which some messages or posts which would be interesting to the user are also blocked. |
| a I·ŏKłyŜ I·ƎŜyŏè KłƎKΦ | **Implications for Reputation:** The accuracy of the credibility analysis is also important in order not to unjustly harm the reputation of an individual, company or organization. The fact that machine agency is high in REVEAL means that the tools should be as accurate as possible in order to lead to accurate results regarding users' reputation.<br>REVEAL is also affected by malicious users who provide comments or recommendations to manipulate other users, either in the original social network, or using the REVEAL recommendation and commenting tools themselves. This however happens to a lesser extent, since a) the REVEAL tools try to identify and eliminate such users as "non-credible" in the original social network and b) the additional comments and recommendations of the REVEAL users does not change the rating already attributed to a content or source.<br>Overall, the credibility analysis in REVEAL deters users from providing false or malicious content, motivates them to check themselves the accuracy of the content before publication, and makes them more aware of their social responsibility to inform other users correctly. |
| a I·ŏKłyŜ I·ƎŜyŏè KłƎKΦ | **Implications for Privacy:** The respect for privacy is also a significant requirement for building trust. Although REVEAL does not serve advertising or tracking purposes, the advanced filtering capabilities could be used by someone for facilitating the identification of user groups with special interests or characteristics, which would be potential targets of an advertising campaign. A crucial implication for services such as REVEAL is to consistently apply the privacy policy of the original medium to which the information was submitted, and to which the user has agreed. For example, if a user does not wish to receive recommendations or advertisements, this should be carried over to any other party using the REVEAL services. Or, if a user deletes his/her account in the original social media along with all posts, then these posts should also be removed from the REVEAL database. |
| a I·ŏKłyŜ I·ƎŜyŏè KłƎKΦ | **Implications for Trust:** In the REVEAL platform, machine agency is high, as the machine components of the systems may strongly influence the actions and intentions of the contributors, and conduct actions reflecting intelligence (retrieving content based on user preferences, predicting trends, assessing credibility). The REVEAL platform provides a specific frame and options by which users can retrieve social media content.<br>At the same time, H2M interaction strength is high, meaning that the human |

| | |
|---|---|
| *Iнa λyΰŜℕI·ŎΰΛ2ƴ ăΰℕŜyƎΰK KΛƎKΦ* | contributors have particularly strong dependency and reliance in the machine components of the networks.<br><br>The sentiment analysis and credibility score is presented to the users, along with the rating for each modality, but calculation details are more complex and remain hidden.<br><br>It is also reasonable to claim that the machine output has an additional impact on the users, both because it is acting as a proxy for different social media (without the user having to access these media directly), and because it quantifies the credibility of the messages and information sources. Thus, the user opinion is greatly affected and shaped by the machine output.<br><br>HMNs with high machine agency may entail challenges concerning trust. The fact that REVEAL only produces the outcome of processing tasks to the end-users, and does not present all details about the underlying algorithms (i.e. operates as a "black-box", to some degree) implies that users initially have a low level of trust, which needs to be built in order for the tools to be successful. |
| <br>*I dzƳI·ƴI·ƎŜyŎë KΛƎKΦ*<br><br>*bŜΰǿ2ℕ⟅ 2ℕƎI·yΛÎI·ΰΛ2ƴ ō2ΰΰ2ƳπdzLJΦ* | **Implications for Security:** Security issues relevant to REVEAL include user identification and authentication and confidentiality of information of both the REVEAL users and the users in the underlying social networks. REVEAL is acting as a third-party application which has access to the information in the original social media. In concluding an agreement to access these media, REVEAL must adhere to the privacy rules of the original social medium, however such data aggregation services are usually attractive targets for intruders who would like to obtain a list of users interested in a certain topic (e.g. for marketing purposes).<br><br>A problem, common to social networks with bottom-up network organization such as this case, is bots or users with fake identities. |

## Case 5 (Wikipedia) – initial implication analysis

Case 5 is Wikipedia, the free online encyclopedia edited by volunteers from all around the world. Wikipedia has achieved enormous success within the 15 years of its life. With more than 36 million articles in 290 different language editions, Wikipedia has become by now the number one general work of reference in everyday practice.

When profiling the open innovation platform following the HUMANE approach, we get a HMN profile as presented in Figure 28.

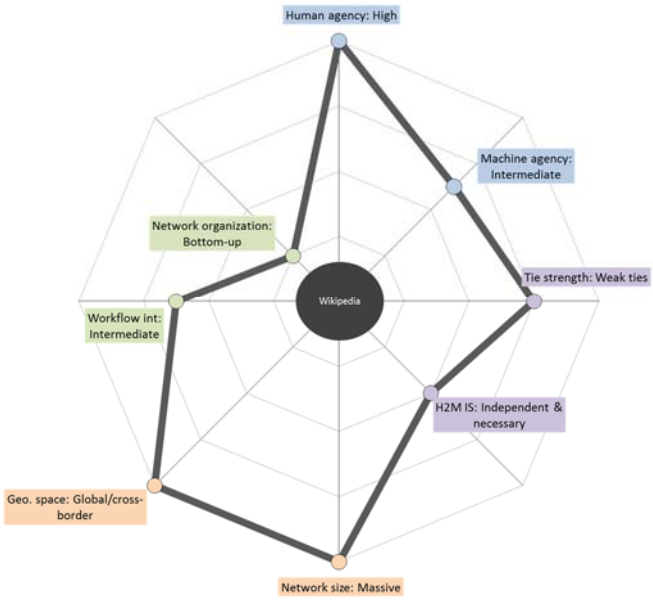
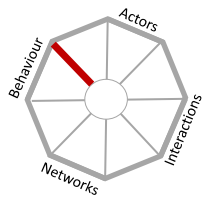
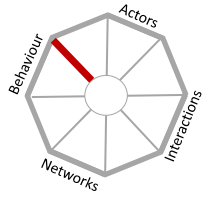



**Figure 28: Case 5 - Wikipedia – initial profile**

- Wikipedia has a system relying on open contribution for human nodes, but these human actors take on a variety of different roles. Most users are able to perform different types of activities such as edits, reverts, multimedia upload, etc.
- Machine nodes in Wikipedia can modify content. The content is restricted and controlled by autonomous computer programmes, called "bots". The bots are carefully programmed for a variety of different tasks, including writing articles.
- In Wikipedia, the interaction among editors, although important and essential to some extent, is characterised by weak ties. Editors have numerous ways of reaching other editors. The ease with which interactions occur is key to a better editing experience.
- Machine actors, such as bots, perform a useful function on Wikipedia by detecting vandalism, fixing grammar and spelling mistakes, cross-linking articles, and checking links, among others. Bots can make changes to the content but human actors can override them.
- Wikipedia's network of editors and bots is massive. In September 2015, the English Wikipedia has around 31K active users (users with >5 edits) and more than 26M total users.
- Wikipedia is definitely global although still very western-centric. It is the most popular and premier destination for information and knowledge on the Web in over 250 languages.
- Wikipedia editors can contribute independently, but de facto they collaborate with humans and machines to produce the

}vš všX ošZ}µPZ Œo}Á‰]Œ šZo Á}vŒŒ{ooo (}}ŒEuš]{v}}v t]l]‰ ] U
o Œ•Z]‰ v ]š]}Œ••[ ]v}šu Œ Œ§š] (o (š}]ŒÀ šŸZ•• ](( šZ •]š X
x E šÁ}ŒI }ŒP v]Ì š]}v t ot}]Á]‰ }§š}]u•rµ}‰••]W Œ • v ÆšŒ u (
• o(r}ŒP v]Ì •Çvšš Œi]X µšl]Z}v•}}( u vÇo]v]š}UŒ•}uŒš]u • š
u vÇ o À o•U µvš]d‰ro}À‰oo}µš‰}µš ~]]X•X]u• (}vŒEÇu o]X‰

| | |
|---|---|
| E šÁ}ŒI }ŒP v]Ì š]}v }šš}urµ‰X<br>E šÁ}ŒI •]Ì u ••]À X | /u‰o] š]}v• (}Œ D}š]À š]}v v t]E]‰Á}Œ I Z'Œ•}Á š}ZšW}ur<br>µ‰ŒP v]ÌUš]}vvšZ • v• šZ vš š‰ZŒ]Eµ u Œ• }( š]À]šÇ }v<br>v šÁ}ŒI Z À u ŒP }À Œ š]u (Œ}u šZ[‰ }]µ ]v ((}Œš<br>}všŒ] µš}Œ•X šš ŠUZt]l•]‰ §] ]• u•]•l•U]À}v]•v]•š]vP }( îô<br>u]oo]}v Œ P]•š Œ }µš]šíîŒE•U ìì v Œ PµoŒE• Á}ZZ§Œ] µš}<br>u v P u}Œ šZ v ïöš]u]oo•]]}w îõŒE ](( Œ v]š]}ÿ íÿVXXPµ P |
| | dZ]• ,DE ‰Œ}(]o Zu‰ou]‰§]Œ}š• v(§}Œ µ• Œ uv}šš]Á}Œ]}v<br>PŒ}ÁšZX Kv t]l]‰ Œ PU vš]Z š}v(‰}Œ} ••]vZ • Œ •µoš<br>}u‰o Æ •Ç•š•u v}( vŒ}Œ Eou• šZ š ‰‰ Œv• Á]v}šu]uŒ}•Xš]vP š}<br>• v Á µ• Œ• Œ Œ Œv oÇ‰Á oŒ š}(Z v qµ Œ}Z ÇµŒ<br>šZ Ç }(š v Z À o•š }(]šš•Z Œ}ŒÀ(Œ}Œš XZ dZd••u d]• šÇ š}<br>Œ šµŒvU Á Z] Z ]v šµŒv ‰}‰P Œµ•š} Z d}v šZ( šZ<br>t]l]‰ ] }uuµv]šÇ '~],Po(Œ}U Œ}U}ŒZ}P voUU îìíî•X |
| | , v U }šš}urµ‰ v š•Á}PŒŒl}Á ZZ šv Z }u oÁ]•oZo r •š<br>u Ç ]u‰ ]š• }Á v À o}‰u vš v (µŒš‰ %ŒŒ}Œ}Z Á šZX<br>u Ç v š} •šŒ µuŒ]v µšŒZ Ç •} šZ( }šŒ]Ì š] À•]vuP}Œš}<br>v Á }u Œ•X |
| d] •šŒ vPšZ WŒ Á]µ• Œ • Œ Z ]µ P Pv•š]•vš‰ šŒš] µ(o }šŒZU ŒŒ À Œš<br>]š}Œ•[ }všŒ] µš]}v•šU Á vP Áµ Œ• Œ}ŒEv•] d]všŒ}À<br>Œš] o • ~ Œ v • ^ µu]oXšU îìXõVîìíí•Œ}k µŒX î•š µZ}Á•(<br>šZ š v P š]À •} ] •o•]µvšZ Œ• Œ}À v vP šv l•• ]Œ] o š | /u‰o] š]}v• (}Œ W o d]l]‰Œ §] }v ]š}Œ• v ]vš Œ š Á]šZ<br>}šZ Œ ]v vµu Œ}µ• Á Ç• t Ç }vÀ Œ•]U PÁ }Œv]š}Œv§P] }ov Z]•š<br>Z }šZ Œ[• µ• Œ ‰ P •U š]vP ‰µ ‰]Œo}Ç‰}}v• v•Á U u]v<br>• v ]vP ‹µ •š]}v• š}U rš ]Xo E•}]š•š•o o }d §}Œ š}PšZ ]v À u<br>Æš vš ]v šZ • š}Œ À]oš•d U• š•Z }À] • šXv E šÀ} Œ šÁZ d •• U<br>šZ]• } • v}š ‰Œ ÀŒv š•]}}v]•o(}Œv§u ]u‰]š§š}Œv]PošZ š]À]šÇX<br>W Œ Á]µ• Œ • Œ Z ]µ P Pv•š]•vš‰ šŒš] µ(o }šŒZU ŒŒ À Œš<br>]š}Œ•[ }všŒ] µš]}v•šU Á vP Áµ Œ• Œ}ŒEv•] d]všŒ}À<br>Œš] o • ~ Œ v • ^ µu]oXšU îìXõVîìíí•Œ}k µŒX î•š µZ}Á•(<br>šZ š v P š]À •} ] •o•]µvšZ Œ• Œ}À v vP šv l•• ]Œ] o š |

| | |
|---|---|
|  <br>bŜűǿ2ℕ⟅<br>2ℕ∃I·yϰÎI·ű𝔞2Yˇű2LJπ<br>Ř2ǿy₱ | **Implications for Innovation**: Zooniverse is organized top-down, meaning that volunteers can rarely have input into what projects should be pursued and how projects should be organized. This is common for most crowdsourcing systems. Such top-down organization may stifle creativity and innovation in the HMN. Through spending hours pouring over the data or the tasks, users could observe patterns that the scientists or the employers did not foresee. If the project is not designed to record such observations, this knowledge will be lost. Due to extensive experience, users are also likely to have a better idea how to design a project in order to attract and sustain high-levels of participation and high quality of contributions. If users are not allowed and encouraged to experiment with designing their own projects, learning will occur much more slowly. |
|  <br>bŜűǿ2ℕ⟅<br>2ℕ∃I·yϰÎI·ű𝔞2Yˇű2LJπ<br>Ř2ǿy₱ | **Implications for Network Growth**: Zooniverse is organized top-down, in the sense that all scientific projects are first designed and built with pre-defined tasks and then released to volunteers to complete the tasks. Until recently, Zooniverse also required all projects to be reviewed and approved by the Zooniverse team. Often, the Zooniverse team was also actively involved in designing and implementing the projects.<br><br>An HMN based on such tight oversight and control cannot scale up easily. Indeed, until recently, Zooniverse could manage only a handful of projects. If users are not presented with a reasonable range of projects and tasks to choose from, they may start leaving the platform and as a result, the HMN may shrink. |
| <br>I⇳YI·yYI·∃ŜyǑè<br>t2ǿ₰<br>a I·ǑKϰyŜ I·∃ŜyǑè<br>t2ǿ₰ | **Implications for Product Quality:** Zooniverse has the so-called push-oriented labour market, where project managers directly allocate appropriate tasks to workers as they arrive. Zooniverse volunteers can rarely freely choose what and how to contribute – they have to follow a set of activities already planned for them. Machine agency in the Zooniverse platform is also low as there are no task-routing or barrier mechanisms in place.<br><br>This combination of profile dimensions is typical for crowdsourcing and citizen science platforms. It is also a likely reason why these platforms struggle with low quality of contributions (Allahbakhsh et al., 2013; Quinn & Bederson, 2011). As the barriers to entry are minimal, the tasks are repetitive, and the feedback mechanisms are sometimes absent, users' work often contains biases and errors, whether malevolent or accidental. |

# 14 Appendix C – Initial design patterns for the HUMANE case studies

In the following, we present the initial design patterns suggested for the six HUMANE cases. In total 36 design patterns were suggested across the six cases. The design patterns are responses to implications identified for each of the cases. Hence, the design patterns are here structured according to the high-level groups of implications considered in HUMANE:

- **User motivation and experience**, including attention, experience, information overload, motivation, and reputation.
- **User behaviour and collaboration**, including behavioural change, collaboration, loyalty, shared responsibility, and social interaction.
- **Innovation and improvement**, including innovation and improvement in general, as well as product quality and network growth.
- **Privacy and trust,** including security in addition to privacy and trust.
- **The underlying technical infrastructure**, including resilience, memory and computational requirements.

In the following sections, we list a set of design patterns pertaining to these high-level categories. All design patterns conform to a standard template:

The design patterns adhere to the format as presented in Section 8.2.

## 14.1 Motivation and Experiences

Patterns are intended to cover aspects of HMN design and implementation such as attention (Section 14.1.1), experience (Section 14.1.2), information overload (Section 14.1.3), motivation (Section 14.1.4) and reputation (Section 14.1.5).

### 14.1.1 Patterns for Attention

#### 14.1.1.1 Campaigns, not routine, for attention in small-scale HMNs

HMN type: *bŜűø2ℕ1πăλÎŜ t2ø*. Implication: *!űűŜyűλ2y˝*Design Pattern Group(s): *IнaΣ aнI*

**Problem**
*I2ø ű2 ădzăűI·λy˝LJI·ℕűλŐλLJI·yű I·űűŜyűλ2y˝λy˝ăYI·ftπăŐI·fŜ I a bă ŘŜLJŜyŘλyƎ 2y˝Ô2yűŝyű Ô2yűℕλōdzűλ2y˝I·yŘ ăKI·ℕλyƎ*

This problem is critical to resolve in HMNs depending on UGC

**Background**
For HMNs depending on content contribution and sharing, a key challenge is to have sufficient attention in the user base. This, in particular, holds for small-size HMNs. Here, the activity over time in the network will remain limited, with the risk of reduced attention due to limited activity, which in turn limits activity even more; a vicious circle.

**Solution**

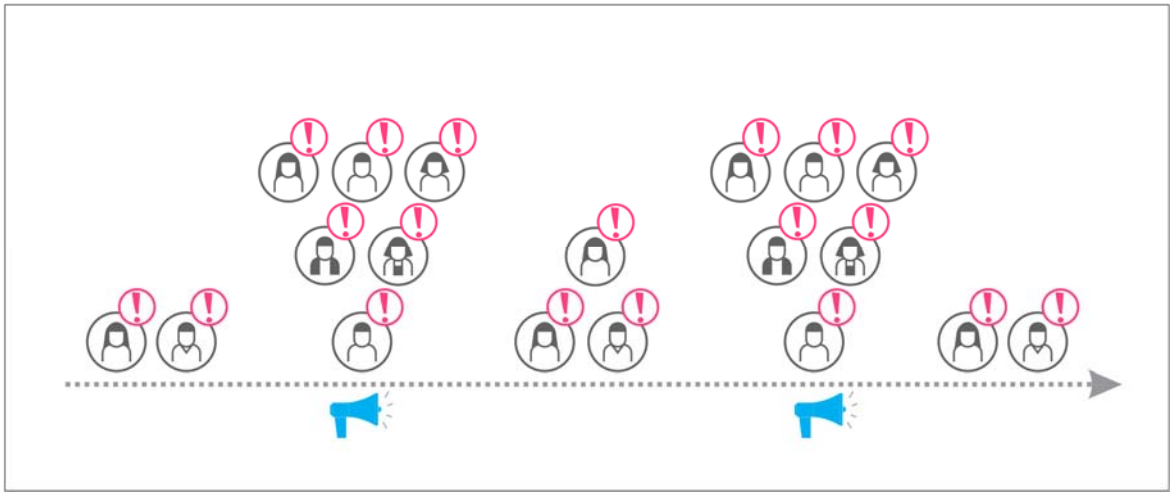
/ I· Y LJI·λ∃yãΣ y2ú ℕ2dzűλyŜΣ Ŧ2ℕ I·ûűŜyűλ2y˘λy˘ă Y˘I·ťfπăŏI·fŜ I a bă

Platforms for content production and sharing are often implemented to run indefinitely. However, for small-scale HMNs, this approach may defy its purpose as there is a risk over time of losing attention. To mitigate this risk, small-scale HMNs for content production and sharing may instead consider implementation for campaigns rather than routine availability.

The technical infrastructure may well be implemented on a permanent basis (possibly as a cloud service), but the actual instantiation of the HMN rather could be implemented as a series of short periods of high levels of attention, separated by longer periods of rest.

A campaign-oriented approach to HMNs for content sharing and production is beneficial both from the perspective of the platform host, who may direct full attention to the HMN during campaign periods, and the contributors, who may be more motivated to contribute as there is a short period of heightened attention among all potential contributors.

**Illustration**



**When to use**

Use in the processing of planning for a small-scale HMN for content creation or sharing. The pattern should be used during the early design phases, to make sure that the design of the recruitment process supports that contributors are nurtured through a process of consumption.

**Sources**

HMNs adhering to this pattern are networks for survey questioning, such as representative panels of volunteers that are invited to questionnaire studies a few times a year. Another platform that is successfully utilizing a campaign approach is Kahoot (https://getkahoot.com/), an eLearning solution where students are tried through short-term gamified quizzes.

#### 14.1.1.2 Maximising the benefits of affordances

HMN Type: *bκ!*; Implication: *!ΰΰŜýΰλ2ƴ;* Design Pattern Group(s): *ΙнaΣ aнΙ*

**Problem**

The pattern addresses the following problem: */2ƴfdzăŜŘ 2ℕ λƴΙ·LJLJℕ2LJℕλΙ·ΰŜ dzăŜℕ ℕŜăLJ2ƴâŜ ΰ2 ăλƎƴΙ·fă Ι·ƴŘ Ι·fŜℕΰă*

High-level Implications: increases the probability of correct response to signals or of appropriate input

**Background**

In extreme situations, such as an emergency evacuation, responses may be triggered at the most visceral level if the situation looks desperate. Traditional signals, such as loud sirens and flashing warning lights, may simply exacerbate a situation. An evacuation may at best be held up during confusion, at worse lead to injury and fatalities.

A similar problem occurs online, the most obvious example being with passwords. The three-strikes-and-you're-out paradigm has been slavishly transferred to access control, meaning that at best users are prompted simply with a warning that if they fail now, they will be locked out. An extension for online applications is to apply the same approach across the board and irrespective of the consequence: locking an eMail account is an inconvenience, shutting down a health monitoring system could be fatal.

The HMN in all such cases needs to respond to context, effectively increasing human understanding within Machine agency. As such, this may be regarded as a specialised aspect of HCI.

**Solution**

*/2ýΰŜÈΰπΙ·ø Ι·ℕŜ ŘŜăλƎƴ' /Ι·LJλΰΙ·fλăŜ 2ƴ˘ăŎKŜΥΙ·ΰΙ· 2ℕ 2ΰKŜℕ Õ2ýΰŜÈΰdzΙ·f óKλăΰ2ℕλŎΙ·fΰ λƴf2ℕΥΙ·ΰλ2ƴ˘*

All the examples above fail to take account of contextual information:

- In an evacuation situation, lighting and noise level will encourage escape via an appropriate route. This is not simply static emergency lighting, but rather to make the whole context appear safer (see the lower corridor in the *Lffdzăΰℕ Ι·ΰλ2ƴ˘* below); and if a particular route needs more care, make this clear via reduced lighting etc. (the upper corridor). This talks to schemata introducing an automatic response;
- Similarly, where no lighting and signage can be controlled in support of evacuation, local knowledge such as the typical routes evacuees would use if left to their own devices, would divert resource and attention to where those people are most likely to be and where they will need help[14];
- For password management, the interface needs to relieve the pressure on the user,

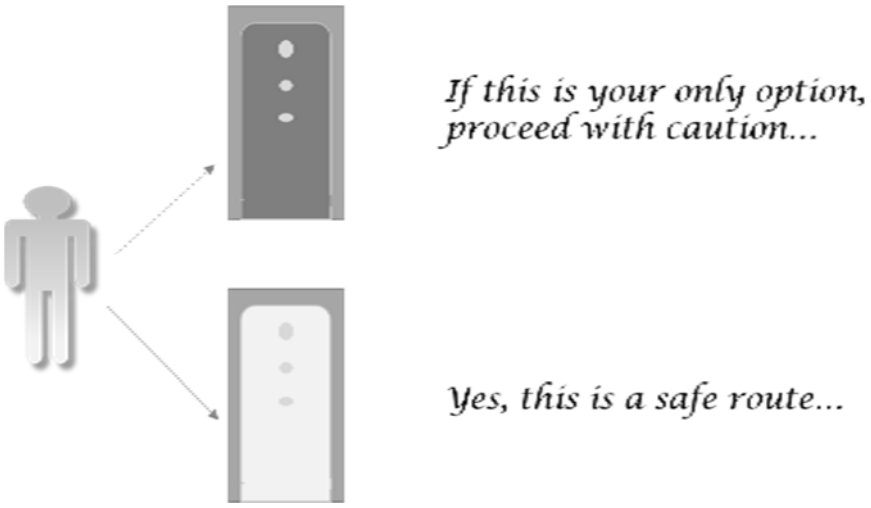
[14] This is precisely the situation in the King's Cross fire.

especially an infrequent user, and support them with reference to history, for example. Prompting with 'OK, you don't seem to remember your password, do you remember the previous one?' or 'Do you remember the last time you logged in?' etc.

- By extension, the user interface should react to the potential severity of the consequence of different decisions and react accordingly. On one level this is an extension of the common "Do you really want to delete this file?" prompt which is often ignored. However, it is well founded. Presenting projections of what will happen on the basis of a critical decision, however, is more likely to raise attentional focus than text.

Interfaces should therefore extend contextual awareness and shift to a mode of engagement with Human agency that promotes either automatic responses (schema-based) or refocuses attention to re-evaluate a situation.

**Illustration**




**When to use**

In any situation where (a) Human agency may be under some duress; or (b) where the consequences of a given behaviour or activity is likely to undermine or compromise the overall aims of the HMN.

**Sources**

The design focus on *I·ŦŦ2WŘI·yŐŜă* provides a clear corollary with a call for a direct cognitive-affective aspect to avoid misuse. Almost all siren- and flashing-light based emergency alert strategies are likely to be less effective without acknowledging human actors' responses.

### 14.1.2 Patterns for Experience

#### 14.1.2.1 Provide what is desired, not just what is known

HMN type: *a l·ŏKλyŜ l·ƎŜyŏë t2ó*. Implication: ¦ăŜℕ ŜËLJŜℕΛŜyŎŜT Design Pattern Group(s): *aнlΣ aнa*

**Problem**
*wŜŘdzŎŜŘ ŜËLJŜℕΛŜyŎŜ ŘdzŜ ű2 tl·Ŏ¦ 2ᴛ l·ŎŎŜăă ű2 ℕŜtŜØl·yű l·yŘ ŜyƎl·ƎλyƎ Ŏ2yűŜyű 2ℕ ℕŜă2dzℕŎŜă*

This problem is critical to resolve in workplace-oriented HMNs with a wider selection of opportunities that can easily be overviewed by a human user, such as in HMNs for content production and sharing, as well as HMNs for networking and collaboration.

**Background**
Low levels of machine agency may entail challenges concerning quality of experience. This is, for example, seen in workplace-oriented HMNs for creating and sharing of content, such as company intranets, where a lack of intelligent filtering and recommendations concerning content in practice reduces the user's access to engaging and relevant content. The same challenge is also seen in workplace-oriented HMNs where people connect to network and collaborate, such as online environments for project collaboration, discussion forums, and also some open innovation platforms. The key challenge is not that the desired content or resources are not there; the challenge is that the users are not aware of its existence or cannot easily locate it.

**Solution**
*tℕ2ØλŘŜ óKl·ű λă ŘŜăλℕŜŘΣ y2ű ƨdzăű óKl·ű λă ¦y2óy*

Workplace-oriented HMNs for networking, collaboration and content sharing can learn much by considering how resembling HMNs are implemented for the consumer market. Whereas workplace-oriented networks typically assume that the humans in the network know what they need and where to find it, HMNs for the consumer market promote what is judged to be desired by the target audience.

Hence, whereas workplace-oriented HMNs for networking, collaboration and content sharing typically provide little in the way of intelligent filtering and recommendation of content and persons (just consider how utterly inconceivable it is that the intranet should recommend needed content on the basis of social filtering), successful consumer market HMNs apply machine intelligence to filter and recommend content and resources based on e.g social filtering.

To learn from consumer market HMNs, workplace-oriented HMNs for networking, collaboration and content sharing need to challenge the assumption that the human in the network always knows what is needed, to predicting what the human in the network need or desire. For example, open innovation platforms could apply filtering and recommendations to present others ideas assumed to be particularly relevant for the user at hand. Workplace intranets could apply social filtering to suggest documents and information that is particularly accessed or sought after in a

behaviour towards socially desirable behaviour patterns.

**Solution**

*. ŜKI·Øłƨdzℕ·ŧ ŎKI·yƎŜ úKℕƨdzƎK ăƨŎłI·ŧ Y˙ƨúłØI·úłƨy˙*

Humans learn and adapt their behaviour in response to the observed behavioural patterns of their social group. In particular, peer groups have been shown to have strong effects on individuals behavioural patterns. Pentland (2014) shows how behaviour associated with political preferences as well as healthy lifestyles are affected by the behaviour and preferences of peers.

One form of human networks, that applies this solution is support groups for change of undesirable behaviour such as alcoholism and drug abuse. Although such human networks are not HMNs they serve to exemplify how being part of a social group with a common goal is used to help the individual change behaviour. Some such networks also apply mediated communication within the group, such as the British NHS quit smoking groups where phone-based communication outside face-to-face meetings is encouraged.

Some social networks apply social mechanisms to change behaviour, as for example seen in Facebook's use of friends behaviour as a motivator for engaging with content. Given the strong effect of social motivation, this could be applied far more frequently in HMNs to modify or change the behaviour of the human actors.

**Illustration**

**When to use**

In the planning phase or during redesign, to increase loyalty through behavioural change.

**Sources**

Strategic use of social context to support behavioural change is discussed by Pentland (2014) in his work on social physics.

**See other patterns**

Pattern 14.2.1.1

### 14.2.2 Patterns for Collaboration

#### 14.2.2.1 Collaboration through gamified engagement

HMN type: {2ŏλI·t ůλŝă f2ǿΣ I н a λyűŝℕI·ŏűλ2y′f2ǿΣ ² 2ℕ⟮ŦŧŁǿ ŁyűŝℕŘŝŁJŝyŘŝyŏŝ f2ǿκλyűŝℕY′ŝŘλI·ůŝ.
Implication: /2ffI·ō2ℕI·ůλ2yΓ Design Pattern Group(s): I н I Σ a н I

**Problem**
I 2ǿ ůŁ2 ăúℕŝyƎűKŝy′Ŏ2ffI·ō2ℕI·ůλ2y′λy′ I a bă ǿŝℕŝ λyűŝℕI·ŏűλ2y′I·Y′2yƎ Kdz Y′I·y′I·ŏűŁ2ℕă λă ƨLJůλ2yI·t

**Background**
In HMNs, establishing vibrant collaboration is often challenging. For example, open innovation platforms which would benefit on collaboration between external contributors often see only parallel contributions with little or no interaction. Hence, opportunities for collaborative refinement of content or actions, as well as engagement among contributors is lost.

**Solution**
/2ffI·ō2ℕI·ůλ2y′ůKℕ2dzƎK ƎI· Y′λŦλŝŘ ŝyƎI·ƎŝY′ŝyű

Gamified engagement is an approach typically seen in online games, but also in social networks. Here, anyone typically is allowed to sign up and also contribute content. However, in order to progress the HMN members need to generate engagement in others. In online games, such as Clash of Clans, substantial progress is only possible through engaging with other players either as battle opponents or as clan collaborators. In social networks, such as Facebook, the level of engagement generated through your posts decided the reach of your future posts. Also, some open innovation platforms have taken on gamified engagement. For example Lego Idea allows anyone to post ideas, but only ideas that receive a predefined level of attention (upvotes and comments) are selected for review by the company.

**Illustration**

**When to use**
The pattern should be used during the early design phases, to make sure that the HMN will be helpful for users to access and engage with desired content and resources. Use in the process of planning the platform intended to serve the HMN.

**Sources**
Online games, e.g. Clash of clans, social networks, e.g. Facebook, and some open innovation platforms, e.g. Lego Idea reflect how gamified engagement may be applied to strengthen collaboration.

### 14.2.2.2 Consider geography in designing collaboration

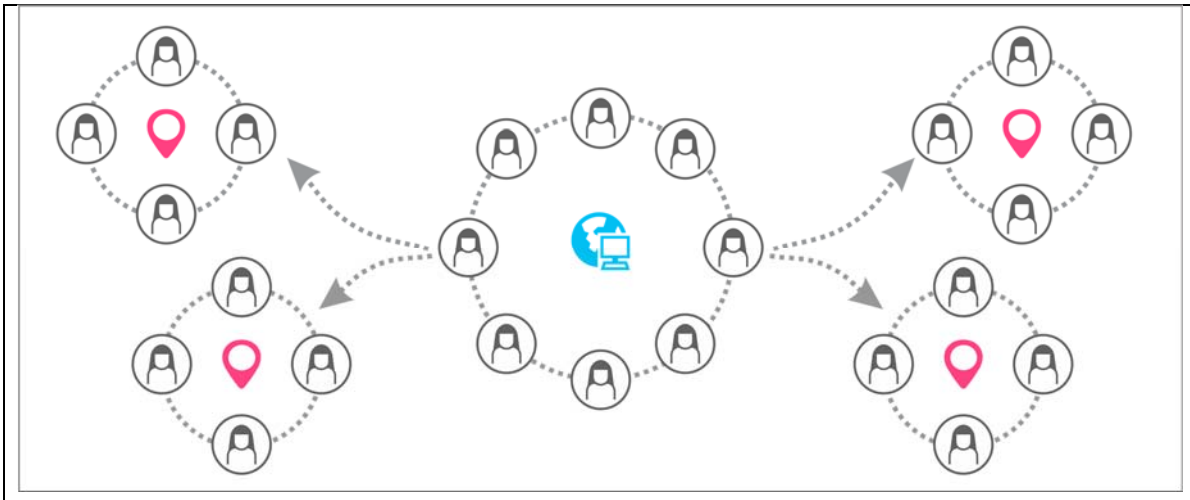
HMN type: *DŜ2∃ℕI·LJKλŎI·f ăLJI·ŎŜ ∃ft2ōI·f¢* Implication: */2ffI·ō2ℕI·ű2yΓ* Design Pattern Group(s): *a н I*

**Problem**
*[2ǿ fŜØŜf 2Ŧ Ŏ2ffI·ō2ℕI·ű2y′ŘdzŜ ű2 ∃Ŝ2∃ℕI·LJKλŎI·f ŘλăűI·yŎŜ¢*

**Background**
In task oriented HMNs that tasks are assigned to users automatically, there is the risk of low quality contribution by users who have been mismatched to the tasks too difficult for them. Different users have different expertise and different interests. It is important to assign them to the right task. This process however needs high level of machine agency and automated intelligence.

**Solution**
Such regularities can be strategically used by citizen science and crowdsourcing platforms to improve the number and quality of contributions and to organize coordinated and collaborative projects. For example, tasks that require continuous input can be routed to users from different time zones. Other kinds of HMNs can also creatively employ the geographical distribution of their users to encourage local collaboration, distribute work load or even server load, and tackle projects and tasks that are inconceivable otherwise.

**Illustration**



**When to use**
Throughout the project.

**Sources**
The emergence of different “chapters” in Wikipedia project is a good example of creation of local communities.

**See other patterns**
Patterns 14.2.2.1, 14.2.2.3

### 14.2.2.3 Organize social events to increase tie strength

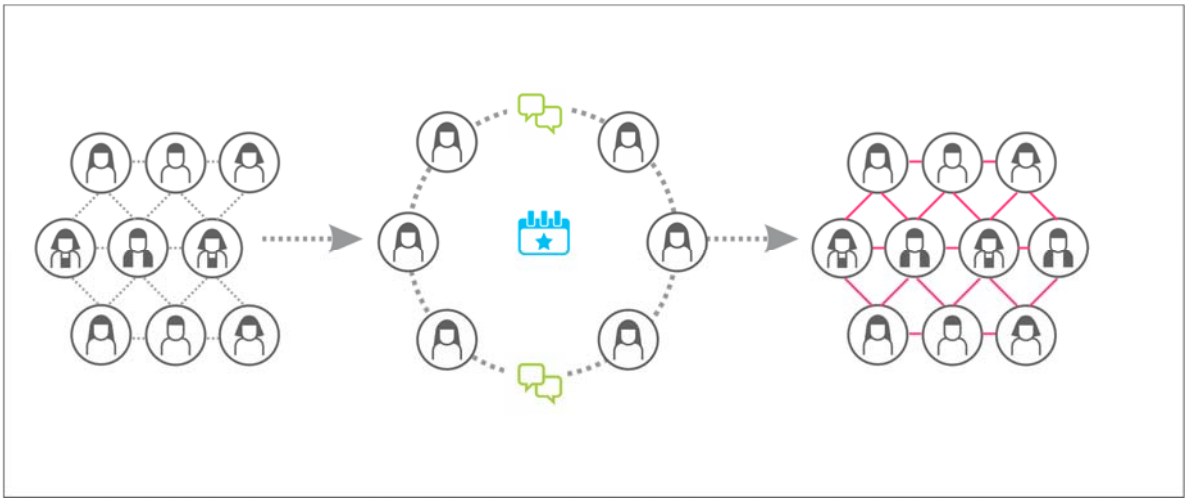
HMN type: ¢ƛŜ ăűŴŜyƎűK ǿŜI·ʔ¢ Implication: /ƨffI·ō2ŇI·űƛ2yϒ Design Pattern Group(s): IнIΣ aнI

**Problem**
[I·Ǒʔ ƨŦ Ǒƨffl·ō2ŇI·űƛ2yϒŘʤŜ ű2 tI·Ǒʔ ƨŦ ă2ǑƛI·t űƛŜă¢

**Background**
In HMNs that have weak or latent, or no social ties, collaboration might be difficult. Collaboration is always entangled with conflict and opinion clashes. To avoid destructive interactions, it is important to make strong social ties between users. Friendship and strong social bounds facilitate more successful and sustainable collaboration and prohibits opinion clashes and conflicts of contributions.

**Solution**
A solution to this issue can be organizing real life events through which users get to meet each other in person and bound social ties. Research has shown that these external events can help to keep the users active and motivated in collaborative systems such as OpenStreetMap.

**Illustration**



**When to use**

The social ties are crucial for collaboration as long as the projects are ongoing. Different communities might form and dissolve, but it is important to keep the users within the social structure of the network.

**Sources**

Wikipedia community of editors have been organizing meet-ups and OpenStreeMap users have “mapping parties”. Both demonstrated positive effects on collaboration (Hristova, Quattrone, Mashhadi, & Capra, 2013).

**See other patterns**

Patterns 14.2.2.1, 14.2.2.2

### 14.2.2.4 Collaboration between machines and humans through machine learning

HMN type: *a l·ŏKλyŜ l·ƎŜyŏè λyűŜℕYŜŘλl·űŜΣ ² 2ℕ⟦Ŧf2ø λyűŜℕŘŜLJŜyŘŜyŏŜ λyűŜℕYŜŘλl·űŜ*. Implication: */2ffl·ō2ℕl·ûλ2y*

**Problem**

*[l·ŏ⟦ 2Ŧ Ŏ22ℕŘλyl·ûλ2yōŜűøŜŜyYl·ŏKλyŜă l·yŘ KdzYl·yă λyŏ2ffl·ō2ℕl·ûλØŜ I a bă¢*

**Background**

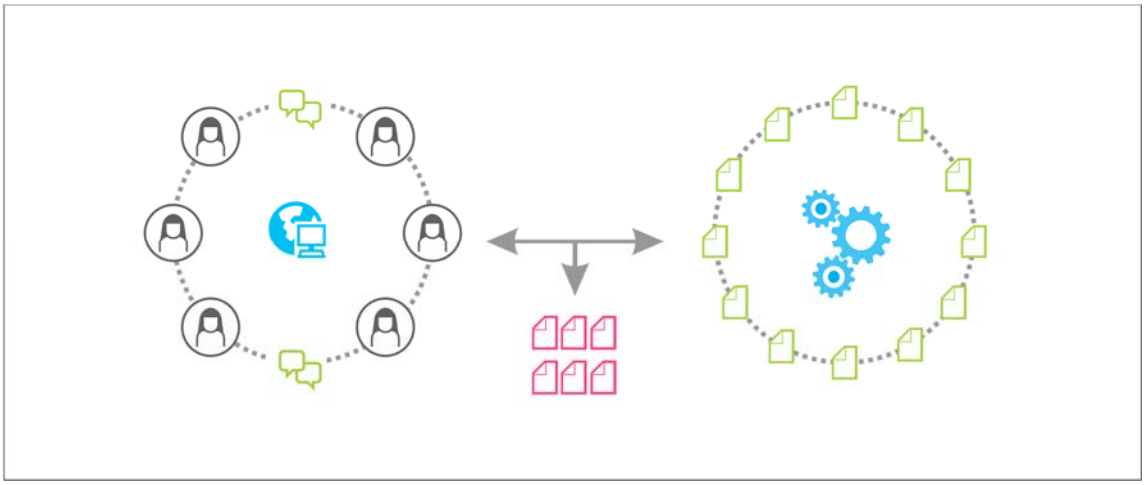
In HMNs where contribution tasks are interdependent, coordination and conflict resolution are essential part of the workflow. Contributing machine nodes, however, may not be fit for such interactions. Designing adaptive and self-updating machines is a challenge for the field of Artificial

Intelligence.

**Solution**

The solution is to design machine nodes that learn from interactions and self-update to respond to disagreement. Alternatively, they should at least recognize conflict and alert humans when it occurs. Social-interaction capabilities should be inherent to machine agents that operate in environments with some workflow interdependence, even if the machine agents are otherwise relatively unsophisticated, specializing in mundane and routine tasks.

**Illustration**



**When to use**

The pattern should be used during the early design phases and throughout the project.

**Sources**

The increasing use of chat bots exemplify potential productive collaboration between humans and machines.

### 14.2.3 Patterns for Loyalty

#### 14.2.3.1 Apply loyalty ladder to build and maintain a sustainable user base

HMN type: *I dzY I·y I·ƎŜyÖè λyűŜℕYŜŘλI·űŜkf2ø Σ ă2ÖλI·f űλŜă f2ø Σ I н a ℕŜfI·űλ2yăKλLJ ăűℕŜyƎűK f2ø*.
Implication: *[2èI·fűèT* Design Pattern Group(s): *I н I Σ a н I*

**Problem**
*I 2ø ű2 ōdzλtŘ I· f2èI·f dzăŜℕ ōI·ăŜ λy I a bă øKŜℕŜ űKŜ Ö2ăű 2T ?2λyλyƎ I·yŘ fŜI·ØλyƎ I·ℕŜ f2øΦ*

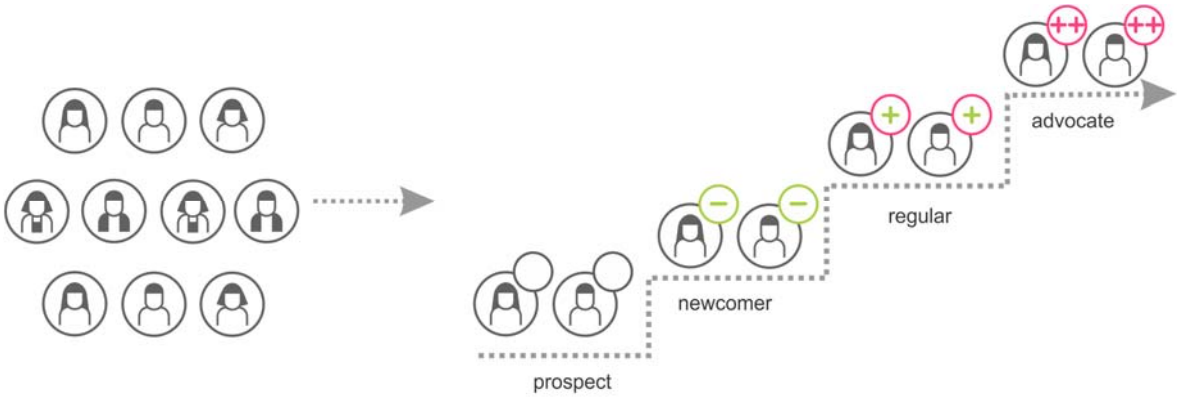
**Background**
Any HMN that is intended to exist for a substantial duration depends on a loyal user base. However, establishing a base of loyal users is challenging, in particular for newcomers. In many HMNs, most users are given the same attention and privileges regardless of their previous history with the HMN. For HMNs with low human agency, low social ties, and low H2M relationship strength, users may not be motivated to maintain their relationship to the HMN.

**Solution**
*! LJLJfè f2èI·fűè fI·ŘŘŜℕ ű2 ōdzλtŘ I·yŘ YI·λyűI·λy I· ădzăűI·λyI·ōfŜ dzăŜℕ ōI·ăŜ*

The loyalty ladder is a well-known marketing tool, where users are seen as moving up a ladder of commitment to a brand or a company from being a prospect user, to loyal user that recommends the company to others or even see themselves as partners with the company.

LinkedIn is a good example of a HMN which have thoughtfully implemented a loyalty ladder. Here, anyone, whether a member of the network or not, can get view some content, but to use most common features signup is required. Furthermore, users are encouraged to build and extend their profiles and networks, which strengthens the usefulness of the HMN to the particular user. Finally, some features are premium options. Users are regularly encouraged to move up the loyalty ladder to achieve new benefits.

**Illustration**




**When to use**
During planning of the HMN, or in redesign to increase customer loyalty and frequency of use.

**Sources**
The loyalty ladder is described e.g. in work on relationship marketing (Payne, 1994).

### 14.2.4 Patterns for Shared Responsibility

#### 14.2.4.1 Encouraging shared responsibility HMNs

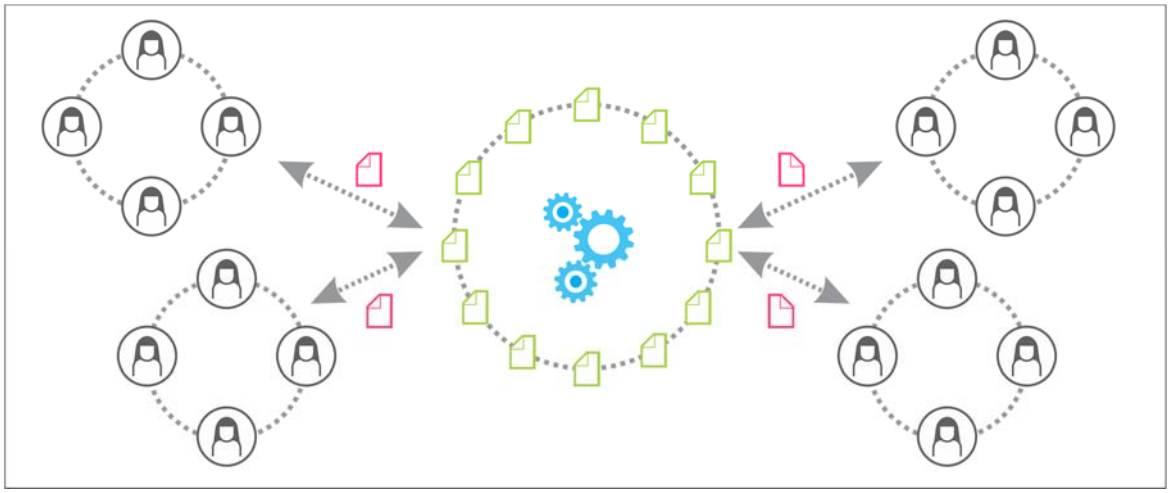
HMN type: *bK!* Implication: *{KI·ℕŜŘ ℕŜăLJ2yãłōłfłúèT* Design Pattern Group(s): *IHIΣ IHaΣ aHI*

**Problem**
*I2ø ű2 ŜyŎ2dzℕI·ƎŜ ŜyƎI·ƎŜYŜyű űKℕ2dzƎK LJℕ2LJI·ƎI·űłyƎ I· ăŜyãŜ 2Ŧ ăKI·ℕŜŘ ℕŜăLJ2yãłōłfłúè Ŧ2ℕ űKŜ 2dzúŎ2YŜă I·yŘ I·ŎűłØłűłŜă 2Ŧ űKŜ ySűø2ℕ¦¢*

**Background**
In some networks, unmoderated content may be incorrect or even offensive. Whether an issue of quality or upset this can expose the continued and effective use of the network. In other cases, such as crisis management or political decision making, it may be difficult to engage human participants if they simply expect the machine components or other human agents to take responsibility. In this case, the outcomes of the network may not be beneficial or even disastrous.

**Solution**
To mitigate risks to continued use or maximise the chances for beneficial outcomes, all agents within the network should be encouraged to respond and provide feedback to any given state of the network or any associated situation. This discourages social as well as technical loafing on the basis that the network state cannot proceed without validation from interested stakeholders.

**Illustration**



**When to use**
The mechanisms to support this should be in place at design. However, the main focus of the

pattern should be at rollout and during normal operation.

**Sources**
Variants of this pattern can be found in ²λ]λLJŜŘλI·, where consumers are encouraged to become prosumers and editors. Similarly in some commercial support networks (e.g., SAP) customers are encouraged to engage with one another to help resolve their questions and respond to their concerns. Further, in eGovernment, the electorate may be encouraged to engage and take ownership of issues via local focus groups and consultations, as well as via online petitions and discussion fora.

**See other patterns**
Compare with all of the patterns in Section 14.3 below.

### 14.2.5 Patterns for Social Interaction

#### 14.2.5.1 Supporting social interaction through strengthening within‐platform communication

HMN type: *I н a* ℕŜfI·ůλ2yãKλLJ ăűℕŜyƎűK f2ó. Implication: {2ŎλI·f λyűŜℕI·Ŏűλ2yΓ Design Pattern Group(s): *I н I Σ a н I*

**Problem**
5λ₣₣λŎdzfű ű2 2LJűλYλÎŜ Ŏ2YYdzyΛŎI·ůλ2yΓLJI·ůűŜℕyã λyΓI·yΓ I a b óKŜℕŜ dzăŜℕă I·ℕŜ ₣ℕŜŜ ű2 I·LJLJfè YdzfűλLJfŜ ŎKI·yỷŜfă 2₣ Ŏ2YYdzyΛŎI·ůλ2yΦ

**Background**
Many HMNs have low H2M relationship strength, implying among other things that the human actors may have a range of means of communication. For example in some HMNs for C2C reselling, the human actors may choose freely to communicate through a wide range of channels such as SMS, phone, email, and chat. This may be beneficial in the short term, as it allows the users to find an approach to communication that suits them. At the same time, it makes it difficult for the platform owners to monitor and optimize social interaction. For example be difficult to find solutions to the challenge pertaining to users quitting a dialogue without concluding it, something that challenges the user experience of the HMN.

**Solution**
{dzLJLJ2ℕűλyƎ ă2ŎλI·f λyűŜℕI·Ŏűλ2yΓűKℕ2dzƎK ăűℕŜyƎűKŜyΛyƎ óλűKλyΛLJfI·ůŦ2ℕYΓ Ŏ2YYdzyΛŎI·ůλ2yΓ

Some HMNs resolve the problem of communication patterns across different channels by strengthening within-platform communication to the point where communication within a network has additional benefits and features compared to communication outside the network. This is typically conducted by making it easier to communicate within the platform than by the alternatives, rather than fully blocking other means of communication. For example, Facebook

makes it easier for its users to communicate through its chat channel Messenger than it typically would be to communicate through other means.

Such strengthening of within-platform should be used with care as users may also need and prefer to communicate through other means as a supplement. For designers, it is important to make the communication support provided within the HMN to be easier and more desirable than general purpose communication means such as email and phone.

**Illustration**

**When to use**

In the planning phase of the HMN, or during redesign to increase user loyalty through behavioural change.

**Sources**

Facebook and LinkedIn are examples of HMNs in which within-platform communication is facilitated, something that motivates the user to stay within the platform.

## 14.3 Innovation and improvement within HMNs

Patterns for Innovation and improvement in HMNs relate not only to innovation and improvement itself (Section 14.3.1), product quality (Section 14.3.2), and Network growth (Section 14.3.3).

### 14.3.1 Patterns for Innovation and Improvement

#### 14.3.1.1 Contributors learn to improve by being consumers first

HMN type: *Idz Y I·y I·ƎŜyŎè KλƎK*. Implication: *LyŷƯØI·ůλƯy I·yŘ L Y LJNƯØÔS Y ŜyÚT* Design Pattern Group(s): *I н a Σ a н I*

**Problem**

*/ƯyÚNλōdzúŜŘ ŎƯyúŝyú λă yƯú ădzŦŦλŎλŜyúfè NλŎK ƯNƯ ŜyƎI·ƎλyƎΣ yŜŜŘ ůƯ ăúNƯŜyƎűKŜy ŎƯyú NλōdzűƯNă I·ōλfλúè ůƯ NŜŎƯƎyλÎŜ I·yŘ ŎNŜI·ůŜ ŜyƎI·ƎλyƎ ŎƯyúŝyúΦ*

**Background**

A number of HMNs depend on users producing and sharing content, such as open innovation platforms, content sharing sites such as YouTube, peer-to-peer redistribution marketplaces, and academic networks for self-archiving.

Successful platforms hosts rich and engaging user contributions. To obtain this, it is critical that the contributors understand how to develop and present content so as to make it engaging. This is particularly important for HMNs which does not include intelligent filtering mechanisms for easy access to content assessed as being particularly relevant of engaging. Developing and presenting engaging content require that the contributors are supported in improvement their contributions, something that may be facilitated through social learning.

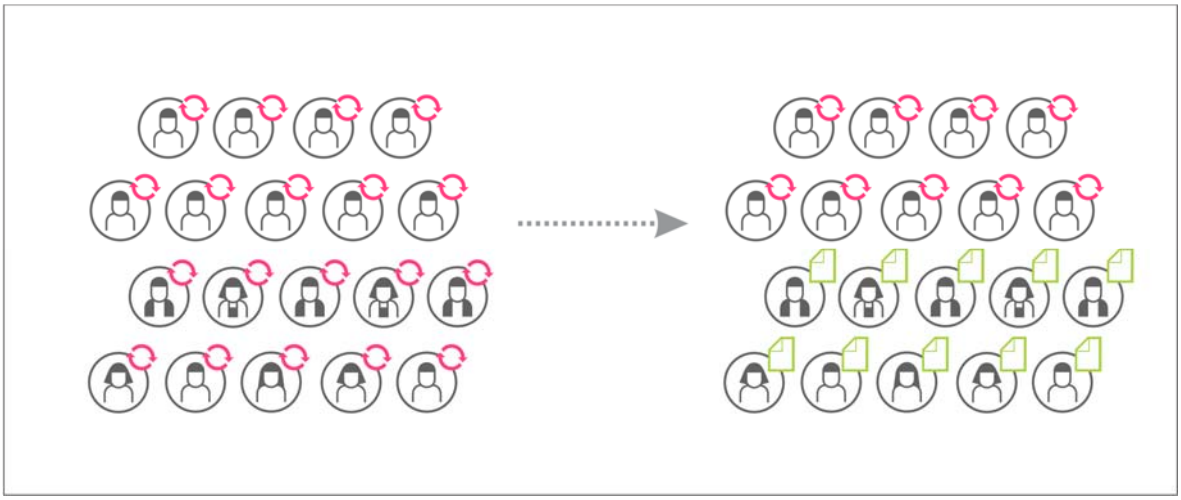
**Solution**

*/ƯyúNλōdzúƯNă tŜI·NyúƯ λY LJNƯØŜ ōè ōŜ ŎƯyãdz Y ŜNă ŦλNăűY wŜŎNdzλű ŎƯyãdz Y ŜNă I·yŘ ƯŦŜN űKŜ ƯLJLJƯNűdzyλűè ůƯ ŎƯyúNλōdzűŜ*

Whereas the norm in successful HMNs for producing and sharing is that contributors also consume content, some UGC-platforms deviate from this pattern. One example of this is some innovation platforms, where contributors may be asked to provide input without also being motivated through consume others' contributions.

Rather than targeting how to recruit contributors in UGC-platforms, it may be more fruitful to recruit consumers and make the offering to contribute easily available. Hence, the contributor will know from own consumption experiences the expected form of contributions, and how to form contributions so as to make these engaging.

**Illustration**



**When to use**

The pattern should be used during the early design phases, to make sure that the design of the recruitment process supports that contributors are nurtured through a process of consumption.

Use in the processing of planning for a UGC platform, or for assessing an existing UGC platform. In particular, the pattern should be useful for UGC platforms where contributors often are recruited on a one-off basis such as innovation platforms.

**Sources**

Peer-to-peer reselling services are good examples of this pattern, where contributors will typically be well acquainted with consuming advertisements before contributing their own.

**See other patterns**

Pattern 14.1.4.1.

### 14.3.1.2 Support improvement through showing trends and good examples

HMN type: *LýűŜℕYŜŘλI·űŜ 2ℕ KλƎK KdzYI·y′I·ƎŜyǒèφ [2ø YI·ǒKλyŜ I·ƎŜyǒè*. Implication: *LYLJℕ2ØŜY′Ŝyű I·yŘ λyŷ2ØI·űλ2y′* Design Pattern Group(s): *aнI*

**Problem**

*CℕŜIjdzŜyǒè 2Ŧ ƒ2ø IjdzI·ƒλúè Ǒ2yűℕλōdzűλ2yã λy′űKŜ I ab*φ

**Background**

In a range of HMNs, the frequency of contributions for individual human actors are relatively

infrequent. Hence, it is difficult for the individual to learn how to improve in the contributions, as there is little room for learning through trial and error. Hence, support is needed for individuals to learn what is considered good and relevant contributions in the network.

**Solution**

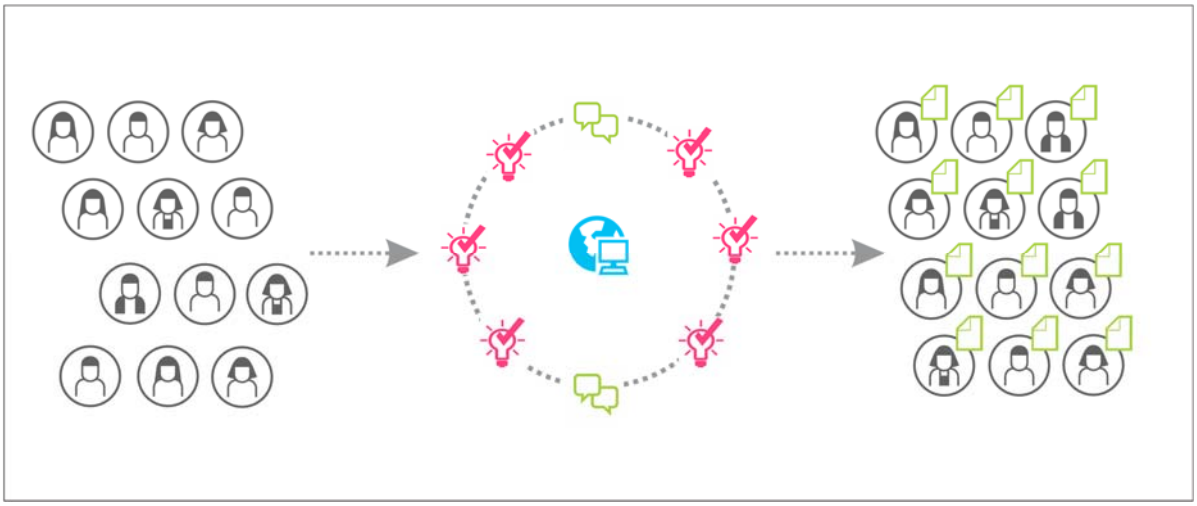
*{ʤLJLJ2ℕŭ ƛYLJℕ2ØŜYŜyŭ ŭKℕ2ʤƎK ăK2ǿƛyƎ ŭℕŜyŘă I·yŘ Ǝ22Ř ŜÈI· YLJťŜă*

Given the dynamic character of many HMNs, what is considered quality contributions change over time, depending on trends and general level of quality in the contributions. For users, such changing quality criteria may be overcome by being exposed to high-quality contributions determined either through editorial assessments or through peer engagement.

Hence, to support improvement in users'contributions, the HMN should provide access to what is considered good examples and trends. This is applied in typical content-oriented HMNs such as Youtube, where content that generates much attention is made immediately accessible and hence may serve as examples to others. Likewise, trend information, such as Twitter trending topics serve to inform users on what is seen as highly relevant at any given moment.

Such mechanisms for supporting improvement could be taken up also in other HMNs depending on user contributions, such as wikis and C2C reselling platforms, where users will benefit from information concerning what type of contributions that generate most interest and attention, and what are seen as particularly interesting trends among the HMN members

**Illustration**



**When to use**

In the planning phase of the HMN, or during redesign to increase users' ability to learn and improve contributions.

**Sources**

Lego Ideas is a good example of a HMN where good examples and trends are profiled.

### 14.3.1.3 Strengthen innovation through infrastructure for informal collaboration

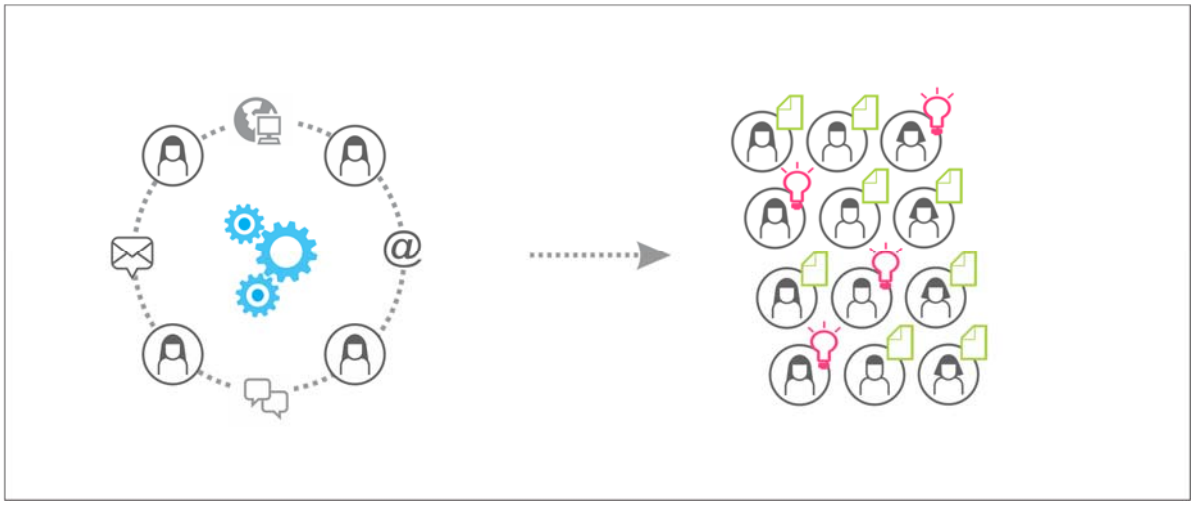
HMN type: *bŜűǿ2ℕ⟧ 2ℕ∃I·yϒÎI·ű12y´ű2LJπŘ2ǿy¶* Implication: *ɨyŷ2ØI·ű12yϒ* Design Pattern Group(s): *aнIΣ aнa*

**Problem**
*[I·Ŏ⟧ 2Ŧ ɨyŷ2ØI·ű12y´ŘʤŜ ű2 ű2LJπŘ2ǿy´2ℕ∃I·yϒÎI·ű12y¶*

**Background**
In HMNs that the network organization is top-down (and often human agency is low), innovation is not likely. Users will stick to the assigned tasks and little "serendipity" happens. This would be problematic considering both users' motivation and emergent value of the network. The HMN should be larger than the sum of its parts and this only happens when there is synergetic innovative contribution. A top-down organization might hinder innovation and "out of the box" thinking.

**Solution**
Parallel to the general workflow in the HMN, there must be infrastructure for informal collaboration and interaction. User forums can serve as a common place for brainstorming and discussing matters outside of the normal workflow of the network.

**Illustration**



**When to use**
The pattern should be considered in the design phase and maintained throughout the project.

**Sources**
Relevant background for this design pattern is provided by Gay et al. (2010). In compliance with this pattern there are user forums and discussion pages in Zooniverse projects.

**See other patterns**
Patterns 14.2.2.2, 14.2.2.3

### 14.3.2 Patterns for Product quality

#### 14.3.2.1 Use AI to ensure quality

HMN type: *I dz Y I·yŜ I·∃ŜyŎè t2ø Σ a I·ŎKλyŜ I·∃ŜyŎè t2ø* Implication: *t ℕ2ŘdzŎű Ijdz I·tλűèT* Design Pattern Group(s): *I н I Σ aн I Σ aн a*

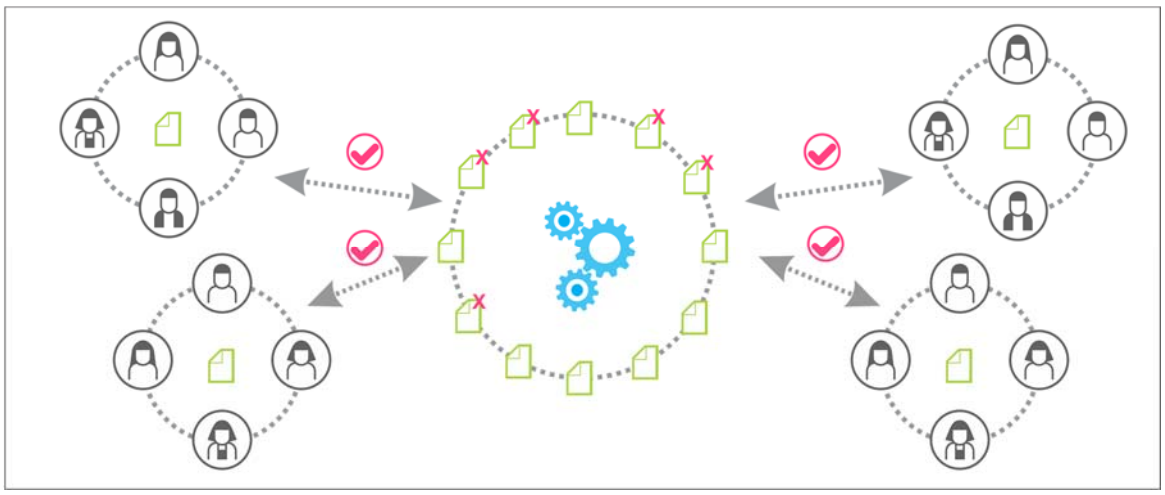
**Problem**
*[2ø Ijdz I·tλűè Ŏ2yńℕλōdzűλ2y Ř dz Ŝ ű2 Y λă Y I·ŭŎK 2Ŧ ú I·ă ʅ*

**Background**
In task oriented HMNs that tasks are assigned to users automatically, there is the risk of low quality contribution by users who have been mismatched to the tasks too difficult for them. Different users have different expertise and different interests. It is important to assign them to the right task . This process however need high level of machine agency and automated intelligence.

**Solution**

One possible solution to this problem is to increase machine agency by implementing algorithms that ban suspected vandals as in Wikipedia, that distribute tasks according to users' expertise and interests, and that appropriately weigh/aggregate contributions.

**Illustration**



**When to use**
Throughout the project.

**Sources**
An example of the solution is the new new task allocator algorithms being developed for the

Zooniverse citizen science platform.

**See other patterns**
Pattern 14.3.2.2

### 14.3.2.2 Employ automatic quality control

HMN type: *Ι λ∃Κ Κdz Υ Ι·γ Ι·∃Ŝγ Ŏë⌽* Implication: *LJℕ2ŘdzŎŭ Ijdz Ι·ſ ŭ ë T* Design Pattern Group(s): *Ι н Ι Σ а н Ι Σ а н а*

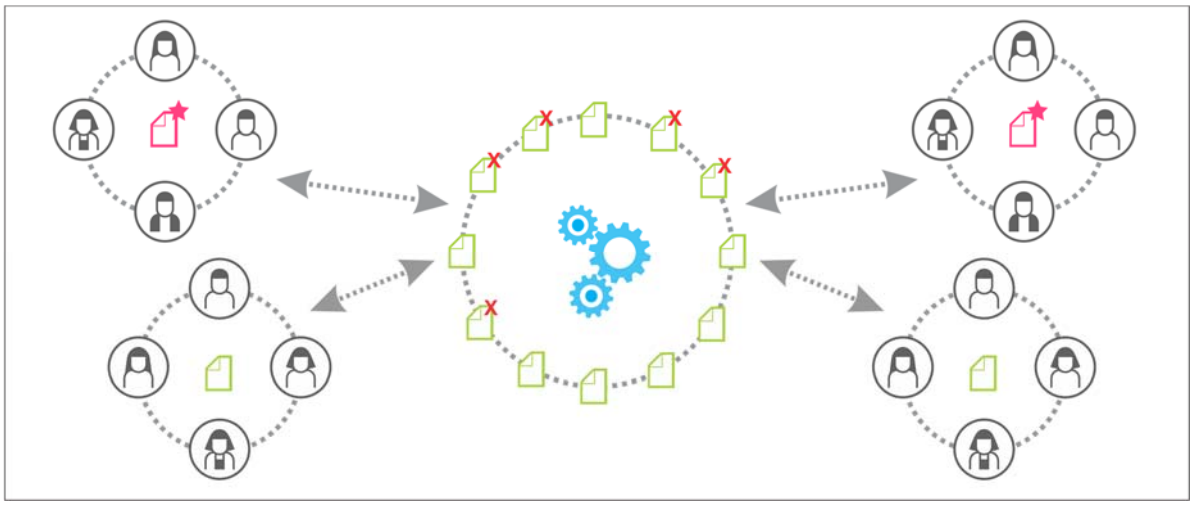
**Problem**
*[2ǿ Ijdz Ι·ſ ŭ è LJℕ2ŘdzŎŭ ŘdzŜ ŭ2 Κ λ∃Κ Κdz Υ Ι·γ Ι·∃Ŝγ Ŏë⌽*

**Background**
In HMNs that the human agency is high and the users are expected to produce creative content, there is a chance for low quality contributions. Usually these networks also have a bottom-up organization, which does not allow for a top-down oversight. While the high agency of users lead to emergence of high value content, the designers have to make sure that there is enough measures of quality control in the system.

**Solution**
There can be automated quality control systems (Cusinato, Della Mea, Di Salvatore, & Mizzaro, 2009). Users contributions can be evaluated automatically using machine learning algorithms or manually by other users in order to detect low quality content.

Various reputation systems can be implemented which assign reputation scores to users and then contributions can be evaluated based on their contributing user's scores, for example.

**Illustration**



**When to use**
The quality control system has to be employed throughout the network's lifetime to ensure the quality of the emergent end product. As the users become more experienced this pattern becomes less important.

**Sources**
An example of the solution is Wikipedia AI to detect low quality contributions, as described by Cusinato (2009).

**See other patterns**
Pattern 14.3.2.1

### 14.3.3 Patterns for Network growth

#### 14.3.3.1 Protect new users from bouncing

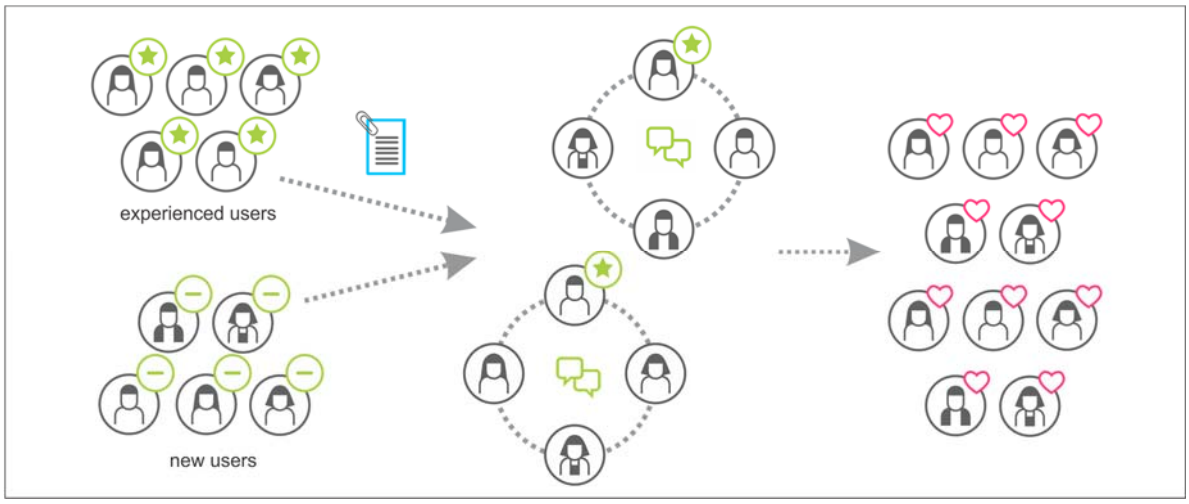
HMN type: bŜűǿ2ℕ⟅ 2ℕ∃I·yϡÎI·ûϡ2Y ōƨűű2Y πdzLJ℗ Implication: bŜűǿ2ℕ⟅ ∃ℕ2ǿűKT Design Pattern Group(s): IнIΣ IнaΣ aнI

**Problem**
Iϡ∃K ō2dzyŎŜ ℕI·ûŜ Ŧƨℕ yŜǿ dzăŜℕă ŘdzŜ ű2 fI·Ŏ⟅ 2Ŧ ădzLJLJ2ℕŰ℗

**Background**
In HMNs with bottom-up organization, new users might be bounced off by more experienced users and that will cause issues with the network growth as the number of new users would start to shrink gradually with older users gaining more experience. This is very important in relation to the network sustainability.

**Solution**
A top-down approach may be needed to streamline the bureaucracy so that it is more forgiving to newcomers. More experience users should be systematically invited to protect newer users and avoid harassing them. There should be a policy system which monitors the interaction between users and protect the newbies (Halfaker et al., 2012).

**Illustration**




**When to use**
The policing system should be implemented from the beginning and as the older users gain more experience and reputation, the system should be applied more intensely.

**Sources**
The solution is discussed by Halfaker et al. (2012; 2013). See also the Wikipedia guidelines on how to treat new users. https://en.wikipedia.org/wiki/Wikipedia:Please_do_not_bite_the_newcomers

**See other patterns**
Pattern 14.1.4.3

### 14.3.3.2 Catering for HMN evolution

HMN type: *bκ!* Implication: *bŜűǿ2₪ʅ ∃₪2ǿűKT* Design Pattern Group(s): *IнaΣ aнIΣ aнa*

**Problem**
*a l·yê ySűǿ2₪ʅă l·ăădzYˇŜ l· ŦλÈŜŘ ăλÎŜ l·yŘ Ŏ2yŦλ∃dz₪l·úλ2yˇ2Ŧ ăŜ₪ØλŎŜă l·ă ǿŜff l·ă ăŜ₪ØλŎŜ dzăŜ₪ă℗ Lyˇ Ŏ2yãŜIjdzŜyŎŜΣ λű λă ŘλŦŦλŎdztű ű2 l·ff2ǿ Ŧ2₪ Řèyl· Yˇλ∃ ∃₪2ǿűK 2₪ ₪ŜŘdzŎűλ2yˇű2 l·ŘI·LJű ű2 2y∃2λy∃ ySŜŘă℗*

**Background**
A common assumption would be that networks, especially at the social machines end of HMNs, are designed to grow and continue growing. To this end, the assumption is, for networks like *² λʅλLJŜŘλl·*, that increased hardware capacity is effectively all that's needed to support the continually growing repository of content. Further, there is an assumption that the "health" of network is somehow related to the number of active participants, and therefore there needs to be significant focus on motivating increased participation (see Section 14.1.4). A rather different perspective would be to allow for the HMN to expand and contract in response to current needs:

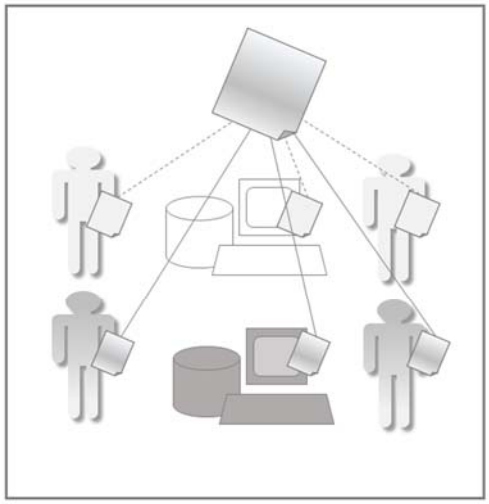
to adapt to the needs and behaviours of the components within the network.

**Solution**

As nodes enter or leave the network (with human agents supported via single sign on: Pattern 14.4.2.1; and machine agents via public key infrastructure and SOA: Patterns 14.4.2.1 and 14.5.1.1), the node identifies itself to the network in terms of what it needs or expects from other nodes (its rŜIjdzλWŜY'ŜyűăŜă) and what it can contribute to the network (its ŎI·LJI·ōλfλűλŜă). These are centrally held to identify what is needed by the network and who or what can support those needs. Over time this may develop into a 'profile' of what the HMN is about (its purpose), which may, of course change (i.e., show emergent characteristics). Further, as agents leave, it can either signal that some capability cannot be met, or has to be re-routed elsewhere, or even send a proactive request to encourage the resource node to return to the HMN.

**Illustration**

*Network nodes with unknown requirements and capabilities*



*Shared (profiled) requirements and capabilities*

**When to use**

This would be needed during rollout to ō22űăűWI·LJ the purpose and profile of the network; and then continually refreshed during operation.

**Sources**

As well as extending existing ICT concepts (for security and service adaptation) to support and exploit the full benefit of human agents, this patterns draws on concepts from autonomic computing and network theory in respect of self-organising networks.

**See other patterns**

This pattern relates to and brings together Patterns 14.4.2.1 and 14.5.1.1, as well as Sections on Motivation 14.1.4 and Collaboration 14.2.2

## 14.4 Privacy and Trust in HMNs

In an online network, privacy and related issues of data and information security are clearly significant issues for network providers as well as those who use them. In this section, we consider patterns relating to privacy (Section 14.4.1), security (Section 14.4.2, and as a consequence or at least related to both, trust (Section 14.4.3).

### 14.4.1 Patterns for Privacy

#### 14.4.1.1 Enhancing security in HMNs concerning data aggregation and content curation services

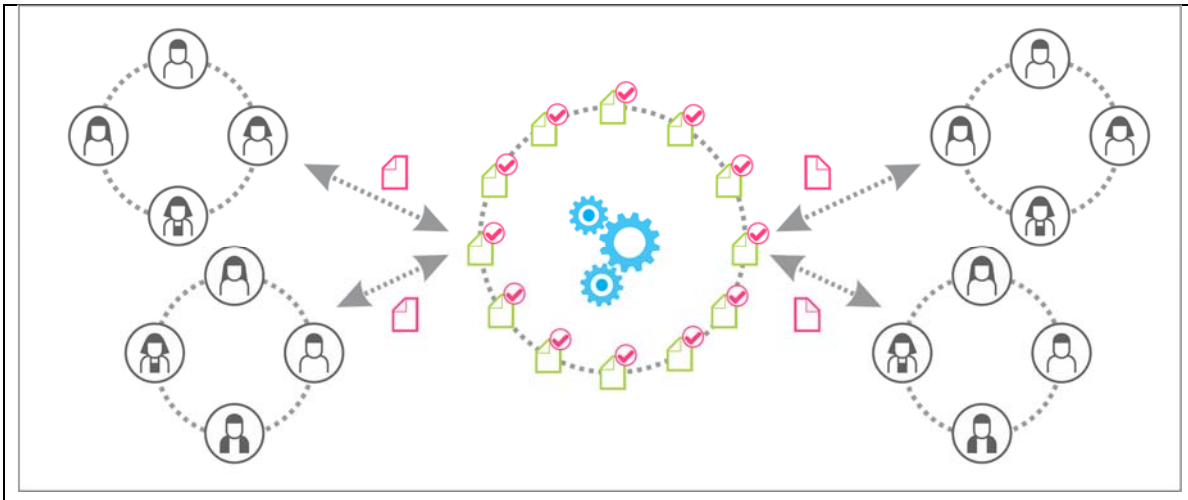
HMN type: *a l·ŏKλyŜ l·ƎŜyŏè λyűŜℕYŜŘλl·űŜkKλƎK*. Implications: *tℕWØl·ŏèT* Design Pattern Group(s): *IнaΣ анIΣ ана*

**Problem**
The problem that ensues is unauthorized access to user information, or improper user if such information. Additionally, a problem in social media are bots, or human users with fake identities.

**Background**
Data aggregation services are usually attractive targets for intruders who would like to obtain a list of users interested in a certain topic (e.g. for marketing purposes). Security issues in this case include user identification and authentication and confidentiality of information.

**Solution**
There is a need to apply enhanced security mechanisms in order to prevent attacks on the HMN. Apart from authentication mechanisms, there should be strict control on how aggregated data can be provided for third-party services, control for fake profiles and strict privacy and confidentiality agreements.

**Illustration**



**When to use**
Such agreements should be made during the early design phase. Failure to do so can result in applications that cannot be deployed on an existing infrastructure without compromising security.

**Sources**
Most social networks (e.g. Facebook) apply techniques to prevent fake profiles while registering a user, but also to recognize fake profiles of registered users.

### 14.4.1.2 Managing privacy

HMN type: *a l·ŎKλyŜ l·ƎŜyŎè λyűŜℕYŜŘλI·űŜkKλƎK*. Implications: *tℕλØI·ŎèT* Design Pattern Group(s): *IнaΣ анI*

**Problem**
*I l·ØλyƎ ŁJℕ2ØλŘŜŘ Ŏ2yűŜyűΣ ŘI·úI· 2ℕ λyf2ℕYI·ûλ2y˝ű2 l·y˝ I a bΣ űKŜ 2ℕλƎλyƛ·t dzăŜℕ óŘI·űI· ădzō?ŜŎű 2ℕ ă2dzℕŎŜú YI·è t2ăŜ Ŏ2yűℕ2f 2ØŜℕ øK2 ŎI·y˝I·ŎŎŜăă ădzŎK ŘI·úI· I·yŘ øKI·ű űKŜè Ř2 øλűK λűΦ*

**Background**

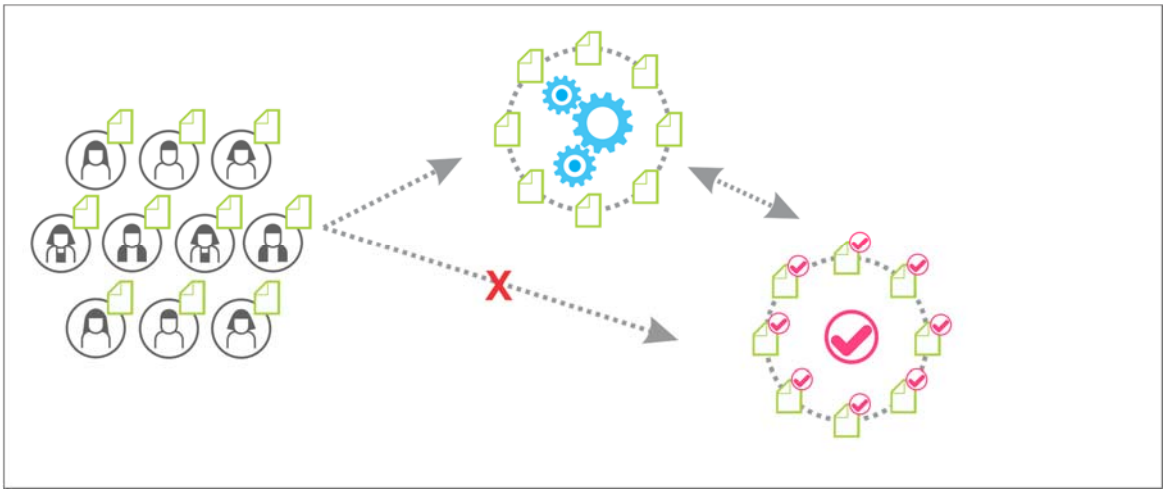
One strength of the Internet is the capability of creating and sharing content very quickly; in some cases often trivial snippets of information or content spreads across the whole web, forwarded by one user to another: it "*Ǝ2Ŝă ØλℕI·f*". At the same time, a great drawback is that sensitive or even incorrect content or information may spread and there is little way of mitigating against this. Legislation has been introduced to regulate this, and yet still fails to provide complete protection (cf. the "Right to be forgotten" ruling[16]).

[16] http://ec.europa.eu/justice/data-protection/files/factsheets/factsheet_data_protection_en.pdf

**Solution**

One simple solution would be for data, information and content not to be released directly onto the network, but instead to be held at an intermediary repository controlled by a trusted third party. Data subjects, content providers, and information sources would be able to specify who and under what circumstances the data or content can be released, even responding to ad hoc requests from unknown parties. In this way, first the data or content would be managed on behalf of the source; secondly, there would be an audit trail to the last authorised party should the data subject or owner suspect that it has been compromised.

**Illustration**



**When to use**

This pattern should be used during rollout and operation to monitor and manage user data and content appropriately.

**Sources**

This approach is being trialled in a number of projects and initiatives (see, for instance, http://www.operando.eu/servizi/notizie/notizie_homepage.aspx).

**See other patterns**

Compare with 14.4.2.1, which deals specifically with access authentication and authorisation.

### 14.4.2 Patterns for Security

#### 14.4.2.1 Securing HMNs

HMN type: *bκ!* Implication: *{ŜŎdzℕ⅄ύèT* Design Pattern Group(s): *ƖнaΣ aнIΣ ана*

**Problem**

*² KŜϒI·ƎŜyύă ⅄ϒI· yŜüǿ2ℕ⌋ ǿ⅄ăK ű2 ⅄yΰŜℕI·Ŏΰ ǿ⅄ύK 2ΰKS̈ℕăΣ 2₮ΰŜϒ ǿ⅄ύK 2ΰKŜℕ I·ƎŜyύă dzy⌈y2ǿϒű2 ΰKŜYΣ ΰKŜℕŜ ySŜŘă ű2 ōŜ I· ăŜLJI·ℕI·ΰŜ ăŜŎdzℕ⅄ύè ySƎ2ΰ⅄I·ΰ⅄2ϒ⅄yŎfdzŘ⅄yƎ I·dzΰKŜyΰ⅄ŎI·ΰ⅄2ϒI·yŘ I·dzΰK2ℕ⅄ăI·ΰ⅄2y℗ ¢K⅄ă I·ŘŘă ű2 ΰKŜ 2ØŜℕKŜI·Ř ₮2ℕ I·ff LJI·ℕύ⅄Ŝă Σ KI·Ø⅄yƎ ű2 ℕŜYŜY ōŜℕ LJℕ2ű2Ŏ2fă Σ LJI·ăăǿ2ℕŘă I·yŘ ΰKŜ f⅄⌈Ŝ℗*

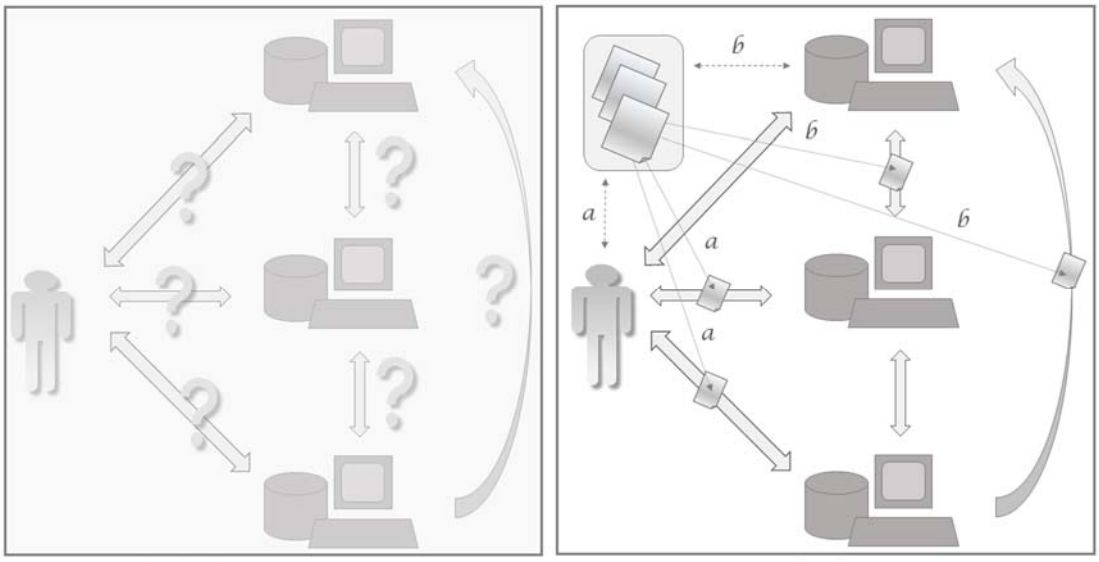
**Background**

Whatever the human-machine interaction mode – human to machine, machine to machine – accessing multiple systems, especially when interactions are infrequent, imposes an additional burden in maintaining records ('memories') of the security procedures or protocols involved and what needs to be exchanged to gain (legitimate) access. This typically involves maintaining multiple passwords, which may become confused or lost; and maintaining digital records which could be compromised and therefore easily enable the proliferation of a cyber-attack.

**Solution**

One way around this would be introduce a single 'authority' who would vouch for individual agents, humans or machines, to mediate their access to other services. For instance, a human agent might log on to a single system which would issue a token that the user would use to access multiple other systems. Similarly, one machine receiving an access request from another would simply ask the authority system whether that access is appropriate or not without having to authenticate the source.

**Illustration**




*Individual security negotiation* *Centralised security*

**When to use**
This would typically be used during rollout and then continued during operation.

**Sources**
This is a typical solution for public key infrastructures (involving a centralised trusted certification authority), as well as the well-known single-signon paradigm (using credentials from one system, e.g., ŦI·ǑŜõ22ʅ, to access other services and systems elsewhere.

**See other patterns**
See 14.4.1.2, which is specifically for data handling.

### 14.4.3 Patterns for Trust

#### 14.4.3.1 Strengthen trust through efficient handling at first point of contact

HMN type: *I ʤY I·y′ I·ƎŜyǑè KλƎKΣ å2ǑλI·t ůλŜă f2ø*. Implication: ¢ℕdzăŰT Design Pattern Group(s): *I н I Σ aн I Σ aн a*

**Problem**
*[I·Ǒʅ 2Ŧ úℕdzăŰ ŘdzŜ ů2 ɤyŜŦŦλǑλŜyů KI·yŘŧɤyƎ 2Ŧ Ǒ2yűℕλōdzűλ2yã 2ℕ ɤyſűλI·ůλØŜ*

This problem is critical to resolve in HMNs depending on user engagement, while providing little in terms of social ties.

**Background**
In HMNs where human agency is high and social ties are low, it is necessary to establish the trust needed for human actors to engage to the level necessary. For example, in open innovation platforms contributions are expressions of creativity and engagement and should be treated respectfully through adequate handling. However, such response may imply a substantial workload for the owner of the HMN, in particular if the response cannot be provided in the first point of contact.

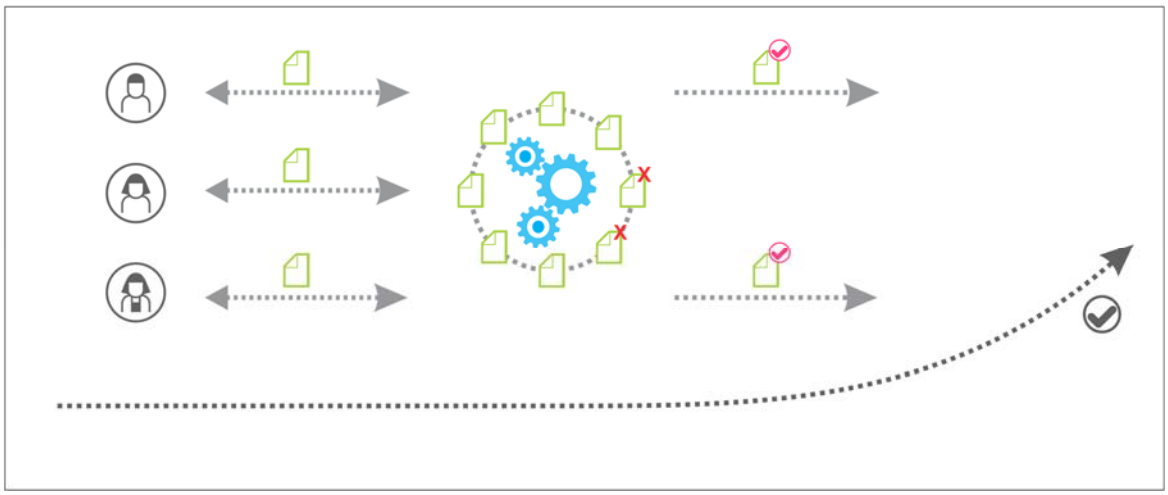
**Solution**
*{űℕŜyƎůKŜy′ůℕdzăŰ ůKℕ2dzƎK ŜŦŦλǑλŜyů KI·yŘŧɤyƎ I·ů ŦλℕăŰ LJ2ɤyů 2Ŧ Ǒ2yűI·ǑŰ*

Call centres arguably are among those HMNs that have come furthest in efficient handling of contributions and initiative. Also for these, human agency may be relatively high, as the human needs to formulate a need or problem, and social ties typically are low. Trust needs to be established through efficient handling.

The solution provided by call centres are to resolve as many initiatives as possible at first point of contact. This is quite the opposite of what is often the case in open innovation platforms, where ideas may be assigned to further processing even though they may well be reviewed and (politely)

dismissed at first point of contact. By quick early handing, both the contributor and the platform owner will benefit as the platform owner can spend the limited resources more concentrated on the few really worth wile ideas. Furthermore, such efficient handling will strengthen trust.

**Illustration**



**When to use**

The pattern should be used during the early design phases, to establish processes through which the HMN will support the efficient and respectful handling of contributions and initiative.

**Sources**

Dixon et al. (2010) discuss resolving issues at first point of contact as key for customer service management, and also illustrates how this is often neglected.

### 14.4.3.2 Strengthen interpersonal trust through rich profiles and recommendations

HMN type: *{2ŎƛI·f ΰƛŜă f2ǿ*. Implication: ¢ℕdzăΰT Design Pattern Group(s): *I н I Σ I н a*

**Problem**

*[I·Ŏ⟆ 2Ŧ ƛyΰŜℕLJŜℕăƨyƖ·f ΰℕdzăΰ ōŜΰǿŜŜyΎΰKŜ KdzYI·yΎI·Ŏΰƨℕă ƛyΎΰKŜ ySΰǿƨℕ⟆*

**Background**

In HMNs where the human actors do not have previous knowledge of each other, establishing trust can be challenging. This is for example seen in C2C reselling platforms where sellers and buyers need to trust each other to complete the transaction.

**Solution**

*{ΰℕŜyƎΰKŜyΎƛyΰŜℕLJŜℕăƨyƖ·f ΰℕdzăΰ ΰKℕ2dzƎK ℕƛŎK LJℕ2ŦƛfŜă I·yŘ ℕŜŎ2YΎŜyŘI·ΰƛƨyã*

Increasingly there is a trend towards personal profiles and recommendations in HMNs, driven by

šZ À o}‰u vš• ]vX•} h]•oŒu• ]]v šZ ,DEv Œ šŒE •šuuo]•Z š ]o
‰ Œ•}v o ‰Œ}(]o ]•u Á]š•ZU ‰v}ŒEµš•ŒŒ]•š Œ Œ} ŒEuu}wu v }ŒE Œ š Z
}šZ ŒX

&}ŒE Æ u‰o U ]v š•ZŒÀ]}u ]ŒE vvš oŒ}}uŒ}}Á}u ŒE•vš v Œ• •š o]•Z ‰Œ}(]
Á]šZ ‰ Œ•}v o ]v(}ŒEuuš]E}vUX µ&‰µ}Ev šZ}u‰šo]}šv]•vPÁšŒEEv• v Œ vš Œ• Œ
µŒP š} Œ š v Œ }}šuZu ŒE X Z Zš]vP v }ŒE• }}µu• w}šš]E ‹µ]Œ ‰Œ}(]o
]v ÁZ] Z ‰ Œ•}v o ]v}(u}uŒEµw]š]šv X•&}ŒE ÆZ w‰oÁ oo Ç•š o]•Z •Ç•š u
(}ŒE Œ }uu v ]vP v ŒŒE šÀ]vvP š•ZŒEo}µPZ(šoZ ••uoÇo vŒE}š‰]ŒE}oµ vÇ ‰ Œ•
]v(}ŒEu š]}vX

/š •Z}µo v}š šµZ•]švšZ( ŒEv] oZ ‰ŒE]](o]oš•Z uvÇ v(}šŒE u} Œ š]}vU š}
u]š]P š ‰}••] o ]v ‰‰Œ}‰Œ] š }vŒE všš]X vdZZ]•oo vÇP vUš }•oš Zu}u} Œ
•Z}µo o š} ](( Œ vš] š šÁ v À ]oŒEµ Œ]šv ]•wZ}µÁoZ]vZš]
u} Œ š • v ]v ‰‰Œ}‰Œ] š }vš vš ~ÇÁZšZ Zu•}Z}ŒEo š}ŒE•ŒX u}À

/ooµ•šŒ š]}v

tZ v š} µ•
/v šZ ‰o vv]vP ‰Z • }( šZ ,DEU }ŒZ vµŒvšvE%E Œ•}P vo šš}Œ•µŒEš v}P šš
,DEX

^}µŒ •
Æ u‰o • }( šZ]v o}uo µš]]}ŒE v v Ç X