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A typology, method and roadmap for HUman-MAchine NEtworks

Deliverable D6.4
Public project report

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Abstract	This deliverable summarizes the activities and results during the HUMANE project (April 2015 to May 2017). Work progress and results are described for all active work packages. The document includes the two yearly reports from the HUMANE research ethics advisor. The deliverable is an excerpt of the confidential deliverable Final activity and management report (D6.5)
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Project summary

In the emerging hyper-connected era, people and appliances are online all the time. In HUMANE we focus on how work, private life, civic engagement, creativity and innovation are increasingly conducted in networks comprising of humans and machines. We term such networks "*human-machine networks*", where *network* reflects a higher abstraction level than the technical system or machine.

Ever more activities in work and private life are conducted within human-machine networks. For example, management and decision support in emergency situations are increasingly embedded in networks of organizations, professionals and citizens, smart devices and sensor networks. As another example, journalists interact with sources, the public, and other journalists in networks that also include services for automatic and semi-automatic distribution and validation of source content. Also, networked society allows for novel approaches to service provision and research, as seen for example within the emerging sharing economy and within networked citizen science initiatives.

In consequence, our society is increasingly influenced by networks. For the individual worker and citizen, the form, experience and outcome of life depend less on the characteristics of the individual, and more on the characteristics of online and offline networks. For European companies, public sector and organizations, productivity, innovativeness and civic participation depend on the characteristics of the networks of which workers and citizens are part. Hence, an advanced understanding of different types of networks and how to benefit from their characteristics, could strengthen European productivity, citizen participation and innovation.

The challenge is that human-machine networks cannot be developed and implemented in the same manner as networks of machine nodes alone. Creating successful solutions for human-machine networks requires awareness concerning the kind of network to be established, and a conceptual framework to support the development of the ICT solutions that constitutes the machine nodes of the network with the intended overall human-machine network.

The overall objective of HUMANE is therefore to improve public and private services by uncovering how new configurations of human-machine networks change patterns of interaction, behaviour, trust and sociability, and how public and private services need to fit the specific networks involved.

To this end, HUMANE has developed a typology and method to support human-centred design on a strategic level. The starting point of the typology development was an extensive review of the research literature on human-machine networks.

The typology serves as a framework with which to analyse human-machine networks in terms of the network actors and their relations, as well as the network structure and extent. Through such analysis, the typology is intended to support cross-domain transfer of design knowledge.

The typology and method have been applied in a series of case trials, within domains such as decision support, emergency management, online journalism, citizen science, and open innovation. Our

experiences from these cases have been used to drive the iterative development of the typology and method.

Furthermore, an online tool (https://networkprofiler.humane2020.eu) has been developed to support the application of the typology and method. The online tool supports profiling of human-machine networks according to the HUMANE typology, and identification of design considerations of relevance for the specific profile of the network.

The HUMANE typology has also been applied as a basis to support future thinking on human-machine networks. Here, the project has developed a roadmapping process for human-machine networks and applied this to three domains for which human-machine networks are of particular interest: the sharing economy, eHealth, and citizen participation.

Activities and results from HUMANE

Literature review: To establish a baseline for the work in HUMANE, in particular the development of the HUMANE typology and method, a systematic review of literature and evidence related to and relevant for human-machine networks was completed in the first phase of the HUMANE project. In the review, an initial set of different types of HMNs was identified based on the levels of interaction among the human and machine actors supported within the networks. We then systematically selected literature on each of these initial types and reviewed it with a focus on design implications. Our discussion helped identify opportunities for designing and developing new kinds of HMNs. The analytical approach applied in the review, applying four analytical layers to investigate human-machine networks, served as basis for subsequently developing the HUMANE typology. The output of this work was the public deliverable "Deliverable of Systematic literature review". The deliverable formed the basis for a review paper in ACM Computing Surveys presenting key findings from the review.

HUMANE typology and method: The HUMANE typology is developed as a framework for cross-domain characterization and analysis of human-machine networks. The typology is based on the literature review, and structured according to four analytical layers: actors, interactions, networks, and behaviours; each including two dimensions. The dimensions are detailed with reference to relevant literature, and with suggestions concerning relevant implications and design considerations. To make the typology actionable for supporting human-centred design on a strategic level, a five step method compliant with the human-centred design process has been developed. Here, the human-machine network of interest is profiled according to the typology dimensions. The profile is then used for implication analysis, where the network is discussed with reference to key topics of interest such as user experience and motivation, behaviour and collaboration, and privacy and trust. Cross-domain transfer of design knowledge and experience is supported through a design pattern approach, where design considerations and solutions are sought from networks with similar profile characteristics. To support the application of the typology and method, and to present findings from the HUMANE cases, an online network profiling tool has been developed. Here, human-machine networks may be profiled following an easy process. The network profile may then be used to

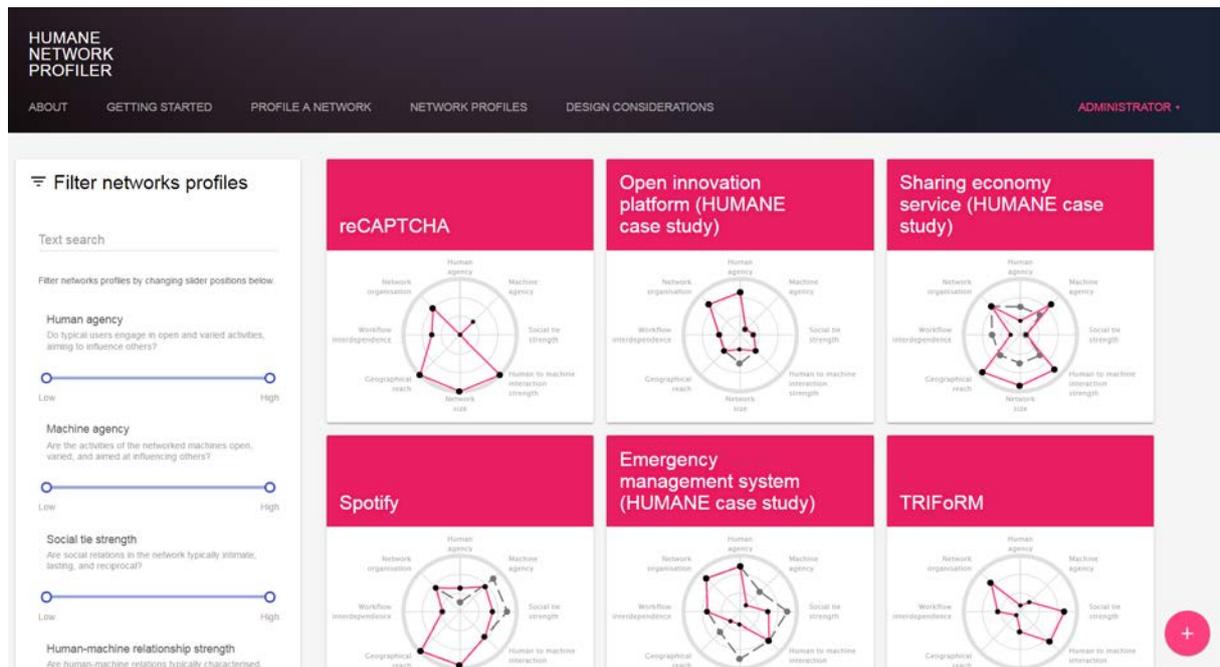identify networks with similar profiles and associated design considerations. The online network profiling tool is available at https://networkprofiler.humane2020.eu.

Figure 1: Example screenshot from the HUMANE network profiling tool.

Eight case studies have been conducted and completed to explore different aspects of human-machine networks and to iteratively validate the HUMANE typology and method and provide input for its iterative development. The case studies contribute to the overall objective of HUMANE (uncovering new configurations of human-machine networks) and were designed to validate the usefulness of the HUMANE profiling approach; the completeness and adequacy of the HUMANE dimensions; and provide input concerning social implications of HMNs. In the first project year, six case studies were conducted to validate the first version of the typology and method, In the second project year, five case studies – three of these extensions of the case studies of year 1 – were conducted, to validate the second version of the typology and method. On the basis of this second validation, the final typology and method was developed. The HUMANE case studies comprise a broad set of human-machine networks, including networks for open innovation, sharing economy, citizen science, decision support, and emergency management. This set of cases indicates the wide applicability of the typology and method. The case study work has been summarized in two project deliverables, and has also led to a number of scientific publications including papers published in Scientific Reports and PLoS ONE. A full overview of papers based on the case studies are listed on the HUMANE website (http://humane2020.eu/publications/).

Typology-driven modelling and validation: An approach for simulation modelling of human-machine networks has been developed to allow for validation of design options for human-machine networks on the basis of simulations rather than building and testing prototypes. Such an approach has the potential for cost saving, and also to enable validation for designs that would otherwise have been infeasible or difficult to test empirically. A Core HMN Model is proposed for describing networks that

can be readily extended and used for simulation purposes of specific HMNs. The approach is demonstrated via two case studies: Wikipedia and Truly Media. The typology-driven modelling and validation is presented in the HUMANE deliverable 3.4.

HUMANE basis for future thinking: A goal in HUMANE is to provide a basis for future thinking and policy making with regard to human-machine networks. As a starting point towards this goals, key implications for future thinking on human-machine networks were identified and discussed in the context of several domains innovative domains that have high potential for bringing fundamental social changes: the sharing economy, eHealth, citizen participation, telework, workplace robotics, and crowd management. Potential challenges and obstacles are discussed, as well as possible ways to mitigate these in future ICT R&I projects. This work served as basis for the work on roadmapping (see below), and is presented in the HUMANE deliverable 4.1.

HUMANE roadmapping process: To support future thinking on human-machine networks, a process for roadmapping of human-machine networks has been developed. The process consist of a series of steps, identifying stakeholders and their goals, as well as actions and strategies leading towards these goal. The roadmapping process is presented in the HUMANE deliverable 4.2, and has been applied for three selected social domains as part of the HUMANE work on future thinking.

Figure 2: the HUMANE roadmapping process

Stakeholder survey: To support the roadmapping work for selected domains, stakeholder involvement has been conducted through an online survey targeting stakeholders in the domains of the sharing economy, eHealth, and citizen participation. Stakeholders in these domains have also been engaged through other activities such as interviews and focus groups. The stakeholder survey is presented in the HUMANE deliverable 4.3

Roadmaps for human-machine networks in three selected domains: Three social domains were selected for application of the HUMANE roadmapping process: The sharing economy, eHealth and citizen participation. The domains were chosen as these represent areas where emerging human-machine networks substantially impact the state of the practice. In the roadmaps, the HUMANE typology is applied as a framework for analysis, and key goals, actions and strategies for human-machine networks within each of the three domains are outlined. The roadmaps are presented in the HUMANE deliverable 4.4.

1   Project objectives

The overall objective of HUMANE is to improve public and private services by uncovering how new configurations of human-machine networks change patterns of interaction, behaviour, trust and sociability, and how public and private services need to fit the specific networks involved.

To this end, HUMANE has developed a HUMANE typology and method, tailored to a human-centred design process in support of ICT developers and designers; and a HUMANE roadmap tailored to the need to support future thinking, regulatory activities and policy-making. The typology and method has been applied in cases which have served to drive iterative development of the typology and method, and also to shed new knowledge on human-machine networks within the case domains.

In the first year of the HUMANE project, the progress towards these objectives concerned the HUMANE typology and method. The following objectives were reached for this end:

- **Systematic literature review:** To ensure a thorough baseline for the development of the first version of the HUMANE typology and method, a systematic review of literature and evidence related to and relevant for human-machine networks was completed in the first phase of the HUMANE project.
- **HUMANE typology and method v1** has been developed, structured according to the four analytical layers from the literature review (actors, interactions, networks, behaviours), each including two dimensions for mapping human-machine networks. On the basis of the dimensions, an HMN profiling framework was developed and initial HMNs types were suggested. The first version of the HUMANE method outlines a tool for profiling and design support.
- **Six case studies** have been conducted and completed to explore different aspects of t human-machine networks and to validate the HUMANE typology and method v1. The case studies contribute to the overall objective of HUMANE (uncovering new configurations of human-machine networks) and were designed to validate the usefulness of the HUMANE profiling approach; the completeness and adequacy of the HUMANE dimensions; and provide input concerning social implications of HMNs.

In the second year of the HUMANE project, the project worked against a broader set of objectives where we continued the work on the HUMANE typology and method and case studies, while also targeting objectives concerning simulation and modelling as well as objectives concerning future thinking and policy-making. Specifically, the work in year 2 of HUMANE concerned the following objectives:

- Develop a **HUMANE typology and method** to support the analysis and design for human-machine networks. The development should be based in extensive case trials. To support the application of the typology and method, an **online tool** for profiling of human-machine networks and transfer of design knowledge was to be developed.
- Conduct **five case studies** to provide new knowledge of human-machine networks within the case domains, and to provide feedback to drive the development of the final version of the

HUMANE typology and method. The case studies were selected so as to complement the set of case studies from the first HUMANE project year.

- Develop and approach for **typology-driven modelling and validation** to support simulations of human-machine network designs at lower cost or in cases where prototyping is impractical and infeasible. The approach should be applied on selected project cases.
- Develop a basis for future thinking and policy making in the form of **roadmaps for human-machine networks** within selected social domains. For this purpose, the following objectives are relevant: Establish an initial basis for future thinking and policy-making, conduct a stakeholder survey within the selected social domains, establish a process for roadmapping for human-machine networks, and develop the domain-specific roadmaps.

Throughout the project, we have also worked towards objectives of dissemination and exploitation.

- **Dissemination** of project results included the establishment and following-up of an updated dissemination and communication strategy, and the following up of the open research data management plan. Furthermore, a HUMANE project website has been set up and refined throughout the project. Furthermore, communication through the HUMANE blog and Twitter account has been a priority, as was the open HUMANE workshop in the second project year.
- **Exploitation** of project results included the establishment and following-up of the HUMANE exploitation strategy. Key exploitable results include the HUMANE typology and method, the online network profiling tool, the simulation modelling approach, and the roadmapping process.

2   Work progress during the project

2.1   WP1: Systematic literature review

The objective of WP1 is to generate a systematic review of significant literature and evidence based research providing a comprehensive analysis identifying the key enablers; functionalities and conditions to design, build and foster the creation of human-machine networks. The review was to be conducted following a set of bibliographic criteria focus on: conducting a multi-disciplinary theoretical and evidence-based analysis; implement a comprehensive framework of analysis and identify the key drivers needed to create or enable human-machine networks. The literature review was completed within the first year of the project.

2.1.1   Work progress towards objective

2.1.1.1 Task 1.1: Scoping (develop review protocol)

In this task we developed the scoping protocol regarding the systematic review (D1.1). We designed a methodology to search and identify from the most relevant publications among the theoretical and empirical studies on Humane Machine Networks. We analysed bibliometric data to select the key publication and harvest the most central literature.

Our protocol in short consisted of multiple steps:

The first step was to identify specific types of HMNs. We did this by brainstorming for concrete examples and describing the interactions among humans and machines. This resulted in differentiating between three kinds of interactions (in addition to "no interaction") for each of the three directed dyadic relations we investigated (human-human, human input in human-machine interactions, and machine output in human-machine interactions). Second, we used the eight HMN types to systematically collect relevant literature. We started by identifying 4-8 "seeds" in each of the types; to represent the most relevant articles with the highest impact. We conducted exploratory keyword search on Google Scholar for each type and selected the articles with the highest number of citations, with an intentional bias for literature review articles. Due to the emphasis on number of citations, there was also a de-facto bias for older publications. We then reviewed the content of the seed articles to manually compile lists of search keywords for each HMN type. The lists of keywords were used for systematic searches within the titles, abstracts, and keywords of all articles on the Scopus bibliographical database (www.scopus.com). We then looked at the first 5000 results, sorted by relevance and selected the highest impact articles, according to the following formula: $C/(2016 - Y) 2 \geq a$, where C is the number of citations and Y is the year of publication of the article. We tuned the value of a to control the size of literature in each subdomain. Finally, we read the abstracts to manually identify the papers that focused on issues related to the functioning and the design of the HMNs. This yielded between 11 and 21 articles (including the seeds) for each HMN type.

2.1.1.2 Task 1.2: Revision and framework elaboration

In this task, based on the literature that we had identified in Task 1.1 we started to develop our analysis framework. More specifically we structured our analysis into three layers: actors, networks, and behaviour. We transferred this revision into WP2 and WP3 where we established the details of the typology and executed the case studies.

2.1.1.3 Task 1.3: Analysis, conclusions and reporting

In this task we further analysed the literature that we had identified in Task 1.1 and within the framework that we had established in Task 1.2. We compared and critically reviewed all the manuscript selected in each of the 8 category of Human Machine Networks. Apart from describing the features and providing examples, we also discussed the risks and shortcomings associated with each category. We also discussed the emergent behaviour and trends in relation to the identified types. The resulting deliverable has later turned into a review paper which has been published in ACM Computing Surveys. Moreover, we delivered a Mendeley library including all the identified manuscripts. This library has later been extended to include references to all previous work applied as basis for the HUMANE work.

2.1.2   Deliverable and milestone list for WP1

Table 1: Deliverable(s) WP1.

#	Deliverable title	Lead	Internal reviewer	Type	Diss.	Due date	Subm.
D1.1	Deliverable of Systematic literature review	UOXF	SINTEF	R	PU	M5	31/08/ 2015

Table 2: Milestones WP1.

#	Milestone name	WP(s)	Lead	Annex 1 delivery date	Achieved Y/N	Achieved date
2	End of first project iteration	All	SINTEF	01/04/2016	Yes	01/04/2016

2.2   WP2: Typology and method

This work package has iteratively developed the HUMANE typology of human-machine networks and associated method. Results from WP1 shaped the initial version of the typology, and the typology has subsequently been refined on the basis of two sets of WP3 case-studies. The typology and method is compatible with a human-centred design process, and complements this with support for analysis and design considerations on a strategic level. In the period, the typology and method has been refined and extended on the basis of case feedback, and to cover more of the human-centred design process. In particular, the period has seen substantial developments pertaining to the transfer of design knowledge in the form of design considerations. The typology and method has been supplemented by an online tool for human-machine network profiling and sharing of design knowledge.

2.2.1   Work progress towards objective

2.2.1.1 Task 2.1: Typology and method v1

In task 2.1, the first version of the HUMANE typology and method has been developed. Here, our aim was to identify the dimensions needed to characterize HMNs so as to enable HMN classification into types, thereby facilitating access to relevant design knowledge and experience, following a design pattern approach.

The typology was structured according to the four analytical layers of the literature review; each including two dimensions. Each dimension was detailed with reference to relevant literature, and with suggestions concerning relevant challenges and design knowledge. This overall structure has been found useful and, hence, kept also in the later typology versions – though the individual layers and dimensions has been reworked and refined.

On the basis of the suggested dimensions, an HMN profiling approach was developed and initial profiles for the six HUMANE use cases have been provided. From the initial profiles, a set of initial HMN types was suggested. Furthermore, a comprehensive method and tool for profiling and design

support was outlined. This method and tool was developed and refined in the later versions of the typology and method.

2.2.1.2 Task 2.2: Typology and method v2

In task 2.2, the interim version of the HUMANE typology and method was developed on the basis from feedback from the first set of case studies (see below). In this version of the typology, we suggested a nuanced set of aspects to more clearly delineate each of the typology dimensions. We also progressed on applying the typology to transfer design knowledge in the form of design considerations, following a design pattern approach.

Key to the HUMANE method is the profiling of a human-machine network according to the eight HUMANE typology dimensions. Following this, and implication analysis is conducted identifying implications pertaining to users' perception and motivation, behaviour and collaboration, innovation and improvement as well as privacy and trust. The implications in turn motivates the extraction of design considerations, on the basis of relevant literature or with reference to similar successful human-machine networks.

In task 2.2, we also developed the initial version of the online tool for profiling of human machine networks. The tool provide support for profiling of human-machine networks according to the HUMANE typology dimensions, cross-domain identification or similar human-machine networks on the basis of profile scores, and transfer of design knowledge in the form of design considerations.

2.2.1.3 Task 2.3: Final typology and method

In task 2.3, the final version of the HUMANE typology and method was developed in response to the feedback from the second set of case studies (see below). In this version, the typology and method was updated in response to feedback from the second set of case studies. Specifically, the purpose and target audience of the typology was made more precise, the typology terminology was updated for increased clarity, and the method was refined.

While the typology and method has been found to be useful for in-depth analysis and considerations of specific cases, we have also explored how the typology may support a type-based analysis of human-machine networks. Specifically, we profiled a large number of human-machine networks (~200) and applied cluster analysis on these profiles to identify typical profiles. While exploratory, this approach serves to exemplify the potential of the typology for cross-domain transfer of knowledge, as the clustering serves to match human-machine networks on other criteria than what may be typically be done within a particular domain.

As part of the work towards the final typology and method, the online tool was further developed with extended functionality and improved design. The final version of the tool is available at https://networkprofiler.humane2020.eu.

In addition to the open deliverables D2.2 and D2.3, the typology and method has been made available on the HUMANE website in the form of a whitepaper summarizing their key elements.

2.2.2   Deliverable and milestone list for WP2

Table 3: Deliverable(s) WP2.

#	Deliverable title	Lead	Internal reviewer	Type	Diss.	Due date	Subm.
D2.1	Typology and method v1	SINTEF	UOXF	R	PU	M7	31/10/2015
D2.2	Typology and method v2	SINTEF	UOXF	R	PU	M16	31/07/2016
D2.3	The HUMANE typology and method	SINTEF	ATC	R	PU	M24	21/04/2017

Table 4: Milestones WP2 in this period.

#	Milestone name	WP(s)	Lead	Annex 1 delivery date	Achieved Y/N	Achieved date
2	End of first project iteration	All	SINTEF	01/04/2016	Yes	01/04/2016
3	End of second project iteration	All	SINTEF	31/01/2017	Yes	31/01/2017
4	Wrap-up	All	SINTEF	31/05/2017	Yes	31/05/2017

2.3   WP3: Case studies

The main objective of this work package was to apply and further refine the typology and methodology developed in WP2 (initially based on the literature studies in WP1) on real case studies of human-machine network scenarios from linked R&I projects. We broke this down into the following objectives:

- Specify and prioritise specific case studies in the linked R&I projects.
- Capture requirements, challenges and issues from selected case studies.
- Application of WP2 typology and methodology on selected case studies.
- Feedback to WP2 on experiences, issues and recommendations of using the WP2 typology and methodology on selected case studies, supporting the iterative development of these.
- Validation of design options for selected case studies via simulation modelling based on WP2 typology and method.

The use case results in WP3 were also to feed into WP4 to help shape the messages to be worked on for sharing HUMANE results with policy makers and planners, as well as for dissemination activities in WP5.

2.3.1 Work progress towards objectives

2.3.1.1 Task 3.1: Use case planning

This task involved all partners in detailing the linked R&I projects identified at proposal time, which serve as sources of case studies for validating and further developing the HUMANE typology and method. Each R&I project was described in terms of the networks they represent, the objectives of those networks and the opportunities they provide in HUMANE. On this basis, potential case studies that could be performed in tasks 3.2 and 3.3 were identified.

All R&I projects, with the exception of Wikipedia, were deemed suitable for both the internal and external case executions in tasks 3.2 and 3.3, respectively. While Wikipedia provided an opportunity for large-scale analysis of human-machine network data, it was decided not to be included in the external case execution as the HUMANE due to its bottom-up structure and difficulties to access the system designers. All other case studies was planned to involve engagements with participants external to the HUMANE project, e.g., via surveys, interviews and focus groups. The different methods laid out for the different case studies allowed a broad validation of the HUMANE typology and method, which should ensure rich feedback to WP2 for the iterative development process. To ensure consistent feedback, SINTEF (as WP2 leaders) detailed the input sought across the different WP3 tasks in accordance with the timeline for the WP2 developments.

A key focus of the use case planning was on ethics. First, each partner analysed and identified ethics considerations needed in each of the case studies. Second, the management of ethics in HUMANE has been detailed (lead by SINTEF). SINTEF, IT Innovation and ATC have written information sheets and informed consent forms for the case studies involving external participants. This information was sent to NSD for ethics approval for all case studies. Further, IT Innovation, in collaboration with SINTEF, established a Memorandum of Understanding (MoU) template that could be used for engagements with R&I projects as part of both WP3 and WP4. It was only required and established with eVACUATE (Case 3) for tasks 3.2 and 3.3.

The outcome of this task was D3.1 (case study plan) at M3, which was led by IT Innovation.

2.3.1.2 Task 3.2: Internal case executions

Six different case studies were conducted and completed with the objectives to explore different aspects of different human-machine networks and to evaluate the first version of the HUMANE typology and method (as presented in D2.1). In summary, the case studies: (1) Validate the usefulness of the first version of the profiling approach; (2) Validate the completeness and adequacy of the suggested human-machine network dimensions; and (3) Provide input concerning social implications.

The eVACUATE case study (conducted by IT Innovation) was designed to validate the usefulness of the HUMANE profiling approach. This study is based on a focus group with four software engineers working in the eVACUATE project yet with no prior knowledge with the HUMANE objectives or resources. Findings suggest that the HUMANE approach is beneficial for facilitating cross-disciplinary

communication and understanding for providing insights into the interaction between human and machine nodes in a network. However, the usefulness of the spider-diagram was questioned with the software engineers regarding it to oversimplify the human-machine network.

The case studies on open innovation (conducted by SINTEF), consumer-to-consumer (C2C) redistribution markets (conducted by SINTEF) and REVEAL (conducted by ATC) were designed to validate the first version of the typology with its dimensions. In the open innovation case study, the findings on the typology are based on individual interviews with seven employees in the Norwegian bank DNB, all involved with the bank's innovation website "Min Idé". The C2C redistribution case study is based on individual interviews with 12 users of two different services. In the REVEAL case study, the findings on the typology are based on focus groups with eight engineers/network designers. Findings from all case studies emphasize the need for simple and unambiguous definitions of the eight HUMANE dimensions, and guidance in reliably evaluating the value on each dimension. The dimensions provide insight into understanding the characteristics and dynamics of different human-machine networks. Yet it is currently not clear enough what the dimensions are intended to measure (validity), and the scales cannot be used to evaluate human-machine networks on these dimensions in a sufficiently reliable way (reliability).

The case studies on open innovation, consumer-to-consumer redistribution markets, REVEAL, Wikipedia (conducted by UOXF) and the citizen science portal Zooniverse (conducted by UOXF) were designed to study social implications of human-machine networks. In the open innovation case study, the findings on social implications are based on the interviews with the bank-employees as well as a survey with 161 end-users of Min Idé. For the C2C redistribution markets case study, data from the 12 end-user interviews were analysed in terms of user-experience and motivation. In the REVEAL case study, the findings on social implications are based on interviews with 11 journalists. The Wikipedia case study is based on 4.7 million reverts from Wikipedia. The Zooniverse case study is based on a dataset of 54 million citizen science classifications in Zooniverse. These case studies provided input to trust, enjoyment, motivation and sustainability linked with human-machine network dimensions, key to expanding the state-of-the-art and informing the implication analysis introduced in the second version of the typology and method (D2.2).

The outcome of this task was D3.2 (Report of first set of case studies) at M10, which was led by SINTEF.

2.3.1.3 Task 3.3: External case executions

Five different case studies were conducted and completed with the objectives to explore different aspects of different human-machine networks and to validate the second version of the HUMANE typology, method, and online profiling tool (as presented in D2.2). The case studies served to validate the usefulness of the refined version of the HUMANE method – specifically the profiling approach, the implication analysis, and the design considerations; validate the suggested human-machine network dimensions in terms of completeness and adequacy; and provide new knowledge on human-machine networks in the studied domains.

The five case studies comprised three of the cases from the first project iteration, as we as two new cases. The new cases were strategically selected so as to strengthen the inclusion of cases targeting human-machine networks designed to support industrial or government processes such as decision making or emergency management. In these forms of HMNs the key aims of the network is not social networking or content production, though this may be a means towards this end, but rather effective and efficient task execution.

The three cases which were included also in the first project iteration included a human-machine network supporting emergency evacuation (Case 3, eVACUATE), a platform for verification of social media content to be used by journalists (Case 4, REVEAL), and a citizen science platform (Case 6, Zooniverse). The new cases were an emergency management system (Case 7) and a decision support system for air traffic management (Case 8).

The eVACUATE case study (conducted by IT Innovation) was designed to validate the usefulness of the HUMANE typology and method; specifically the profiling approach, the implication analysis, and the design pattern approach. This study is based on focus groups and a survey with target audience users.

The REVEAL case study (conducted by ATC) was also set up to validate the typology and method, but in addition included a validation of the online profiling tool. The case study was conducted by workshop and surveys.

The Zooniverse case study (conducted by UOXF) was designed to validate the typology, the profiling process of the HUMANE method, as well as the design pattern approach. The validation was conducted as semi-structured interviews.

Finally, case 7 and 8, concerning an emergency management system and a decision support system (both conducted by SINTEF) was set up so as to validate the typology as well as the method aspects of profiling, implication analysis, and the design pattern approach. Also, the validation targeted the online tool. The validations included semi-structured interviews, presentation of results and feedback from case representatives. Case 8 also returned a set of novel design considerations, included in the online tool.

A cross case-analysis found the typology to be relevant and useful for strategic considerations, and recommended this to be the main use case for the typology. The typology was also found to be sufficiently comprehensive, but some cases suggested the need for better capture of the dynamic character of HMNs.

A cross-case analysis was also conducted for the steps of the proposed method. The profiling process (step 2 of the method) was found to be relatively fast and easy, but it was noted that profiling will likely require in-depth knowledge of the typology. Some challenges to the profiling were noted, such as insufficient support for addressing dependencies between dimensions and for reliable profiling.

The implication analysis and design pattern approach were both found to be useful, providing relevant output. Some concern was raised regarding the potential domain specificity of identified implications from the implication analysis, and also regarding the implementability of the design patterns,

accentuating the need to accentuate the strategic rather than implementational usefulness for the typology and method. The cases also provided concrete recommendations for the online tool.

The cases, hence, returned a set of recommendations which served to guide the subsequent development of the final version of the typology, method and online tool.

The outcome of this task was D3.3 (Report of second set of case studies) at M21, which was led by UOXF.

2.3.1.4 Task 3.4: Typology-driven modelling and validation

This task explored the opportunities for modelling and simulation of HMNs to help evaluate design options coming out of applying the HUMANE method, underpinned by the typology developed in WP2.

As HMNs are complex networks wherein emergent behaviour stems from the interactions and behaviour of both humans and machines, modelling and simulation such networks is a challenging task. Therefore, we have developed a Core HMN Model in this task to aid the modelling task. This model reflects key aspects of HMNs captured in the HUMANE typology to describe the actors, their interactions and structure of the network. The Core HMN Model was developed by IT Innovation and validated in collaboration with ATC.

The modelling approach taken in the project enables the model to be used for agent-based simulation, which was identified as the most relevant and suitable simulation method for HMNs based on a state-of-the-art review conducted by IT Innovation. Agent-based simulation modelling lends itself specifically to model and simulate complex networks to capture emergent phenomena. It is also an extensible approach, which was important, allowing us to create a generic model of HMNs that can be widely applied and specialised to different HMNs.

The application of the Core HMN Model, along with the general approach for evaluating HMN design options has been described in the context of the HUMANE method. The Core HMN Model was implemented in Java and has been used in two Proof of Concept (PoC) demonstrators within the project, by IT Innovation and ATC. These PoCs demonstrate the simulation modelling approach and provides two examples of how the Core HMN Model has been successfully applied to two different HMNs at completely different stages in their lifecycle. One of the HMNs was Wikipedia, which is a well known and mature HMN, whilst the other is a new HMN called Truly Media, which is currently under development.

Wikipedia has been a case study project in HUMANE since the start. Truly Media is a development that has come out of REVEAL, which has also been an existing case study since the start of the project, based on the work carried out by ATC and Deutsche Welle. Truly Media offered a great opportunity to show the application of the approach to a new HMN while also being able to demonstrate impact as the simulation model results have informed the implementation choices in the network.

The outcomes were reported in D3.4 (Typology-driven modelling and validation of design options) at M26, which was led by IT Innovation.

2.3.2   Deliverable and milestone list for WP3

Table 5: Deliverables WP3.

#	Deliverable title	Lead	Internal reviewer	Type	Diss.	Due date	Subm.
D3.1	Case-study plan	IT-Innovation	SINTEF	R	CO	M3	01/07/2015
D3.2	Report of first set of case-studies.	SINTEF	UOXF	R	CO	M10	22/02/2016
D3.3	Report of second set of case-studies.	UOXF	IT Innovation	R	CO	M20	15/12/2016
D3.4	Typology-driven modelling and validation of design options.	IT Innovation	UOXF	R	PU	M23	19/05/2017

Table 6: Milestones WP3.

#	Milestone name	WP(s)	Lead	Annex 1 delivery date	Achieved Y/N	Achieved date
2	End of first project iteration	All	SINTEF	01/04/2016	Yes	01/04/2016
3	End of second project iteration	All	SINTEF	31/01/2017	Yes	31/01/2017

2.4   WP4: Implications for future thinking and policy making

The objective of this work package was to build a series of policy roadmaps which provide guidance for improving Human-Machine Networks (HMNs) in different social domains. In order to achieve this, we needed to foresee future trends, examine the broader impact and implications of HMNs, the technical and regulatory challenges, and set the desired goals at the end of each roadmap. The activities pertaining to WP4 were all conducted in year 2 of the project.

2.4.1   Work progress towards objectives

The work was separated in two phases. In the first five months (M13-M17), the aim was to set out the implications for future HMNs in different social domains based on the systematic research analysis conducted in WP1, and the typology and methodological approach from WP2.

In the second phase (M20-M26), the contribution was two-fold: on the one hand, we established the process for developing these roadmaps (roadmapping process) and on the other we developed the roadmaps for three selected social domains: the sharing economy, eHealth, and citizens' participation. All of these domains embrace exciting technological applications that promise to give great societal benefits. The process for developing the roadmaps has been designed so as to take into account implications of HMNs with regard to notions of trust, motivation, or network size – which are of central interest to the HUMANE project – and to make use of best design practices which were identified during the course of the project. Despite focusing on these three domains, the

presented roadmapping process is general and can also support roadmap creation in other domains. The roadmaps themselves provide steps toward understanding higher level goals for HMNs in these domains, and aid stakeholders in recognizing shared goals and their roles in reaching them.

2.4.1.1 Task 4.1: Baseline for future thinking and policy making

In task 4.1, the focus was to set out the implications for future thinking and policy making in Human-Machine Networks (HMN). We explored relevant characteristics and implications of HMNs in a number of innovative domains that have high potential for bringing fundamental social changes: the sharing economy, eHealth, citizen participation, telework, workplace robotics, and crowd management. We also identified potential challenges and obstacles, as well as possible ways to mitigate these in future ICT R&I projects.

Our work is positioned relative to the general EU priorities and relevant strategy plans. We also reviewed future opportunities and recommendations for R&I actions.

The work done in this task was an initial attempt at understanding HMN challenges, opportunities, and needs for future thinking in the selected domains, and all these were finalized during roadmap development (task 4.3).

2.4.1.2 Task 4.2: Survey of user needs

In previous work (task 4.1), we identified significant challenges that should be addressed in order to ensure the successful integration of machines in HMNs. Examples include challenges in privacy and security, the need for scalability as the volume of data and the number of nodes increases, the need for automated decision support, and legal and ethical issues. To overcome these challenges, a concerted effort from a number of different stakeholders is needed. Thus, the work in this task was a necessary step towards finalizing the roadmaps. A roadmap acts as a reference for a collaborative effort, therefore consensus should be reached for the set of goals that we are trying to describe, the steps to achieve them, and the roles of the involved parties. In absence of a consensus, at least all different opinions should be documented and the best possible strategy should be selected.

We conducted an online survey, which contained targeted questions in order to collect such feedback: questions about the challenges for HMNs, the proposed actions and roles of stakeholders, the current level of maturity of these actions, their level of difficulty and dependencies between them. For each domain (sharing economy, eHealth and citizen participation), we asked the participants to: describe their experience in using HMNs, rate the importance of systems and services used in HMNs, rate the importance of the identified challenges, assess the level of difficulty in their implementation, and describe the roles of stakeholders for implementing the actions in the roadmaps. The specific questions differed somewhat across the domains, but followed the same overall structure. Moreover, the survey presented the opportunity to identify more detailed objectives, other appropriate design strategies or examples of design strategies that have already been applied in specific products or use cases. Besides the questionnaire, focus groups and interviews conducted as part of this work have provided detailed feedback from stakeholders and stimulated the exchange of opinions.

2.4.1.3 Task 4.3: Roadmap on future human-machine systems

The main contributions of this task are the detailed approach for producing the HUMANE roadmaps and the roadmaps for each of the selected domains (sharing economy, eHealth and citizens' participation).

The roadmaps were first produced in M21 and continuously updated in the course of the project.

To develop the roadmap, we have combined desk research with feedback received from stakeholders through user surveys, focus groups or interviews (output from previous task), which helped to arrive at a consensus view of the roadmap for each domain.

In the roadmaps, we described what we want to achieve and the need to improve HMNs in the domain of interest, the current technological situation, policy background and regulatory context, the goals and the actual outputs of the roadmap, and the required actions to achieve the goals. For each roadmap, we explained the HUMANE design strategies, which are suitable to address design goals of the HMNs. We also provided prioritizations for the required actions, if appropriate, and give a timeframe for their implementation. Notions of trust, motivation, and network size, which are predominant in HMNs, were examined extensively in the roadmap, and solutions were proposed to address their implications.

All roadmaps followed the common structure that is defined in the roadmapping process, but have been developed independently by different consortium partners.

2.4.2 Deliverable and milestone list for WP4

Table 7: Deliverables WP4.

#	Deliverable title	Lead	Internal reviewer	Type	Diss.	Due date	Subm.
D4.1	Report on implications of future thinking	ATC	UOXF	R	PU	M18	07/10/2016
D4.2	Roadmap of future human-machine networks	ATC	IT Innovation	R	PU	M21	13/01/2017
D4.3	Survey of users' need results	ATC	SINTEF	R	PU	M22	28/02/2017
D4.4	Final roadmap of future human-machine networks	ATC	IT Innovation	R	PU	M26	31/05/2017

Table 8: Milestones WP4.

#	Milestone name	WP(s)	Lead	Annex 1 delivery date	Achieved Y/N	Achieved date
3	End of second project iteration	All	SINTEF	31/01/2017	Yes	31/01/2017
4	Wrap-up	All	SINTEF	31/05/2017	Yes	31/05/2017

2.5   WP5: Dissemination and exploitation

The objective of this work package was to conduct a multi-stage and multi-stakeholder dissemination, exploitation and communication campaign adopting different communication channels and strategies. The aim was not only to assure that the final deliverables will be available online but to provide on going public-access reports along during the whole research. The dissemination strategy was intended to facilitate that partners and cases-studies would systematically share their learning outcomes achieved throughout the research. Therefore a number of complementary initiatives oriented to deploy "knowledge transfer" was to be implemented.

2.5.1   Work progress towards objectives

2.5.1.1   Task 5.1: Dissemination, exploitation and communication strategy

In this task, we further detailed our dissemination, exploitation and communication strategy. At the onset of the project we evaluated different options available for an effective communication process and set our dissemination goals for the rest of the work package. At the end of the first year, in the interim version of D5.1, these options were reassessed, and the communication process was refocussed to better reach all key target audience groups. We also set a series of KPI's to ensure the progress in the interim version of the D5.1.

2.5.1.2   Task 5.2: Online presence

We launched the project website in M1 of the project (humane2020.eu). The website is designed internally and hosted on Wordpress. The website includes static parts such as the overall project and partner-descriptions as well as dynamic sections which include publications, events, and blog posts.

We also set up a Twitter account for the project (@Humane2020), through which we tweet the project updates and further spread the news related to the project topic.

We have been posting bog post regularly and the posts have been featured on social media platforms as well as the Oxford Internet Institute website.

We have also set up a Mendeley library for the project, in which we made the identified literature in WP1 publically available.

Following the plans described in the interim version of D5.1, we refocused the website to put the focus on the tools and interactive content rather than deliverables and scientific outcomes of the project. We also scheduled a series of blogs to make sure that during the second year of the project the results are being communicated as they are produced. Finally, we watched the KPI's closely to ensure that the activities are in line with the plans.

2.5.1.3   Task 5.3: Data availability

As a participant in the Open Research Data pilot HUMANE is requested to ensure open access to research data and scientific publications. For this end, we have specified a Data Management Plan

(D5.3), which have guided our efforts towards this objective. Specifically, we have gathered and processed 14 data sets as part of the HUMANE research activities, of which nine has been openly published on Zenodo (eight data sets) or Figshare (one data set). For the remaining five data sets we have had to opt out of the open publishing due to issues of confidentiality. An overview of the gathering and processing of all data sets is provided in the deliverable D5.7, along with details on open publication and details on the rationale for opting out for the data sets for which this was necessary. In this deliverable, we have made note of ethical considerations of relevance for open publication of qualitative research data; specifically, transcripts from semi-structured interviews.

The project has also generated a number of scientific publications in this year 2 of HUMANE; all made available open access. The papers and their open access availability are all listed in the deliverable 5.7.

2.5.1.4 Task 5.4: Organization of event and outreach

In order to contribute to the dissemination and exploitation actions, the majority of partners have been active in presenting the main findings in different national and international events as well as publication in open-access scientific international journals. As of March 2017, we have 5 accepted peer-reviewed journal-paper; submitted one papers for peer review and publication to journals; and we have 5 accepted papers presented in an international conference (See section 4.2, 4.2.1 and 4.3).

In addition, we organized a final workshop in Oxford https://humane2020.eu/workshop/ with 60+ participants from different sectors, a report of the workshop is online and will be summarized in D5.6. In brief, we manage to actively engage with stakeholders from different sectors interested in HUMANE, members of the human-machine networks, individuals interested as well as strategic representatives from policy-making in the field of ICT.

2.5.2 Deliverable and milestone list for WP5

Table 9: Deliverables WP5.

#	Deliverable title	Lead	Internal reviewer	Type	Diss.	Due date	Subm.
D5.1	Dissemination and communication plan	UOXF	None	R	PU	M2	02/08/ 2015
D5.2	Online platform	UOXF	All	Web	PU	M2	26/06/ 2015
D5.3	Data management plan	SINTEF	IT-Innovation	R	PU	M6	29/09/ 2015
D5.4	A compendium of ongoing results	UOXF	All	Web	PU	M12	01/04/ 2016
D5.1 interim	Interim dissemination and communication plan	UOXF	None	R	PU	NA	30/07/ 2016
D5.5	Exploitation strategy	UOXF	All	R	CO	M23	23/02/ 2017

D5.6	Final overall report of dissemination and exploitation	UOXF	All	R	PU	M26	13/06/ 2017*
D5.7	HUMANE Open Research Data	SINTEF	All	R + Web	PU	M24	31/05/ 2017

*)estimated delivery date

Table 10: Milestones WP5 in this period.

#	Milestone name	WP(s)	Lead	Annex 1 delivery date	Achieved Y/N	Achieved date
1	Project set-up completed	5, 6	SINTEF	01/08/2015	Yes	01/08/2015
2	End of first project iteration	All	SINTEF	01/04/2016	Yes	01/04/2016
3	End of second project iteration	All	SINTEF	31/01/2017	Yes	31/01/2017
4	Wrap-up	All	SINTEF	31/05/2017	Yes	31/05/2017

3   WP6: Project management

The objective of this work package is:

- To establish and adhere to a project management structure within the project and towards the EC;
- To ensure compliance with project plans and that the project activities meet the appropriate quality levels, and manage related risks;
- To monitor the quality of the work delivered through assessment of deliverables.

3.1   Work progress towards objectives

The project management structure was established in the first year of HUMANE and has been adhered to throughout the project. This structure has worked well and efficiently. The management structure of WP-leaders, Task-leaders and Project Coordinator has been adequate for aligning with the need to plan, oversee and control the project activities.

HUMANE was characterized by highly interdependent WPs and the involvement of most or all partners in all scientific or technical tasks. The only exception from this was task 3.4, which only involved two of the four partners. This interdependence and extensive interaction in the project has required close collaboration across partners and knowledge domains. The cross-disciplinary nature of the four partners has been experienced as beneficial and served to strengthen the scope and relevance of the work completed.

At the same time, the interdependence and broad collaboration has at times been demanding in terms of coordination, which has caused the need for some delay for some of the deliverables in the period. Also, a two-month extension of the project period was seen as necessary to complete the deliverables in the final project year with good quality.

All deliverables that were planned in the project have been completed, though with some delays – as detailed in the following section.

3.2   Deviations from schedule

The interdependent nature of the WPs in HUMANE, and the highly collaborative character of the work, have caused some deviations from the project schedule. It should, however, be noted that these deviations have not at any point compromised the quality of the project outcome and deliverables. In this section, we detail the deviations from the schedule.

I the first project year, some extensions of the deadlines from the project deliverables were needed due to the complexity in some of the tasks and interdependence with other tasks. The deadlines in questions were extended following dialogue with the project officer. Specifically, D1.1 (literature review) and D3.2 (first set of case studies) was somewhat delayed. However, the overall milestones were kept, and the first year project review was conducted according to plan.

In the second project year, the project partners realized that the increased complexity in the work tasks as well as the highly interdependent project structured required additional extension in the project to uphold the quality in the project deliverables. At the fourth plenary project meeting and management board meeting (in M18) the consortium agreed to kindly ask for a two-month extension of the project. Following subsequent dialogue with the project officer, a formal request for a project extension was sent the director of DG CONNECT, Directorate H. Upon the approval of this request, a revised Annex 1 – Description of Action - Part B was submitted (M19). The Amendment to the Grant Agreement was finalized M21, including the new project end data (M26) and the revised Annex 1.

In the revised Annex 1, the due date for most of the remaining deliverables were extended. In addition, for some of the deliverables the consortium saw the need to kindly ask for additional extensions, because of unforeseen issues pertaining to coordination and availability of resources. All extensions were confirmed as acceptable by the project officer; this was the case for D2.3, D3.3, D3.4, D4.2, and D4.3.

3.3   Communication and project meetings

The communication and collaboration among project partners in the consortium has had a constructive and reciprocal character throughout the project. Internal communication and collaboration between plenary meetings primarily has been conducted through the following services:

1. The mailing list (humane2020@googlegroups.com) for communication about technical and managerial aspects of the project.
2. GoToMeeting (www.gotomeeting.com), Skype (www.skype.com), and Webex (www.webex.com) for conducting remote WP- and project-meetings.
3. The Content Management System in eRoom, for simple and secure document management.

Physical project- and plenary meetings have been organized as detailed in Table 11:

Table 11: Overview of meetings

Meeting type	Date	Venue	Additional details
Kick-off meeting	05-06/05/2015	Oslo, Norway	Included a three hour research ethics session with HUMANE ethics advisor Charles Ess
1st plenary meeting	14-15/09/2015	Oxford, UK	The first MB-meeting was organized together with this meeting
2nd plenary meeting	12-13/01/2016	Southampton, UK	The second MB-meeting was organized together with this meeting.
3rd plenary meeting	19-20/04/2016	Oslo, Norway	Meeting organized the two first days after the first year project review. The third MB-meeting was organized together with this meeting
4th plenary meeting	31/08-01/09/2016	Athens, Greece	The fourth MB-meeting was organized together with this meeting
5th plenary meeting	06-07/12/2016	Southampton, UK	The fifth MB-meeting was organized together with this meeting
6th plenary meeting	22-23/03/2017	Oxford, UK	Meeting adjacent with HUMANE workshop. The sixth MB-meeting organized with this meeting
GoToMeeting/ Skype/Webex	Regularly/as needed	Remote	Conducted to align, plan and monitor progress with task-activities in the active WPs.

3.4   HUMANE performance indicators

In D6.1 we included a first version of objectives and measurement indicators in HUMANE. In D6.2, and updated version of the objectives and measurement indicators in HUMANE was provided. In Table 12 we provide an overview of these indicators, along with the progress for the periods M1-12 and M13-26 respectively.

Table 12: HUMANE Performance indicators.

Dimension	Objective	Measurable indicator	Progress M1-12	Progress M13-26
Theory development	To provide a strong and up-to-date theoretical multidisciplinary and scientific approach to better understand the state-of-the-art on human-machine networks.	At least **one** peer reviewed journal or conference article submitted, which discusses how current human-machine networks challenge and advance relevant theoretical perspectives (e.g. SNA, ANT, trust).	One article submitted to *ACM Computing Surveys.* (now accepted and published)	
Case-studies	Delineate and model	At least **two** peer	One article	Two articles

	different types of real-world human-machine networks as empirical examples of the ways human and machines act and interact.	reviewed journal or conference articles submitted, which discuss existing and emergent human-machine networks in hyper-connected societies.	accepted in *Journal of media innovations* (now published). Two articles submitted to Scientific Reports. (one of these now accepted and published)	accepted and published in PLoS ONE. Three articles submitted to scientific journals. One paper submitted to scientific conference.
Typology	Classifying and contextualizing the barriers, gaps and pitfalls that may generate mismatch between the novel ICT solutions and the intended human-machine network.	At least **one** peer reviewed journal or conference article submitted, which distinguishes prioritized dimensions for different types of human-machine networks (e.g. purpose, relationship characteristics, time, space).	Two conference-papers accepted at HCI International 2016 (now published).	
	Final typology should delineate and model networks comprehensively and provide predictive consequences for trust, privacy, shared responsibility and motivation.	At least **one** peer reviewed journal or conference article submitted, in which we deduce archetypical human-machine networks with adherent characteristics and discuss the predictive consequences of tweaking different network-characteristics-dimensions.		One conference paper accepted at HCI International 2017. One conference paper accepted at ICMMI 2017.
Method	Final method will serve to identify and mitigate critical issues that might obstruct the successful implementation for human-machine network solutions.	HUMANE online profiling tool, which allows users profile their HMNs, find matching HMNs and design-patterns for successful implementation. White paper on methodology for	Alpha-version of HUMANE online profiling tool in progress, expected to be launched in M14.	Initial version of HUMANE online profiling tool launched in M14. Updated version in M24. White paper on HUMANE methodology

		resource-efficient and reliable context-analysis, human-machine network requirements, design patterns and analytical evaluation.		developed and made available through the HUMANE project webpage.
Roadmap	Vision: Clear identification of how the roadmap will provide guidance for understanding challenges and opportunities for future human-machine networks.	• Clearly defined trends and tendencies for future HMNs. • Identified key technologies and enablers of future HMNs. • Identified themes and problem-areas for research and innovation. • Identification of expected impacts. • Identification of implications for governance.		Identified in D4.1
	Needs: Corresponds to stakeholder needs, requirements and priorities.	White paper summarizing and discussing needs and experiences from relevant private and public stakeholders and policy-makers. Validated and finalized through the HUMANE workshop.		White paper on HUMANE survey results and uptake, made available through the HUMANE project webpage. The roadmap work was presented as the HUMANE workshop.
	Action: Roadmap provides easily applicable guidance and actionable steps for planning and leveraging future HMNs.	White paper distilling and simplifying current vs. desired end-state, needs, and optimum sequence of how to enable human-machine networks to accomplish desired outcomes, and how to mitigate challenges and		Three white papers on HUMANE roadmaps developed for three domains: sharing economy, eHealth and

		obstacles. Roadmap visualizations that convey the key roadmap priorities and status at a glance.		citizen participation. Made also available through the HUMANE project webpage.

3.5   Deliverable and milestone list for WP6

Table 13: Deliverables WP6 in this period.

#	Deliverable title	Lead	Internal reviewer	Type	Diss.	Due date	Subm.
D6.1	Project quality and assessment plan	SINTEF	All	R	CO	M3	01/07/2015
D6.2	Periodic activity and management report	SINTEF	All	R	CO	M12	15/04/ 2016
D6.3	Periodic activity and management report	SINTEF	All	R	CO	M26	12/6/ 2017
D6.4	Public project report	SINTEF	All	R	OP	M26	12/6/ 2017
D6.5	Final activity and management report	SINTEF	All	R	CO	M26	12/6/ 2017

Table 14: Milestones WP6 in this period.

#	Milestone name	WP(s)	Lead	Annex 1 delivery date	Achieved Y/N	Achieved date
1	Project set-up completed	5, 6	SINTEF	01/08/2015	Yes	01/08/2015
2	End of first project iteration	All	SINTEF	01/04/2016	Yes	01/04/2016
3	End of second project iteration	All	SINTEF	31/01/2017	Yes	31/01/2017
4	Wrap-up	All	SINTEF	31/05/2017	Yes	31/05/2017

4   Publications and dissemination

4.1   HUMANE as Open Research Data pilot

HUMANE, as a research and innovation action under ICT 31, participates in the Open Research Data pilot. Hence, the project is required to make access to research data and scientific publications generated in the project as open as possible. Following and elaborating on the guiding principles for open research data and open access publication outlined in year 1 (D5.3), we have adhered to the requirements of open research data.

Open research data: The guiding principles for open research data in HUMANE have been grounded in the principles as laid out by the European Commission. Specifically, we have aimed to be as open as possible and as closed as necessary. In total 14 datasets have been gathered and processed during the HUMANE project. Of these, six where gathered in year 1. In year 2, we have finalized anonymization and storing of all datasets as described in our report on the open research data pilot (D5.7). The majority (nine) of the data sets are openly published. However, for five of the datasets considerations regarding confidentiality and challenges pertaining to informed consent made it necessary to opt out of such open publication of data. For two of these, we also share our experiences concerning unforeseen issues on informed consent of open publication of qualitative data. Open publication of research data has been done at Zenodo for most of the datasets, except one which was published on Figshare.

Open access to publications: The guiding principles for open access to research publications in HUMANE also followed the principles as laid out by the European Commission. All publications resulting from the project have been or will be made available through green or gold open access. Furthermore, submitted or pre-print author versions of the papers have been made available through the preprint service arxiv.org.

Openly published datasets and publications are aggregated at the HUMANE project page at OpenAIRE. This is an aggregator site. Hence, the project has no direct control of which data-sets or publications that are linked to OpenAIRE.

4.2   List of accepted journal publications

Milena Tsvetkova, Ruth Garcia, Luciano Floridi, and Taha Yasseri. "Even good bots fight." PLoS ONE 12(2): e0171774. (2017).

Marika Lüders, "Mennesker og maskiner" Comment in Norsk medietidsskrift, 22(3), 2015.

Marika Lüders, "Innovating with users online? How network-characteristics affect collaboration for innovation", Journal of Media Innovations, Vol. 3 No. 1, pp. 4-22, 2016.

Milena Tsvetkova, Ruth García-Gavilanes, and Taha Yasseri, "Dynamics of Disagreement: Large-Scale Temporal Network Analysis Reveals Negative Interactions in Online Collaboration" Scientific Reports 6, Article number: 36333, 2016.

Milena Tsvetkova, et al. "Understanding Human-Machine Networks: A Cross-Disciplinary Survey." ACM Computing Surveys (CSUR) Surveys Homepage 50(1), 12.

4.2.1 List of submitted journal papers under review

Khairunnisa Ibrahim, Samuel Khodursky, and Taha Yasseri. "Spatiotemporal patterns of classifications to the Zooniverse." under review.

Petter Bae Brandtzaeg, and Asbjørn Følstad. "Usefulness and trust in online fact-checking and verification services" under review (collaboration between the HUMANE and REVEAL projects)

Petter Bae Brandtzaeg, and Marika Lüders. "Time Collapse in Social media: Extending the Context Collapse", under review (collaboration between the HUMANE and REVEAL projects)

4.3 List of accepted conference-papers

Asbjørn Følstad, Vegard Engen, Ida Maria Haugstveit, Brian Pickering, "Automation in Human-Machine Networks: How Increasing Machine Agency Affects Human Agency", to appear in the Proceedings of ICMMI 2017, arXiv preprint, arxiv:1702.07480 (2017).

J. Brian Pickering, Vegard Engen, and Paul Walland, "The Interplay between Human and Machine Agency", arXiv preprint, arXiv:1702.04537, to appear in proceedings: The 19th International Conference on Human-Computer Interaction (2017).

Aslak Wegner Eide et al., "Human-Machine Networks: Towards a Typology and Profiling Framework", In Proceedings of the 18th International Conference on Human-Computer Interaction, Lecture Notes in Computer Science, Vol. 9731, pp 11-22, arXiv preprint: arXiv:1602.07199, 2016.

Vegard Engen, J. Brian Pickering, and Paul Walland, "Machine Agency in Human-Machine Networks; Impacts and Trust Implications", arXiv preprint arXiv:1602.08237, in proceedings: The 18th International Conference on Human-Computer Interaction, 2016.

4.4 List of industry/public conference talks/presentations

Petter Bae Brandtzaeg, M. D. Chaparro, and A. Følstad. "Context collapse of news". Presentation accepted for AoIR 2017: The 18th annual meeting of the Association of Internet Researchers, Tartu, Estonia, October, 2017. (collaboration between the HUMANE and REVEAL projects)

Asbjørn Følstad, "Fra en intervjustudie om delingsøkonomi og menneske-maskin nettverk" (From an interview study on the sharing economy and human-machine networks), SoCentral, Oslo, Norway, April 2017.

Taha Yasseri, "Humans and Machines fighting on Wikipedia" London Computational Social Science Initiative, University College London, 2017.

Milena Tsvetkova, "Even good bots fight", GESIS Winter Symposium on Computational Social Science, Cologne, Germany, Dec 2016.

Marika Lüders, "Snap! Selg! Kjøp! Innovasjon, redistribusjonstjenester og forbrukererfaringer", Konferanse om forbrukeren i delingsøkonomien, Oslo, Norway, Feb 2016.

Milena Tsvetkova, Ruth Garcia-Gavilanes and Taha Yasseri, "The dynamics of disagreement: A large-scale analysis of the Wikipedia revert network", 2nd GESIS Computational Social Science Winter Symposium, Cologne, Germany, Dec 2015.

Taha Yasseri, "What Does the Internet Tell Us about Human Behaviour?" Department of Experimental Psychology, University of Oxford, Oxford, UK, Nov 2015.

4.5   List of other dissemination and activities

UOXF organized the HUMANE workshop in Oxford in March 2017, with all the partners presenting the workpackages.

UOXF co-organized an "Editathon" on the 15th birthday of Wikipedia, 15th of January 2016, Oxford, UK: http://www.oii.ox.ac.uk/events/?id=749

Walland, P. represented HUMANE at the RRI-ICT 2015 Event in Brussels 8-9th of July 2015.

Lüders, M. represented and presented HUMANE at the 1st RRI-ICT Concertation Meeting in Brussels on the 24th of April 2015.

5   Appendix A: Feedback and report from the Research Ethics Advisor – year 1

Professor Charles Ess (Department of media and communication, University of Oslo) is HUMANE's Research Ethics Advisor. Professor Ess participated at HUMANE's kick-off meeting in Oslo on the 5th of May 2015. His initial assessment and comments from the kick-off meeting with regard to research ethics in HUMANE are included in this Appendix (see section 5.1) together with his report based on relevant documents (research ethics sections in DoA, D3.1, D3.2 and D5.3) (see section 5.2).

5.1   Research ethics discussion from Kick-off meeting

Overall the research ethics judged by Ethical Advisor is relatively well taken care of in the planned HUMANE case studies. General comments and input included the following:

Table 15: General comments on research ethics.

Comments from Charles Ess	Follow-up in HUMANE after kick-off
Concerning informed consent: All cases should consider, if relevant, to explicitly mention the study participants' option to leave the study at any point in time	The option to withdraw has been included in the information-sheets to participants in case-studies C1-C4.
Concerning international cooperation: International cooperation on data collection should be made explicit in the reporting to regulatory bodies (e.g. NSD). As Norwegian ethical requirements are stricter than in other EEC/EU countries, ethical reports acceptable in Norway should also be acceptable in other EEC/EU countries	In the notification form submitted to NSD on 22nd of May 2015, we informed about the international cooperation. NSD has asked SINTEF as the data controller to set up data processor agreements with the consortium-partners. Data processor agreements have not yet been set up.
Concerning data storage: Location of data storage should be made explicit on the level of country	This requirement has been included in D5.3, p. 11.
Implementation of minors' exclusion policy needs to be considered in particular.	This requirement is noted in D3.1 (Table 10). This requirement could be spelled out in somewhat more detail. At the same time, however, it is to be noted that in the example of Case study C2 (C2C redistribution markets – see section 5.2.2), researchers encountered precisely an issue having to do with minors as interviewees. The specific issue –

	two of the interviewees were 15 – was reviewed and approved by the Norwegian Data Protection Official for Research. This indicates that the researchers are appropriately aware of this component of research ethics and have proven responsive to these issues as they have arisen – and in ways approved by the relevant authorities.

Case-specific comments are included in Table 20.

Table 16: Case-specific comments.

Comments from Charles Ess	Follow-up in HUMANE after kick-off
REVEAL: Need to be able to analyse and write up the data in a way that anonymizes all involved actors, including both sources and journalists.	In the REVEAL case-study (C4 as reported in D3.2), it is not possible to identify any of the interviewed participants.
Zooniverse: All participants complete an informed consent prior to data collection. Only anonymized data will be passed on to third parties. Should be ok in terms of ethics.	The evaluation-report from NSD confirmed the Zooniverse case study to take the appropriate means for gathering and analysing user-data (see section 6.1 in D3.2).
Wikipedia: Follows the Wikipedia contributor agreement**.** Potential issues: (a) participants may contribute without registering a user name, which implies that the participants are associated with an IP-address, (b) no control whether minors participate as no age data are collected from participants. No storage; live SSH access to the Wikimedia server.	The evaluation-report from NSD confirmed the Wikipedia case study to take the appropriate means for gathering and analysing user-data (see section 6.1 in D3.2).
eVACUATE: For the HUMANE purposes, the foreseen data collection will include interviews and interactions with those who build the system. Data collection will be conducted only following informed consent.	The described procedures were followed in the eVACUATE case study.
Center for Service Innovation (CSI) and CITI-SENSE: Data collection and storage will include analysing open innovation portal content (not by automatic crawling),	As described in D3.2, we chose to conduct a survey with company-customers rather than interviews.

interviews with service company employees, and interviews with company customers. All data collection will be conducted following ok from NSD. Ess comments that there is a need to inform the NSD on possible sharing of data in international consortium. Also a good idea to keep the detailed analysis confidential and to share openly only the aggregated analysis	We did not gather any directly or indirectly identifiable data through the survey. Thus far the raw-data from the interviews and the survey has not been shared in the consortium.

5.2   Research ethics assessment by Ethics advisor Professor Charles Ess

To begin with, let me make my starting points for this evaluation explicit: my suggestions and comments derive from my understanding of the European Union Data Protection requirements, as well as the (oftentimes more stringent) requirements of the Norwegian social science data services (NSD). Finally, these comments and suggestions are further informed by both the ethical guidelines of the Association of Internet Researchers (AoIR – 2002, 2012) and my knowledge of the best practices in research ethics that have emerged in these domains over the past 15 years or so.

Overall, it is clear that the project and individual case studies have consistently met the various research ethics requirements as designed and stipulated. This is indicated in good measure by receipts of ethical approvals from the relevant university or national ethics agencies – i.e., the Faculty Ethics Committee of the Faculty of Physical Science and Engineering at the University of Southampton (Number: 18541), and the Norwegian social science data services (NSD: 43552).

Moreover, specific concerns raised at the outset of the project have been clearly addressed. For example, as noted above (5.1, Table 17, p. 1), it was recommended that "All cases should consider, if relevant, to explicitly mention the study participants' option to leave the study at any point in time." Accordingly, "The option to withdraw has been included in the information-sheets to participants in case-studies C1-C4."

As well – and as is perfectly common in research, as specific projects unfold – new ethical questions and considerations have arisen. These are detailed specifically for: C2C redistribution markets case study (see section 5.2.2); eVACUATE case study (see section 5.2.3); and REVEAL case study (see section 5.2.4). I discuss each of these in greater detail below. Broadly, those responsible for the case studies have changed or modified their ethical practices appropriately.

In general, it is quite clear that the project at large and its component case studies have well met both national and international – i.e., EU-level – requirements for research ethics, as aimed in the first instance at protecting identity (of both research participants and, in some cases, the researchers in turn), confidentiality, and anonymity, along with correlative requirements (in some instances) of informed consent. The project is also properly attentive to the requirements for research data storage and security, as well as to the ethical requirements that come into play during dissemination of results. This last point is especially critical as the research results will be, by design, fully and publicly available online.

There remain, however, two points to attend to. To begin with, as noted above (5.1, Table 17, p. 1), in response to the observation that because Norwegian ethical requirements are as strict or stricter than in other EEC/EU countries, NSD was duly notified of the international dimensions of the project. In response, "NSD has asked SINTEF as the data controller to set up data processor agreements with the consortium-partners." This is still to be done.

In addition, Table 17 includes the further action requirement:

> Implementation of minors' exclusion policy needs to be considered in particular.

As noted there, some further work needs to be done in terms of developing a more detailed policy. At the same time, the Norwegian research team, as described in Case Study C2, encountered and successfully resolved (i.e., with the approval of the Norwegian Data Protection Official for Research) a first application of determining how minors are to be included or excluded from research – and if included, under what conditions.

5.2.1   Case study C1: Open innovation

Section 6.2.1, "Ethics consideration in the CSI open innovation case study revised," (D 3.2, p. 145) details the procedures as required to ensure that "no indirectly or directly identifiable information would be disclosed" in the open publications based on this case study.

All of these procedures are standard and important – including informed consent; storing person's names and reference numbers separately from the empirical data collected; destroying interview recordings once transcribed; and anonymization of the bank involved and its domain. In particular, no IP addresses were collected during the use of Surveymonkey.

A standard concern in using such commercial survey instruments is how far the company / companies involved manage to protect any personal or sensitive data. In this case, however, this concern is not warranted because no personal or sensitive data was collected in the first place.

5.2.2   Case study C2: C2C redistribution markets

As noted above, this case study involved a change in methodology – i.e., from a qualitative, content-analysis approach to a quantitative approach. The researchers' new approach, nonetheless, allowed them "to manually code and analyse ads without gathering or archiving directly or indirectly identifiable data" (D3.2, p. 146). They further undertook collecting informed consent from interviewees, followed by standard requisite procedures of ensuring separation between the list with names and reference numbers vis-à-vis gathered (and eventually published) empirical data. Finally, the researchers were careful to notice that two of the interviewees were 15 years old; fortunately, the researchers were informed by the Norwegian Data Protection Official for Research that it is "common practice" to observe "an age limit of 15" for giving informed consent, vs. 16 "for gathering sensitive personal data". As noted above, no sensitive data was gathered during the interviews.

A (further) question arises, however, with regard to the screen shots of ads that were collected during the research. The researchers assure us that "it is not possible to identify users based on these

screen-shots." (D 3.2, p. 146). Dr. Marika Lüders, the primary PI, has subsequently explained that this is because the usernames are blurred and no head shots are included.

At the same time, a common distinction in this sort of research is between person-based and text-based research (cf. Heidi A. McKee & James E. Porter, *The Ethics of Internet Research: A Rhetorical, Case-based Process* [New York: Peter Lang, 2009], p. 82). Insofar as the materials to be used in publication can be considered as *texts* – i.e., public objects with identifiable authors – anonymization, etc., is not a primary concern: for that, copyright and attribution are. That is, the typical procedure here is to acknowledge the author of a text as copyright holder – ideally, with permission to reproduce the materials involved. The researchers involved may need to consider this as an additional step.

5.2.3   Case study C3: eVACUATE

As noted (in D3.2, p. 147), the project received requisite approval from the Faculty Ethics Committee of the Faculty of Physical Science and Engineering at the University of Southampton (Number: 18541); hence all relevant research ethics requirements were met by the original project design and methodologies.

Something of a new wrinkle arose, however, as the software engineers involved in the project felt the need to protect their own anonymity. Accordingly, and as noted, identifying information was deleted once interview transcripts were checked and validated; further, personal identifiers, including name or project role, were pseudonymised.

It should be noted, however, that in cases such as this – i.e., involving relatively small communities, whose members often know one another fairly well in any event – pseudonymisation may not always perfectly protect the anonymity of a source. For example, it is not uncommon for community members to be able to recognize the source based on distinctive characteristics of expression, opinions, etc. The researchers involved may want to be especially careful when it comes to dissemination and publication to ensure that none of these sorts of identity markers "leak through" in publicly accessible documents.

These concerns appear to be particularly well placed vis-à-vis the community of software engineers involved: they are recognizable as software engineers employed by the firm IT Innovation, <u>and</u> as involved with the research project eVACUATE. Especially in connection with the raw interview data intended for inclusion in the Open Access publication of the project, individuals within this quite small community will be readily recognizable. *Prima facie* this means that such raw data cannot be published.

For other publications, one alternative researchers can consider is the common practices of identity aggregation and composite identities. These involve developing a fictive identity marked by a set of expressions, behaviours, attitudes, etc. that are important for illustrating or exemplifying research findings. These expressions, etc., may be shared among several specific individuals; the fictive identity can then further be characterized as holding an attitude, expression, etc. that in fact is true of only a single individual. Such an aggregate or fictive identity hence makes it very difficult (if not

impossible) to trace specific claims, etc., to an individual, known person. This is currently being reviewed by the researchers prior to any final decision on how the data might be made available to the broader scientific community.

5.2.4   Case study C4: REVEAL

As with the previous case study (C3), the REVEAL case study initially met standard research ethics requirements – and likewise encountered an (unexpected) problem of the software engineers involved in the project feeling a strong need for ensuring their own anonymity. Again, relevant steps were taken, i.e., "no personal information was noted that could be used in order to identify specific individuals" (D3.2, p. 147).

At the same time, however, I would repeat the points made above regarding the specific challenges of maintaining anonymity in the dissemination and publication phases when small communities are involved. Specifically: the researchers involved may want to be especially careful when it comes to dissemination and publication to ensure that none of these sorts of identity markers "leak through" in publicly accessible documents.

Again: one alternative they can also consider is the common practices of identity aggregation and composite identities. These involve developing a a fictive identity marked by a set of expressions, behaviors, attitudes, etc. that are important for illustrating or exemplifying research findings. These expressions, etc., may be shared among several specific individuals; the fictive identity can then further be characterized as holding an attitude, expression, etc. that in fact is true of only a single individual. Such an aggregate or fictive identity hence makes it very difficult (if not impossible) to trace specific claims, etc., to an individual, known person.

5.2.5   Case study C5: Wikipedia

In both this and the next case study, the research ethics requirements are comparatively straightforward and easily managed.

At the same time, however, as this project moves towards publication and dissemination, the researchers involved may want to take on board the comments offered in conjunction with the previous two case studies. That is, depending on how the research findings are to be presented – in this case, for example, with regard to the behaviors of "higher-status editors" – care should be taken not to inadvertently reveal any information that might lead to a specific editor.

To be sure, given the scale of the communities involved in this case study, the risks of such revelation are considerably lower than in the previous two case studies. Nonetheless, depending on how they intend to present their findings, the researchers involved may want to consider strategies of identity aggregation and composite identities if these seem necessary and appropriate.

5.2.6 Case study C6: Zooniverse

As with the previous case study, the ethics requirements for the Zooniverse case study are comparatively straightforward and easily managed. This case study enjoys the further advantage that Zooniverse participants "consent to scientific research on the logs of their activities" when joining the platform. So far as I can see, including following a review of the findings as presented in D3.2, p. 131-141, the procedures for respecting the relevant ethical requirements are appropriate, in place, and carried out accordingly.

6   Appendix B: Report of the Research Ethics Advisor – year 2

Research Ethics Considerations: HUMANE, year 2

Charles M. Ess

Ethics Advisor

Introduction

My role as ethics advisor to the HUMANE project entailed two activities this year: (1) discussion and review with HUMANE Project Coordinator (HPC) Asbjørn Følstad of a particular set of ethical issues concerning open research data (March-April 2017), and (2) review and final responses to an extensive document, "HUMANE: Input to ethics advisor for the second project year" (referred to in the following as "Ethics Input"), also provided by HPC Asbjørn Følstad. In the following, I summarize the primary issues and resolutions taken up in these. By way of conclusion, I will offer a few suggestions regarding (a) ethical dimensions regarding future publications emerging from the project, and (b) the ethical dimensions and their resolutions for similar sorts of projects.

1. Issues regarding HUMANE as a European Commission Open Research Data Pilot: Discussion and review with HPC Asbjørn Følstad (March-April 2017)

In late March (24), 2017, I received an email from Asbjørn Følstad requesting advice concerning the ethics of publishing HUMANE research data as open research data.

Brian Pickering, a project participant from IT Innovation, put the question precisely:

> Notwithstanding that our data is used by us and may only [be] used by others for research purposes only, in preparing our research data for publication via a controlled external repository, we have come across the following problem. *For qualitative data (e.g., transcripts of interviews), only limited pseudonymisation is possible*: we can change personal names and company affiliations, but *we cannot guarantee that a 3rd party wouldn't identify respondents via cross matching with our publically available deliverables*. For example, we may have pseudonymised an organisation using the name 'Lindstrøm AG' within an interview which discusses issues or challenges for companies offering online retail trading services. Given that the GDPR explicitly describes measures which would not involve excessive 'costs of implementation', it is our plan in these specific cases:
>
> > (a) To pseudonymise personal data by obscuring personal names, contact details, affiliation names, job title;
> >
> > (b) To review the transcript for the potential for negative conclusions or observations being made in respect of the real organisation the individual is affiliated with, and on this basis:
> >
> > > a.   If comments are positive, we will take no further action and transfer the pseudonymised data to the repository;

   b. If comments are negative, we will first show to our contact(s) in the relevant organisation to ask for their consent to make the data available;

   c. In either case, any such data where we believe there may be a possibility of identifying the original organisation or individual, we propose to make such data available only on request to us and an assurance that the data will only be used for research purposes.

We believe that this would reasonably demonstrate our obligation to the data subjects not least in terms of the consent they have provided, but also demonstrate that we are taking all reasonable measures to show compliance with appropriate data protection laws.

(email, 24/03/17; emphases added, CME)

In addition, Asbjørn noted the further difficulty – namely, that in the informed consent documents provided to participants, in "… some cases (but not all), we forgot to mention the possibility of the anonymized data being made openly available." (email, 24/03/17)

In response to the first set of concerns, I observed first of all that these are absolutely standard concerns for projects of this sort – and hence there is considerable precedent and experience to draw from, along with the Association of Internet Researcher's most recent set of ethics guidelines for internet research.[1]

I then raised three questions and a suggestion:

1) Did the funding agencies – in this case, the European Commission – have specific guidelines as to exactly what must be made publicly available – and what not?

2) Had the project contacted the Norwegian Data Protection Authority (Norsk Datatilsynet - NSD) with a request for advice and/or permission to proceed along these lines?

The latter would be especially critical if the response to this next question were negative:

3) was the publication of interview data – in pseudonymized ways – part of the original request to the NSD for permission to undertake the HUMANE project and its constituent work packages?

I suggested that, especially if renewed contact needed to be taken up with NSD, that it would be helpful to consider proposing a standard approach to providing more robust protection of individual persons and their personally identifiable information (PII) – namely, by way of developing an aggregate or conglomerate identity: such an identity is somewhat fictive, but can convey the main points or illustrations required for publication while still protecting the persons and their PII. At the same time, it is a common procedure to keep the original data in a secure fashion, making it available to researchers under specified circumstances for the sake of being able to validate and replicate the research, etc.

In response to the second issue, I pointed out that not including the possibility of pseudonymized / anonymized comments in an open publication as part of the original informed consent conditions did indeed represent a significant ethical problem.

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[1] Annette Markham and Elizabeth Buchanan. 2012. Ethical Decision-Making and Internet Research: Recommendations from the AoIR Ethics Working Committee (Version 2.0). Available at <https://aoir.org/reports/ethics2.pdf>.

One possible resolution would be to return to the original informants and ask for their consent to this new condition.

In all events, taking up these concerns with the NSD was the clear next step.

HPC and NSD responses

HPC Asbjørn Følsted duly contacted the NSD, and informed me of their response as follows:

> *- If interview data are anonymized, it is ok with NSD that these are made open*. Also without informed consent. Also, *there is no need to inform NSD about the open publishing of anonymous data*.
>
> - NSD pointed out that *there still, of course, be ethical issues associated with making anonymous interview data openly available without informed consent - even though it is ok with regard to privacy regulations*.
>
> *- If interview data are not fully anonymized*, this is a different story altogether. First, the project will then have to report this to the NSD and get a permission for handling non-anonymous data after the ending of the project. **Second, making such data openly available will be problematic, even with the informed consent from the participants, for example as one loses control of where data is stored which purposes it is used for (including possible non-research purposes), and the individual loses the opportunity to retract data.**
>
> - **The open publishing of non-anonymous interview data will, likely, not be possible under the GDPR as, according to the NSD, one hardly will be allowed to gather such a sweeping informed consent**.
>
> (email, 03/04/17; emphases added, CME)

Most importantly, the HPC offered his own response:

> As I see it, in our cases we need to make an assessment whether or not we are able to anonymize the interview data fully. If we are able to do so, we may make the data openly available if we have informed consent. ***If we do not have informed consent**, my ethical compass tells me that it is maybe not ok to make data openly available even though it would be ok in terms of privacy regulations*.
>
> (email, 03/04/17; emphases added, CME)

From my perspective, this was an exemplary response on both the part of the NSD and the HPC to a complex problem. Moreover, this response was especially critical as no less than five of the cases and activities in the HUMANE project came to face this problem. At the same time, one case (**Roadmapping Work – Citizen Participation**) managed to avoid this problem: see analysis and discussion below.

As can be seen in the next set of documents, we agreed that in these cases (beginning with the discussion of **Case 1, Open Innovation**, and **Case 2, Sharing economy** (Conserve & consume) [but further extending through **Cases 7** and **8**, as well as the penultimate activity, **Roadmapping work – sharing economy D4.2, D4.4** – see discussion below], the HPC was making the best ethical judgment

– i.e., <u>not</u> to make pseudonymized (i.e., non-anonymous) interview data openly available without informed consent.

We further agreed to meet and discuss these matters in more detail, which we did on April 27, 2017. In addition to reviewing the above ethical issues and responses, as detailed in the next section, we further agreed on a procedure for soliciting responses from project partners regarding ethical concerns within each case or activity for the sake of developing this report.

2. Solicitation, review, and responses to HUMANE Cases and Activities – year 2

Partly inspired by our discussion of the above issues, we agreed that a useful way to develop the project's second annual report would be to first solicit input from the project partners – specifically in response to the following set of (collaboratively developed) questions:

(a) please provide a brief overview of the *hypotheses*, *research questions*, *methods* and *plans for dissemination*.

In particular:

what sorts of material /analyses /results / findings do you plan / <u>must</u> you publish as an outcome of the research?

Do your methodologies / hypotheses / research questions <u>require</u> the publication of information that can be traced to a given individual (e.g., direct quotes analyzed from the standpoint of discourse analysis, as a primary example)?

(b) ethical aspects of the case – what do you yourself see as the key ethical aspects of the case or activity?

(c) what are your strategies for collecting informed consent?

(d) copy of the informed consent form (where applicable)

(e) please provide an account of how personal data is handled – including procedures for storing, processing, and anonymization.

(f) local ethics approvals (if relevant): if you have gathered ethics approval locally (at your institution or similar), please attach this.

Project partners provided (generally) very complete and helpful responses to these questions; the HPC then collated these ("Ethics Input") for my review and response.

(Please see the "Ethics Input" for the full responses and related materials, including informed consent forms when relevant, for each case and activity).

Overall, as suggested by the discussion of **Cases 1** and **2** above concerning the late-stage ethical problems catalysed by requirements imposed by the EC Open Research Data Pilot – problems further shared by **Cases 7** and **8**, as well as the **Roadmapping work – sharing economy D4.2, D4.4 –** the attention to and care with resolving the ethical issues arising through the research projects are generally exemplary.

At the same time, one case – the **Wikipedia simulation modelling (D3.4)** – while meeting good research ethics practices, nonetheless occasions an important observation about internet-facilitated research that must be kept in mind for both current and future research projects.

Given their shared ethical problematics, I have first taken up **Cases 1, 2, 7,** and **8,** and then the activity **Roadmapping work – sharing economy D4.2, D4.4** in sequence. I then turn to the remaining cases in the order they are presented in the Ethics Input document.

Responsa

As noted above, both **Case 1** (Open innovation) and **Case 2** (sharing economy – conserve & consume) faced new ethical issues in response to the general requirement that the HUMANE project, as part of the EC Open Research Data Pilot, make its research data openly available.

The response provided for Case 1 is exemplary:

> In Case 1, data were gathered through **semi-structured interviews with case company employees and through a questionnaire with case company customers**.
>
> For research data to be made openly available, **these should be anonymized**. This has been done for all the gathered data, including the interview transcripts.
>
> However, for publication of anonymized data we see two additional issues as relevant:
>
> - **Informed consent: Raw interview transcripts may have a personal character, even if anonymized**, as personal thoughts and opinions are revealed. Hence, the **publication of such raw anonymized interview transcripts may be problematic without the informed consent of the participants**.
> - **Confidentiality**: **Raw questionnaire data and raw interview transcripts may, while anonymized, reveal the organizations which the participants are parts of**, or of which the participants speak. In cases where the data collection is conducted in collaboration with these organisations, **it could represent a breach in confidentiality if data are published unless this is permitted by the organisation.**
>
> In Case 1, both these issues represent challenges for open publication of research data.
>
> **For the interview data, we did not think of asking for informed consent for open publication of the raw transcripts (we did however ask for informed consent to use the interview data as part of scientific publications),** Furthermore, as the interview data contains opinions of the employees in the case organisation, **open publication would also represent a breach in confidentiality with the organisation**.
>
> The survey data, while not representing issues of informed consent, represent a confidentiality issue as these reflect users' opinions of the specific company and service; some positive, some negative. We are currently in the process of enquiring with the case company whether we could get permission to openly publish these data, but this cannot be guaranteed as **such open publication was not agreed on with the case company prior to data collection**. On the contrary, **the case deliverable (D3.2) was to be confidential for the purpose of maintaining such confidentiality**.
>
> **Given these issues, we have decided against publishing the anonymized interview transcripts.**
>
> (Ethics Input, p. 3, emphases added, CME)

While not explicitly stated here – a particular problem with small-scale interviews within a company or community whose members thus know each other well is that even if comments, etc. are anonymized or pseudonymized, informants and/or other members of the organization or community can often discern who might have (likely) made a specific set of comments, etc. In this way, publication of even anonymized material can all too easily threaten to violate promised confidentiality and anonymity.

This is a very common problem in this sort of research – and, for better and for worse, most frequently leads to the judgment enunciated here, namely, <u>not</u> to publish such materials.

Similar comments hold for **Case 2** (Ethics Input, p. 4) as well as for **Cases 7** and **8** (Emergency management system and Decision support system – Ethics Input, pp. 20-21). All three cases again raise the potential risk of publicly accessible information, even if anonymized, allowing for tracing back to PII and/or specific individuals. In **Cases 7** and **8**, while "short anonymous participant quotes" will be used to illustrate summary findings in publication – "Due to confidentiality in the cases, as discussed for **Case 1**, the interview transcripts will not be published as open research data" (Ethics Input, p. 20). As well, both informed consent and data storage procedures are, as in Case 1, exemplary.   Finally, these cases received NSD ethics approval (Ethics Input, p. 21).

Likewise, the penultimate activity – **Roadmapping work –sharing economy D4.2, D4.4** (Ethics Input, 26F.) – encounters a similar problem.

The activity entails semi-structured interviews with representatives from three different stakeholders (service owners, "researchers with competency in sharing economy services, and policy maker representatives from interest organizations and public sector bodies" (Ethics Input, 26).

The researchers plan to "publish summary findings, illustrated with short anonymous participant quotes," i.e. in keeping with the informed consent document and procedures approved by NSD.

At the same time, however, the researchers acknowledge the ethical problems opened up by making some of the data openly / publicly available:

> However, due to confidentiality aspects in the service owner interviews, **the interview transcripts will not be made available as open research data**. This in spite that we in HUMANE aim to make research data openly available. This because though the interviewed individuals are not identifiable in the anonymised transcribed interviews, neither through direct or indirect person identifiable data, **the organizations in which the interviewees work may possibly be identified**. (Ethics Input, 26)

On the other hand, the last activity – **Roadmapping work – Citizen Participation (D4.2, D4.4)** (Ethics Input, 28-29) – provides a good illustration of how to avoid the ethical pitfalls of research in relatively small groups or communities.

The project methodology is worth noting here: following an initial online survey offered through a mailing list ("from those attending a UK-based event, with approval from the event organizer"), the first results were summarized and circulated to the whole list; participants were then asked if they would like to participate in a second survey round.

During the course of the survey, "No personal information was collected." At the same time, the project description recognizes the problem of recognition of individuals within a small organization or community: against this, "no benefit would be gained, nor would there be a guarantee of identifying a given participant" (Ethics Input, 28).

As well, participants had to acknowledge an informed consent form, and the project was approved by NSD.

The remaining cases are as follows.

Case 3 – eVACUATE (year 1) (Ethics Input, pp. 5f.)

Case 3 raised issues similar to those in Case 1 and 2 – namely, what to do with potentially sensitive interview data.   The risks to the participants are sharpened here, however, because the project entails using direct quotations – even if anonymized in such a way that they are not immediately traceable to a specific person.

The case responsible person further recognize that as members of a relatively small group, informants could be able to trace back specific quotes to a given individual. They offer two mitigating points in response:

> 1) They argue that the risk here is low, "since the potential gain from identifying individuals would be minimal"; and

> 2) "…we shared pseudonymised versions of the transcript with participants, once again outlining potential publication of isolated quotations, and the intention of making the transcripts available as part of open research data. Participants were therefore given an additional opportunity to request withdrawal or further obfuscation of identity." (Ethics Input, 5)

This second step is especially critical – and is in keeping with the approach towards gradations of informed consent that are endorsed in the AoIR guidelines.[2] In this case, offering the informants the opportunity to agree to or prevent the use of their comments in publication meets the standard ethical requirements.

Case 3 is further exemplary in its handling of personal data:

> Focus group participants were approached as part of an opportunity sample known to the researchers (colleagues). So no contact details beyond normal office operations were requested or stored.

> As outlined above (Sections (b) and (c)), focus groups were recorded and transcribed; transcriptions were done by a trusted University approved supplier operating under standard confidentiality terms; transcriptions were pseudonymised by the researchers, and re-circulated as outlined in (b)(ii) above.

> Transcriptions were held on a secure University facility behind a firewall, accessible only internally by researchers. Pseudonymised transcripts will be shared as disclosed to participants as open research data.

> The original recordings and transcripts were destroyed once the pseudonymised transcripts had been approved by participants. (Ethics Input, p. 6)

Not surprisingly, in my view, Case 3 received not only umbrella NSD approval, but also approval from the University of Southampton, Faculty of Physical Science and Engineering: ERGO reference: FPSE/23350 and FPSE/23351 (see HUMANE D3-3, p. 75).

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[2] See also Patricia Lawson (2004), "Blurring the Boundaries: Ethical Considerations for Online Research Using Synchronous CMC Forums," in *Readings in Virtual Research Ethics: Issues and Controversies*, E. Buchanan (ed.), Hershey: Idea Group, pp. 80–100.

Similar comments hold for **Case 3 – eVACUATE (YEAR 2)** (see Ethics Input, pp. 9-16).

Case 4 – REVEAL presents itself as ethically unproblematic. On first reading, however, this was not immediately clear to me. On the contrary, since the project included a focus group discussion resulting in the publication of anonymous participant quotes – in my mind, the project evoked the possibility of encountering the same issues discussed above regarding Cases 1 and 2, i.e., possible risks of sensitive or personal information thereby becoming known to other involved.

A review of the project report in D3.3 (pp. 104-112), however, helped counter these concerns. First of all, there seems to be no particularly sensitive information involved in the participant responses; secondly, the report notes that "The online survey received ethics approval from Athens Technology Center" (D3.3, p. 104).

[**Case 5** was not continued into this second year.]

Case 6 - Zooniverse

This project is likewise ethically unproblematic. It involved semi-structured interviews with only two participants, with interview data to be anonymized, "used at aggregate level and only within the consortium" (Ethics Input, p. 19).

Wikipedia simulation modelling (D3.4)

This activity provides an interesting example of ethically legitimate use of publicly available data – while it also raises a critical ethical issue that must be kept in mind for current and future research projects.

On the one hand, the project entails the use of information about "the chosen nick-name of people who contribute to Wikipedia, or IP addresses of anonymous contributions" – which could, as is further noted, "be used to trace contributions to an individual."

At the same time, however, several counter-points are posited:

> this information is already available in the public domain, viewable to anybody visiting a Wikipedia article or using the Wikipedia data sets made available to the public via Wikidata: https://www.wikidata.org/.

> [and]

> Users have deliberately put data online publicly. We do not expose information that is not already in the public domain. (Ethics Input, p. 22)

Moreover, what amounts to informed consent is

> Already collected by Wikipedia in their terms and conditions for using their services: https://wikimediafoundation.org/wiki/Terms_of_Use

And, just for good measure:

> All content is available under a free public domain licence: https://creativecommons.org/publicdomain/zero/1.0/ (*ibid*)

On balance – as indicated by the (umbrella) approval of the NSD, this seems reasonable and sufficient.

But I do have one ethical point of information here – for future projects at least.

On the one hand: the HUMANE project partners are all located in Scandinavia and Europe, and so protected by the GDPR of the European Union.

On the other hand, the privacy policy of the Wikimedia Foundation makes explicit their U.S. provenance:

> If you decide to use Wikimedia Sites, whether from inside or outside of the U.S., you consent to the collection, transfer, storage, processing, disclosure, and other uses of your information in the U.S. as described in this Privacy Policy. You also consent to the transfer of your information by us from the U.S. to other countries, which may have different or less stringent data protection laws than your country, in connection with providing services to you.
>
> <https://wikimediafoundation.org/wiki/Privacy_policy#introduction>

As is well known, the data / privacy protections in the U.S. are considerably less stringent than those in the EU: in particular, in the *Schrems* case, the European Court of Justice has ruled that previous "privacy shield" arrangements for data transfers between the EU and the U.S. are insufficient for sustaining EU-level data / privacy protections.[3]

In the case of the HUMANE project – again, as the NSD approvals suggest – by accepting the terms of service and the privacy policy of the Wikimedia Foundation, Wikipedia contributors have thereby agreed to a *weaker* set of data & privacy protection conditions than are enforced in the EU and by the NSD. So presumably these same contributors would be even happier with and thus consent to the *stronger* set of conditions in play in Scandinavia and Europe.

In future projects, however, the ethical tables may be turned, and so explicit attention would need to be paid to these important differences between US and EU law and regulations.

Roadmapping work – cross-domain + eHealth (Ethics Input, 24-25)

This project rightly states that "there are no particular ethical aspects regarding the conducted surveys, as they were completely anonymous" (Ethics Input, 24). Recognizing that research in eHealth can often be ethically fraught, the project authors further point out that

> Regarding the focus groups for eHealth roadmap, only a summary of these were presented in D4.3, without any individual references. In addition, there were no other commitments or future engagements of participants. (*ibid*).

I concur with the project authors' account of their approach as ethically unproblematic.

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[3] See, e.g., <http://www.infolawgroup.com/2016/05/articles/gdpr/gdpr-getting-ready-for-the-new-eu-general-data-protection-regulation/>

Summary comments,

On balance, the HUMANE project has carefully and conscientiously met the ethical obligations required for specific cases and activities – both as initially presented to and approved by the NSD, and as taken up in dialogue with the ethics advisor in both years 1 and 2.

In particular, as discussed above, both individual project directors and the HPC have provided exemplary analyses and responses to the late-stage ethical issues evoked by the requirements of the EC Open Research Data Pilot.

At the same time, especially these more recent experiences and analyses suggest the following important lessons and suggestions for future research projects.

Suggestions for future research

1. Careful attention to the global nature of internet-facilitated research.

As we saw above (**Wikipedia simulation modelling (D3.4)**), while the contrasts between US and EU approaches to data privacy protection did not result in an ethical challenge – such contrasts are deep, in flux, and certainly offer every potential for ethical difficulties in multi-national and globally focused projects such as HUMANE. This means, in practice, that scrupulous attention must be given to the specific provenance and affiliated legal conditions of a given research object or resource – in this case, Wikipedia – vis-à-vis those of the research partners (as almost always located in the EU).

2. Changing legal and regulatory conditions.

Relatedly, it should also be kept in mind that even if researchers and their partners have demonstrated due diligence in attending to relevant national laws and regulations, the Terms of Service (ToS) and other legal dimensions of a given research object or source – these can change, sometimes dramatically, over the course of a research project.

For example, Twitter has recently announced that it will revise its ToS so as to substantially reduce privacy protections (see <https://www.eff.org/deeplinks/2017/05/new-twitter-policy-abandons-longstanding-privacy-pledge>). Especially as initial research designs may depend on taking into account the "ethical settings" – i.e., the requirements and affiliated assumptions and expectations concerning privacy as a primary ethical driver in research ethics – if these should shift significantly in mid-stream, there may be tremendous repercussions for the project.

In this case, if researchers were looking into Twitter users in some way, they would originally depend on Twitter's privacy policy to shape their own research and design – including, e.g., an informed consent process that depended on the Twitter ToS as guidelines and reinforcement. Such a change as this in the ToS would, on the one hand, likely loosen the requirements on researchers to likewise protect privacy via anonymity and confidentiality promised to informants at the outset of a project. At the same time, however, this change would do nothing to alter the informants' original expectations and the delineations and processes of privacy protection they would have agreed to in the beginning stages of the project.

The upshot would be the clear need to revisit and, if necessary, revise the research and ethics design of such a project – perhaps including a renewed round of seeking informed consent, with a revised form, pending renewed approval by the relevant oversight bodies (e.g., NSD), and so on.

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3. Greater preliminary ethical assessment?

Again, while all has gone well with HUMANE in terms of research ethics – it may be that the development of the ethical aspects of such projects would be still further improved by distributing the sorts of questions we raised only towards the end of the project at the beginning of the project as well. In addition to the ethical questions researchers will be familiar with at the beginning stages of a project – these questions raise issues that more often arise in the publication or dissemination phase of the project, i.e., questions that researchers may be less likely to ask during the beginning stages.