CANDID
Checking Assumptions aND promoting responsibility In smart Development projects

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1. Introduction

This deliverable contains the first communication package aimed at the CANDID 'extended peer review community'[1]. Its aim is to carry out an extended dialogue between Social Sciences and humanities (SSH) scholars and ICT-LEIT communities that can provide multi-directional *checks on assumptions* operative in main ICT-LEIT[2] agendas. That is, being CANDID an SSH project, it proposes that SSH scholars possess certain key insights and qualifications that could be used to question, critique, articulate and improve on, themes, topics and beliefs whose validity is taken for granted within the ICT-LEIT fields. Since the project is intended to contribute to ICT H2020 programme, it also provides the opportunity for ICT-LEIT practitioners to answer back to SSH scholars, thus providing a mutual check.

Such 'checking of assumptions' focus particularly on the role of the public/s in the design, deployment and consumption of 'smart' technologies, and is concentrated around three thematic areas, or modules as described in the DoA: (*a*) user configurations, (*b*) risks, rights and engineering, and (*c*) sensing infrastructures. The dialogue with peer reviewers will be followed up and supported by discourse analytical work, describing and analysing the ways in which a discourse on 'smart' becomes embedded within and across the three thematic modules. The purpose of such critical dialogue is to reach a ore in-depth and comprehensive understandings of the problems underlying and informing main policy programmes and agendas, hopefully also to contribute to better public policies and innovation practices.

[1] FUNTOWICZ, S. O. & RAVETZ, J. R. 1993. The Emergence of Post-Normal Science. *In:* VON SCHOMBERG, R. (ed.) *Science, Politics and Morality: Scientific Uncertainty and Decision Making.* Dordrecht: Springer Netherlands.

[2] See ICT-Leadership in Enabling and Industrial Technologies (LEIT) Work Programme under H2020.

1.1 Exploring sensor technology through interdisciplinary work

The sentient and analytical capacities of smart infrastructures and their relationship with the people who consume, operate, and design them represent a complex topic, which is investigated by experts from a variety of scientific fields. Each group pays attention and develops methods to study a portion of the world to produce advancement in practice or understanding. Theories, methods and tools make scientists see clearly some aspects of what they are investigating. However, by focusing on some aspects they miss other aspects or the entire picture.

Talking to experts from other disciplines and performing some interdisciplinary work can improve one's knowledge and creativity. By *interdisciplinary work* we mean people from different academic disciplines—or epistemic communities—who come together to work on the same project. Interdisciplinary work is a process, not an assumption or a starting point.[3] It requires the creation of physical material and theoretical ideas to gather around and some shared working definitions of the issues, problems and options available. It also demands people to engage in respectful forms of dialogue, recognise plurality of opinions and ideas, be able to embrace critical thinking and mutual learning.

Interdisciplinarity is also one of the ways to implement Responsible Research and Innovation (RRI). RRI implies that all involved societal actors (researchers, citizens, policy makers, business, third sector organisations, etc.) work together during the whole research and innovation process in order to better align the research objectives, priorities and its outcomes with the values, needs and expectations of society.

1.2 CANDID mutual-checking procedure

The aim of CANDID is precisely to develop instruments to enable interdisciplinary work in the field of smart technologies and systems, and facilitate the collaboration between different epistemic communities such as those working in Social and Human Sciences (SHS) and those working on Information and Communication Technologies (ICT). To achieve this goal, the project relies on analysis of discourses and representations of different smart technologies. Module Three explores the realm of sensor technology and sensing infrastructures used in smart city project or in crisis and disaster management.

1.3 Sensing infrastructures

The inclusion of **sensors** into systems such as geographical regions, cities, organisations, people's bodies, create systems with the ability to learn and react to changes happening in the physical environment in which they operate. Sensors are devices that transform physical elements, such as light, heat, motion, moisture, pressure, into electronic signals which can be read or processed by a human or artificial observer such an actuator or a warning system. The increasing interconnection between sensors and the systems they are embedded into have created sentient or **sensing infrastructures**. These infrastructures transform the way the urban space is designed, conceived and experienced by individuals.

[3] ROMMETVEIT, K., DIJK, N., GUNNARSDOTTÍR, K., O'RIORDAN, K., GUTWIRTH, S., STRAND, R. & WYNNE, B. 2017. Working responsibly across boundaries? Some practical and theoretical lessons. *In:* VON SCHOMBERG, R. (ed.) *Handbook of Responsible Innovation.* Edward Elgar Publishing Ltd.

Sensing infrastructures have the ability to record, encode and analyse physical attributes, that is their *sensations,* by means of connected sensors, big data and the participation of citizens as codifiers or interpreters of this new source of information. They are developed for addressing different challenges and used in a variety of contexts. RFID sensors are used in the retail and apparel sector to monitor goods along the global supply chain. Biometric is used to identify travellers while they move from one country to another one. Facial recognition software is increasingly used to transform CCTV systems into smart system which can identify suspects and trigger alarms when they detect anomalous behaviour. These technologies have been applied in airports, at borders and to secure war-zones and for anticipating and preventing 'anti-social' and criminal behaviour.

The wide reliance on risk-management perspectives has also promoted the adoption of sensors and sensing infrastructures in other areas such as disaster and emergency management. Information coming from mobile phones, social media, weather radars, earthquake monitoring and seismic systems, and alike are merged and analysed to anticipate disasters and communicate with the population. A similar logic is applied in the case of sensing infrastructures within smart city projects. In that context, sensors are used to monitors several aspect of city such as pollution, noise, traffic, energy consumption, use of public transport and alike. With all their connected devices—smartphones, tablet, laptops, smart meters, wearables—even citizens send signals as they were sensors and contribute to feed information into the sensing infrastructure.

1.4 Controversies around sensing infrastructures

Scholars in Social Science and Humanities (SSH) have explored controversies around sensing infrastructures, and have identified alternative visions of smart and their implications and have paid attention to critical aspects related to the design and deployment of these technologies. By reviewing previous studies on smart cities and sensor technology, we have identified three fundamental areas of concern.

The first area explores the effects that the information gathered through sensors may have on people's perception and level of awareness of certain problems and issues.

Sensing infrastructures produce streams of detailed data that contribute to create new perceptions and understanding of the world around us and of ourselves. We may say that they create new 'regimes of perceptibility' in the sense that, through computational operations and data visualizations, sensing infrastructures contribute to create understandings, practices and perceptions that influence people's decisions and behaviour in a particular way. These operations contribute to raise awareness and appraise phenomena such as pollution or energy and act upon them; in the case of disaster management, sensing infrastructures determine acceptable and critical risk levels and trigger policy and collective actions. Yet, sensing is not neutral and may also produce unintended effects. In some cases, it may contribute to reduce complex issues because non-quantifiable aspects of reality, those aspects that cannot be "sensorized", may be left aside and ignored.

The second area concerns the opportunities offered by sensing infrastructures to empower citizens.

Increasingly, policy makers and planning authorities are emphasizing that smart cities need smart citizens to function and be really efficient. Sensing infrastructures and decision-support tools are conceived to facilitate the involvement of citizens and as a means to empower them by giving them more information, more choices, and better services. People who are part of a variety of bottom-up, advocacy-led, DIY-hacker-oriented initiatives use their skills to open up the technology, experiment with it, and participate in public debates over the state of the environment by gathering data on pollution levels or toxic substances and experiment with alternative technological paths. These approaches oppose top-down governance models of smart technology and advocate for the need to increase public participation and create grassroots smart projects.

Finally, the third area of concern pays attention to the ethical and practical implications embedded with the development of machine learning computer programs to analyse the large amount of information gathered by sensors. Each area is presented in further detail below.

Sensing infrastructures gather data through sensors and analyse information in real time by means of technology known as big data. Big data and big data analytics help make sense of data generated by sensors. However, the algorithms which run on these systems and make them 'intelligent' and 'smart' can replicate discriminatory practices, contain mistakes and inaccurate data, and can be based on faulty assumptions about signs of anomalous or abnormal behaviour. The more systems are automated, the more we need to ask questions about who should pay for errors made by autonomous machines.

2. Exploring controversies around sensing infrastructures: online consultations

Since CANDID is meant to explore ways to foster interdisciplinary work between SSH and ICT peers by helping them checking mutual epistemological assumptions, the project foresees different consultation phases and methods. In the first round of consultations, an online form was designed and used to reach ICT and SSH peers working on sensor technology all over the world.

A paper-based copy of the online form, which has been developed by UOC team members, is included in the appendix. In this section, we summarise information on the organisation of this round of consultations.

The first round of consultations of Module Three was carried out between the 10th of April and the 10th of May 2017. A total of 104 invitations were sent to peers via email, followed by 59 reminders. Personalised invitations, with information on study goal and structure, required contribution and benefits, and project's data protection policy, were sent to peers. The invitation also contained a link to an online form with further information and questions. Peers were identified on the basis of their competences and professional experience. A list of ICT and SSH experts working in areas related to sensor technology, sensing infrastructures, sensor networks, environmental pollution, smart cities, and crisis and disaster management, were identified.

Peers working in many different geographical locations were invited to participate in the consultation (47% Europe; 37% UK; 9% USA; 7% rest of the world). The majority of peers were ICT experts (73%) and the minority were SSH experts (28%). 73% of invited peers work in private or public universities, 13% work in public or private research centres, 9% work in private firms, 3% in non-profit entities and 3% in local governments. 77% of invited peers were males, and only 23% females.

Of the 104 peers invited to contribute to the study, 25 experts finally participated in the consultation by filling in the online form. As a result, response rate was 24%. 80% of respondents are ICT peers (n=19) working on sensor technology, sensor networks, internet-of-things. The reimaging 20% (n = 5) are SSH peers working in areas related to environmental issues such as air pollution and disaster management. The large majority of peers work in universities and public research centres (80%), while the remaining 16% of peers work in private firms or in the non-profit sector (4%). Peers from all over the world participated in the consultation. More specifically, 52% work in the EU (i.e. France, Germany, Greece, Italy, Nederland, Portugal, Spain), 32% work in the United Kingdom, and 16% work in the United States, Canada or New Zealand. 76% of peers contributing to the consultation are males, while 24% are females. Finally, most peers wanted their contribution to be publicly acknowledged and have their name appear in the acknowledgement section on the official project website.

3. Next steps

Written evidences collected in the first round of consultation will be analysed by CANDID team members and results published in academic publications. A preliminary analysis of the data already gathered is also informing the design of the second phase of consultation, which, in the case of Module Three, will be carried out by means of face-to-face interviews. The aim of the interview will be to obtain a more in-depth understanding of the epistemological assumptions, set of values and barriers to collaboration that may prevent the exchange of knowledge and the cooperation between SSH and ICT peers. In September 2017, a joint meeting with external ICT and SSH peers and CANDID team members working on all three modules will be held to facilitate the exchange of impressions between all three modules and the further investigation of assumptions, infra-concepts, and representations of smart between different epistemic networks.

APPENDIX

CANDID

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Welcome to CANDID

The CANDID project partners would like to invite you to join an extended peer community of experts and stakeholders working on--or taking decisions related to--smart technologies and systems. We would like you to share your knowledge, concerns, doubts and experience with CANDID partners and other experts and stakeholders in order to identify critical aspects that need to be discussed at the time of developing smart technologies and systems.

For more information on CANDID project and its data protection policy, please visit the following page: http://www.uib.no/sites/w3.uib.no/files/attachments/privacy_policy.pdf

Please read the information presented in each section and write your thoughts in the space provided. There is no right or wrong answer. We are just interested in knowing your opinions based on your experience and knowledge.

- Answering to all questions would take approximately 5-10 minutes depending on the length of your answers.
- You may skip any questions you do not wish to answer. If you do not wish to complete the form just close your browser.
- The answers you give are anonymous. Any identifiable information you may include in your answers will be deleted.
- An opt-in option to have your effort acknowledged and your name included on the acknowledgement page on the official CANDID project website is provided at the end of the form.

To receive a copy of your answers and join the extended peer community, please insert a valid email address in the box below.

☐ I have read and understood the terms of the study, I certify that I am 18 years old or older and, by submitting the form I indicate my willingness to take part in the study.

Sensing Infrastructures

The inclusion of sensors into systems, such as geographical regions, cities, organisations, creates sensing infrastructures that have the ability to learn and react to changes happening in the physical environment in which they operate. Sensors are devices that transform physical elements, such as light, heat, motion, moisture, pressure, into electronic signals that can be read, or processed, by a human or artificial observer such an actuator or a warning system.

Sensing infrastructures transform the way the urban space is designed, conceived and experienced by individuals. Sensing infrastructures have the ability to record, encode and analyse physical attributes—that is, their sensations—by means of connected sensors, big data and the participation of citizens as codifiers or interpreters of this new source of information.

They are developed for addressing different challenges in a variety of different contexts.

In the field of disaster and emergency management, information coming from mobile phones, social media, weather radars, seismic monitoring systems, and alike, are merged and analysed to anticipate disasters and communicate with the population.

Within smart city projects, sensing infrastructures are used to monitor several aspects of city life, from air pollution to traffic congestion or energy consumption. With all their connected devices—smartphones, tablet, laptops, smart meters, wearables—even citizens send signals as if they were sensors and contribute to feed information into sensing infrastructures.

There are several examples of sensing infrastructures to solve a variety of problems. For instance, in the case of disaster management, Rotterdam's flood control strategy (http://www.rotterdamclimateinitiative.nl/) or the population warning system Notico Safe (http://notico.com/pro/notico-safe/?lang=en) are potential examples. In the context of smart city project, the Barcelona's sensor and actuator platform Sentilo (http://connecta.bcn.cat/connecta-catalog-web/) or the SmartCitizen project (https://smartcitizen.me/) and the H2020 CAPTOR project (https://www.captor-project.eu/?lang=en) stand out as relevant examples.

Do you know other interesting projects that you would like to share with us?

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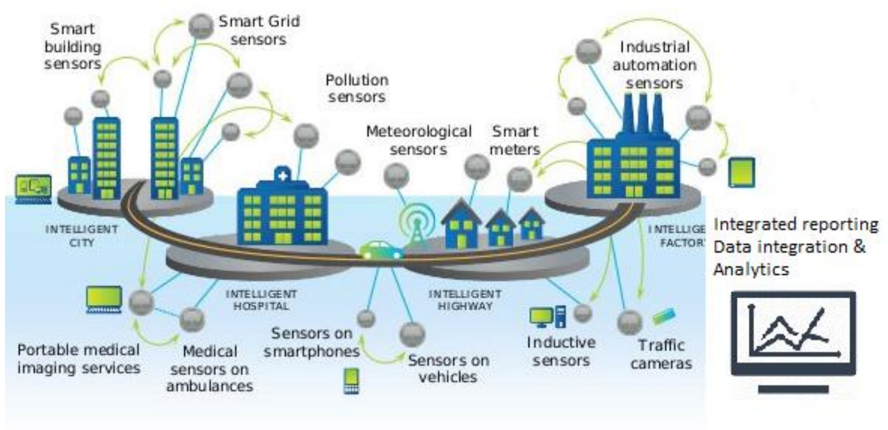
Sensing infrastructures in the smart city



Controversies around sensing infrastructures

Exploring the controversies around sensing infrastructures, scholars in Social Sciences and Humanities (SSH) have identified alternative visions of smart and their implications and have paid attention to critical aspects that we would like to discuss with you. A few of the questions inspiring current research in SSH are listed below. Please read each question and share your thoughts and impressions with CANDID team members and your peers.

In your opinion, what are the fundamental risks, open issues and major benefits of relying on sensors and sensing infrastructures?

…

Which group of users (e.g. citizens, policy makers, private firms, scientists, etc.) do you think can benefit most from - or face negative consequences from - the deployment of sensors and sensing infrastructures?

…

Issue ONE - Awareness

Sensing infrastructures produce streams of detailed data that contribute to create a new perception and understanding of the world around us. In a sense, they create new ‘regimes of perceptibility’. In other words, through computational operations and data visualization, sensing infrastructures contribute to create understandings, practices and perceptions that influence people’s decisions and behaviour in particular ways. These operations contribute to raise awareness and appraise phenomena such as pollution or energy and act upon them. In the case of disaster management, sensing infrastructures may have an influence in determining acceptable and critical risk levels and in triggering policy and collective actions. However, what the system is designed to measure is not neutral and may produce unintended or unforeseen effects on decision-making. In some cases, it may contribute to produce a reductionist vision of complex problems since non-quantifiable aspects of reality—those aspects that cannot be “sensorized”—might be left aside and ignored. Based on these considerations, we would like to invite you to reflect on the following topics.

In what sense sensing infrastructures might be challenging the way we perceive, understand and tackle certain problems and issues? Please provide some examples.

…

Do you think the pervasive implementation of sensing infrastructures could create misleading perceptions of certain issues among users? Please provide some examples.

…

Issue TWO – Citizens' empowerment and participation

Increasingly, policy makers and planning authorities are emphasizing that smart cities need smart citizens to function and be efficient. Sensing infrastructures and decision-support tools are conceived to empower citizens by giving them more information, more choices, and better services. However, it remains unclear how citizens should intervene to transform sensing infrastructures into smart projects. For instance, a variety of bottom-up, advocacy-led, DIY-hacker-oriented initiatives suggest opening up the technology, experimenting with it, and generating and consuming their own data. These approaches oppose top-down governance models of smart technology and advocate for the need to increase public participation, create grassroots smart projects and explore alternative technological paths.

What role do you think citizens should play in relation to these sensing infrastructures and overall speaking in smart city projects?

…

In what sense do you think sensing infrastructures might enable or rather disable citizens' participation and collective responses to public issues? Any example to share?

…

Issue THREE – Intelligent and autonomous machines

Sensing infrastructures are part of smart systems that rely on big data analytics to make sense of data and trigger automatic responses and alarms. Analytics converts sensing infrastructures into intelligent systems, that is, systems that are expected to improve, or optimize, decisions and performance. However, automated decision-making may bring unexpected risks such as relying on inaccurate or outdated data. Algorithms can unintentionally contribute to reproduce discriminatory practices and their operational logic can proceed from faulty assumptions. It seems that the more systems are automated, the more we need to ask questions about who should be made accountable for potential mistakes and ethically controversial decisions taken by the same system.

In which cases do you think autonomous machines can provide fairer solutions or rather reproduce prejudices and moral assumptions that generate ethically controversial decisions? Why?

…

Who should be responsible for checking the accuracy and appropriateness of the decisions made by autonomous systems?

…

Any other comment?

…

THANK YOU!

Thank you for sharing your experience and opinions with us. If you wish to join the CANDID extended peer community and have your name on the CANDID official webpage acknowledgement page please provide information in the space below.

Name (title, name, surname, post, institution - if you want it to appear in the acknowledgement)

Please provide some keywords to describe your expertise
