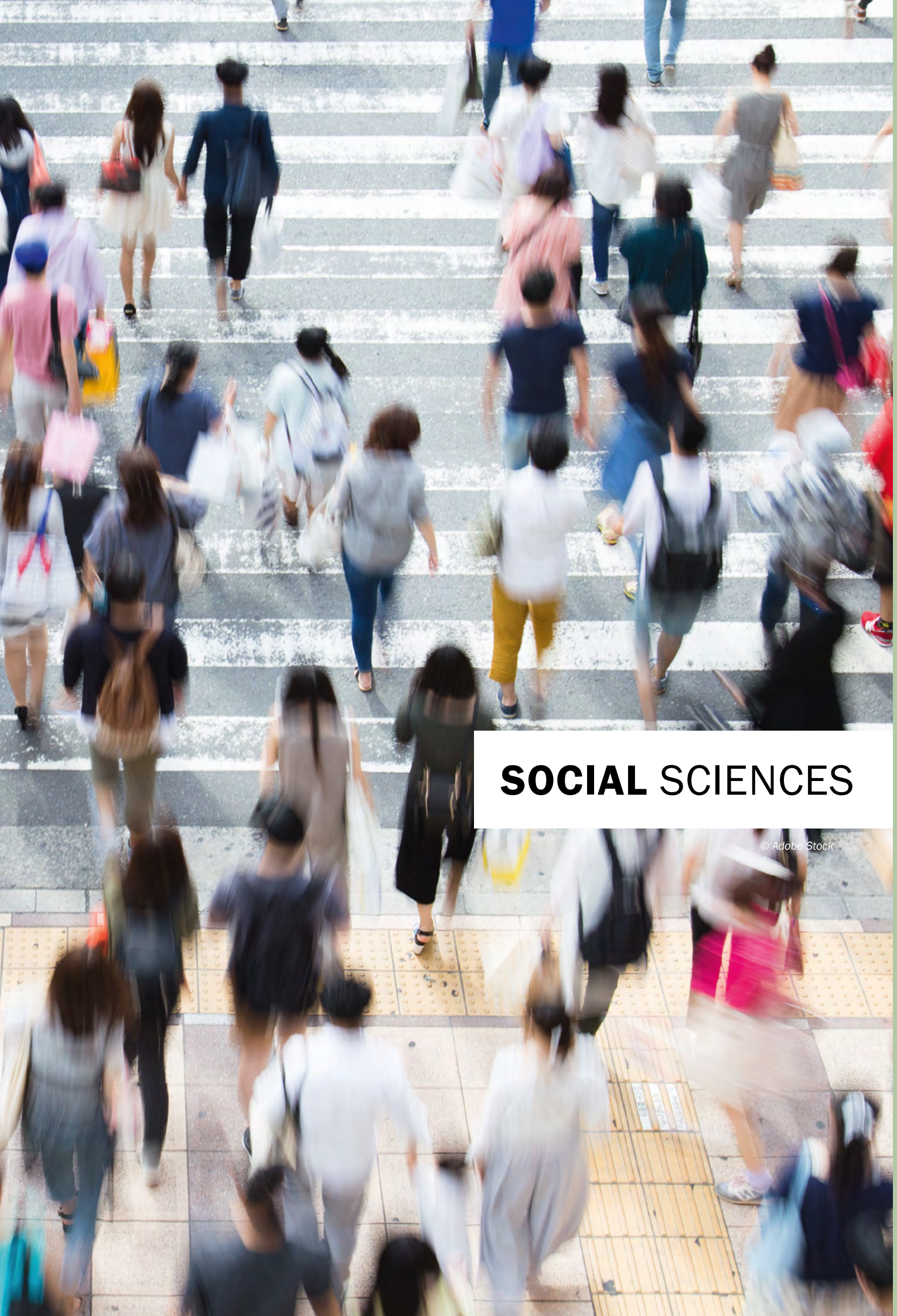

SOCIAL SCIENCES

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Towards an interdisciplinary research in social sciences dedicated to the space sector

Feedback on the partnership with research laboratories in Social Sciences (SS), introduced by a reflection on innovation at CNES, enriched by a better understanding of the contribution of space activities in societal challenges and evolving towards the creation of an incubator for interdisciplinary studies.

ORIGIN

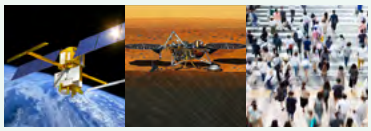
In 2008, a reflection involving partners from social sciences was launched at the request of CNES President, concerning the stakes of innovation. This reflection led to the creation of a unifying research programme conducted in partnership with French laboratories. The aim was to address space activities' contribution to the major contemporary problems of society, focusing on the conditions of this contribution, particularly on the dialogue with public decision-makers, the identification of areas of cooperation and the modalities of co-construction with emerging players. This programme, entitled "Espace Innovation Société" (Space Innovation Society) was in itself a methodological innovation in view of the small proportion of social sciences work on space activities. The questioning expressed was structured around 3 themes: the functioning of the French space agency and the stimulation of its innovativeness; the analysis of the conditions of contribution of space services and applications to the problems of society; the dynamics of interaction and co-construction with an innovative ecosystem.

TANGIBLE RESULTS

Each one of these themes was explored to provide answers to the initial questioning, the researchers below have largely contributed in close collaboration with CNES engineers:

- *Mathias Béjean, researcher at the Research Institute of Management in Paris-Créteil University, investigated possible organisational developments on exploratory studies. This work led to the formalisation of a methodology that enriched the process of conducting these studies.*
- *Sylvain Lenfle, researcher at the Centre of Research in Management at the Polytechnic School. His work shows how identifying all the actors of the ecosystem (citizens, national agencies, politics, scientists) and taking their needs into account very early in the designing process (including the designing of the instrument) increases the value of space data.*
- *Arnaud Saint Martin, researcher in sociology at the Printemps laboratory at Saint Quentin University, takes part in the construction of a sociology of space activities. He began his work with an investigation on the International Charter 'Space and Major Disasters', then he analysed the Copernicus programme to pursue with the study of the transformation of the space sector and of the role distribution between public and private actors.*
- *Flore Guiffault, PhD student in sociology, focuses on the tools creating a risk-based governance in Haiti. The purpose is to oversee the flow of information, from the production of raw data (satellite images, seismic data, etc.) to products that are used for risk management activities, through an ethnographic study.*
- *Francis Château Raynaud leads the GSPR Pragmatic and Reflexive Sociology Group in EHESS School of Advanced Studies in the Social Sciences, his field surveys allow to get as close as possible to the users and thus enhance our understanding of the consequences of the use of data in context.*

Further work will be based on these researchers' results but others took part in the reflection of the programme, such as Isabelle Sourbès-Verger, a researcher at CNRS, the French National Centre for Scientific Research intervening at the A. Koyré Centre.



PROSPECTS

The year 2016 has been dedicated to the outcome of the programme and allowed to highlight 2 main evolutions:

- *Expand the field of action to other disciplines of Social Sciences:*
  This work began with new partners, among which the geographers of the Passage Laboratory in Bordeaux University (studying the citizen movement of participatory mapping), the sociology of politics with the Universities of Paris Nanterre and Picardie Jules Verne (History of the Franco-Russian cooperation regarding the careers of those who lived it) and an economic thesis (macroeconomic indicators of business sectors operating space infrastructures). A dialogue with other initiatives undertook before by CNES will complete this work. These initiatives deal with legal, economic and managerial matters (Sirius chair led by Toulouse Business School and Capitol 1 University in partnership with Thales Alenia Space, Airbus Defence and Space and CNES) as well as ethics.
- *Encourage the emergence of interdisciplinary studies:*
  The experience showed the importance of creating meeting places for researches from very different background, combining soft and hard sciences (Physics, Geology, Biology, Engineering). This space would take the form of an incubator for interdisciplinary studies that would provide the conditions for collaboration. The incubator, which is currently in gestation itself, will be based on the group of researchers from the initial programme. Indeed, the quality and durability of the relation between these researchers and CNES engineers already involved are crucial: they moved beyond the stage of learning the other's language and are now grasping the problematics of each one. Together, they are fuelling a reflection that is materialising through actions in their own field.

Fig. 1: Céline Calleya

Fig. 2: Cove of Saint-Marcel in Saint-Martin, the Caribbean, seen by Pléiades before (February 2017) and after (September 2017) the passage of hurricane Irma. Pléiades *© CNES 2017, distribution Airbus Defence and Space*

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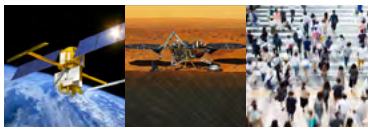
Floating in space? On the strangeness of exploratory projects

The context in which this research takes place is of particular significance for our argument. Indeed, the space industry constitutes an archetype of the rational approach of project management. Most of the current tools of contemporary project management come from the U.S. aerospace sector, be it military (the Department of Defence) or civilian (National Aeronautics and Space Administration, or NASA, see Lenfle *et al.* (2010) [3]. This gave birth to a model of project management that emphasises the control of project execution through a phased approach; the use of managerial tools to control time, cost, risk, and quality; and the setting up of strong project structures to implement this approach. This method of project management is still dominant in the space industry today.

The strengths and weaknesses of the rational project management approach are well documented in the literature. The great strength of this type of approach is the application of process control techniques developed for production to the designing work. Such processes have been shown to improve control of the convergence toward the predefined goal in terms of cost, quality, and delay. For complex, high-cost space projects there probably is no alternative to the rational project management approach. But problems arise when this approach is blindly applied to all kinds of projects. In particular, Sehti *et al.* (2008) [5] demonstrate the irrelevance of this process in situations where radical innovations are being made. Indeed, this "rational" view of project management does not fit with the logic of radical innovation that is characterised by divergence, discovery and unforeseeable uncertainty Loch *et al.* (2006) [4]. Sehti *et al.* (2008) [5] thus show that stage-gate processes lead to what they call "project inflexibility"—that is, the inability to change the project's goal after initiation. This, they argue, leads ultimately to failure.

At CNES, the problem appeared with the emergence of "strange" projects in the domain of space telecommunications at the end of the 1990s. Our interest in space telecommunication was triggered by a presentation of the head of the navigation and telecommunication projects during a one-day workshop on innovation management. He explained that in the telecommunications sector, CNES was increasingly encountering what he calls "strange projects." In order to illustrate his idea, he presented a slide with Hieronymus Bosch's famous painting *The Garden of Earthly Delights* (see Fig. 1). He used the unexpected and confronting nature of the elements in the painting as a metaphor for his perception of a mismatch between the "strange projects" and the phased approaches that typify project management at CNES. Indeed, the projects he supervised looked nothing like those defined in classical project management frameworks: the goals were not clear at the beginning, the projects worked on new concepts and not necessarily with objects, it was hard to define deadlines and they were frequently changing.

In theoretical terms he was confronted to exploratory projects for which one can neither make the assumption that the goal of the project is clearly defined beforehand, nor that the knowledge base is sufficient [2]. Compared with the dominant model of project management, exploratory projects look strange because there are ambiguous goals and no requirements, the



projects work on new concepts and not necessarily on objects (for example on "flexible payload" for telecommunication satellites), it is hard to define deadlines, and the risks are unknown. In other words, they seem to be "floating." Our purpose in this paper has been to study the management of these "strange" exploratory projects within the context of the space industry. In so doing, we have made 3 contributions:

- First, the case studies provide rich material on how exploratory projects unfold, their management and the problems encountered by the actors. It underlines the need to differentiate management processes according to the nature of the projects, standard or exploratory;
- Second, we demonstrate that exploratory projects are not at all floating. They may appear so, if they are viewed through the rational model. But we show that, on the contrary, these projects are carefully managed, and they actually obey a logic of their own. At a conceptual level, they correspond to the experimental learning process proposed by Loch *et al.* (2006) [4] in which goals and the means to reach them are progressively identified over the course of the project. Design theory helps us clarify the "expansive" logic of these projects, which are exploring both new concepts and new knowledge. We are thus able to characterise how they unfold (double expansion in concept and knowledge), specify their results (EQM, prototypes, new design models, new knowledge), and identify promising criteria (saturation and expandability) for their evaluation.
- Third, we demonstrate that exploratory projects constitute a powerful tool for structuring the potentially very fuzzy processes of exploration for 3 reasons:
  - they are oriented toward goals;
  - they help pace exploration, they provide opportunities for sense making;
  - and they foster coordination between different disciplines that, otherwise, would remain scattered throughout an organisation.

We believe that what is at stake here is important for the evolution of project management research and practice. Indeed, we have to reconsider the concept of the project itself that, for too long, has been equated with the rational model. This perspective has hindered our ability to think about other types of project logic. As a result, project managers of exploratory projects have considered themselves the "dunce" as their supervisors talk of "strange" projects. Given the role of innovation in today's competitive environment, it is all the more important to formalise and circulate a relevant model of exploratory project management.

Fig. 1: Bosch's *The Garden of Earthly Delights* (around 1503–1504, Prado Museum).

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Geospatial information for disaster management: processes and challenges in Haiti after 2010

While geo-information is a useful tool to manage disasters, it is likely that, in time of crisis, some territories lose their ability to make and use information. Though, a crisis can be an opportunity to access certain devices usually out of reach. In a case study on Haiti after the 2010 earthquake, we explore the consequences of crisis on local data producers. Our results suggest that the earthquake has led to economic, technical and legal challenges for information making and sharing.

Disasters are becoming more and more recurrent because of the global warming but mainly because it is used as a category to govern all kinds of events. Once an event is labelled as a disaster, it allows the mobilisation of different tools to frame a response. Geospatial information is one of these tools. It has been used to characterise a disaster: its nature, its location, its power. It has been used to evaluate its impacts: the number of people, buildings, roads, trees, etc. being affected. And it has been used to organise the action of first aid: to communicate, to get around, to assure safety [1].

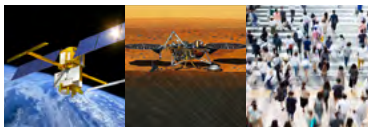
Geospatial information however is not available everywhere at the same level. While some territories are information-rich, characterised by a wide production, dissemination and an easy access to information, others are just not [2]. In a case of a disaster, it might as well happen that the information available on a territory is destroyed by the very disaster and/or that the ability of the inhabitants to produce information is reduced. In those cases, the activity of producing geospatial information is carried on by external actors.

In the case of the 2010 earthquake in Haiti, the cartography of the country, including the capital Port-au-Prince, was incomplete and difficult to access from abroad. Besides, a dozen of the top national experts on cartography perished in the destruction of the national center for geospatial information (CNIGS). In response to the great destruction that affected the country, many actors started mapping activities and geospatial information became one of the main response fields. In addition to the usual humanitarian mapping activities, a group of international online volunteers launched the first crisis participative cartography campaign of that magnitude [3, 4].

However, besides the massive mobilisation of many actors to provide geospatial information and several years later, Haiti still lacks some of the basic data needed to build disaster management policies. So why does Haiti still present similarities with information-poor environments? And how did the geospatial information produced in the context of the earthquake's response affect the mid-term and long term national production of geospatial information?

Those issues have been addressed through from 2 interdisciplinary studies – mainly in law, political sciences, sociology and geography – which examine different, albeit interrelated, aspects of geospatial data use for disaster management (DM) in Haiti. Whereas the first study is concerned with ongoing practices and challenges surrounding data use for risk reduction activities, the second focuses on these processes in the context of response and recovery efforts. In this way, the researchers were able to compare and analyse their respective data to get a combined overview of developments around data sharing in all phases of the DM cycle.

Primary data was collected through semi-structured interviews, field (participatory) observations, project meetings and informal discussions with relevant stakeholders within Haiti and abroad. Study one interviewed 46 individuals between the dates of July 2015 to June 2017. Study 2 interviewed



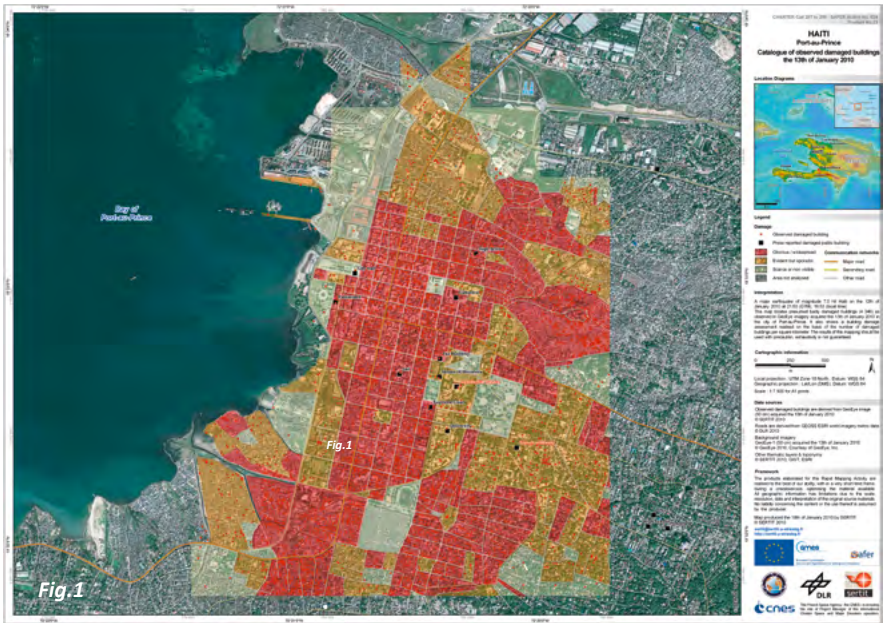


Fig. 1: Cartography of presumed damaged buildings made by SERTIT from satellite imagery © *SERTIT*

Fig. 2: Participative cartography made by Ushahidi volunteers based on information they collected on social networks and by SMS they received © *Ushahidi*

16 individuals between the dates of October 2016 and June 2017. Some interviews were recorded digitally and others were conducted through note taking (by hand or computer) as participants did not feel comfortable being recorded. Secondary data sources included an extensive review of official reports, government texts, media outputs, and prior research on the technical and operational humanitarian-based undertakings by stakeholders at different levels in Haiti prior to and after the 2010 earthquake.

Overall, the article finds that the increasing recognition, use and value of data for disaster management activities since the earthquake is contributing to a number of interrelated economic, technical and legal processes and challenges for data sharing among stakeholders in the country.

Economic findings are primarily centred around the impact which donor funding, project based work and the incursion of "new market" actors is having on data sharing. In this environment data retention has largely become the norm, which has led to the duplication of datasets, quality concerns and informal networks for data sharing at the local level.

These issues feed into technical findings, where the increasing number of actors and projects working with data leads to quality control issues. Here, data producers and users within the country are becoming increasingly hesitant to use and/or release data which has not been internally generated and/or validated. Furthermore, the methods and modes for data exchange have expanded alongside the development of spatial data infrastructure such as web portals. But the expansion also creates some confusion among respondents and hesitance in terms of the relevance and reliability of available data, and where to find it.

Lastly, the legal findings indicate there is an ongoing uncertainty around data licensing, regarding which types of data can be shared and with whom. Importantly, open data is increasingly underlying all of these processes and challenges, albeit not always in the ways in which it was intended for.

As environmental disasters are a growing issue, this study has contributed in understanding the impacts and challenges of an international geospatial cooperation. Some issues deserve further researches such as the CEOS recovery observatory launched after hurricane Matthew stroke Haiti in October 2016.

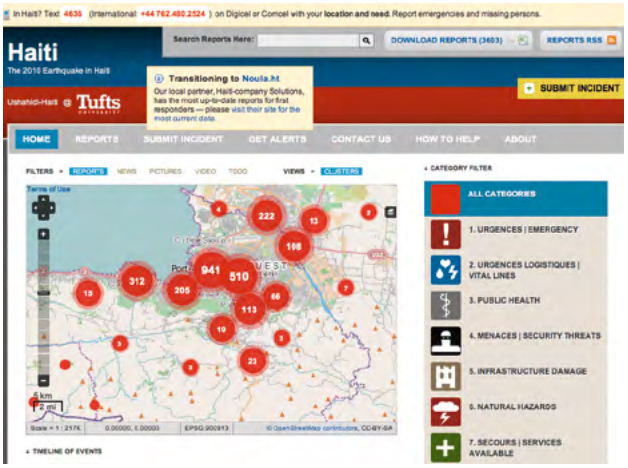


Fig.2

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