A new approach to structured processing of feedback for discovering and investigating interconnections, cascading events and disaster chains

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ABSTRACT

Post-disaster information processing is relevant for the continuous improvement of operations and the reduction of risks. The current methodologies for post-disaster review suffer from several limitations, which reduce their use as a way of translating narrative in data for qualitative and quantitative analysis.

Learning or effective knowledge sharing need a common formalism and method. Ontologies are the reference tool for structuring information in a "coded" data structure.

Using the investigation of disaster management during the 2017 hurricane season in the French West Indies within the scope of the ANR "APRIL" project, this contribution introduces a methodology and a tool for providing a graphical representation of experiences for post-disaster review and lessons learning, based on a novel approach to case-based ontology development.

Keywords

Knowledge management, multiperspectivity, lessons learning, crisis management.

INTRODUCTION

Subject matter and study goals

After an emergency, each entity involved in crisis management may provide hot and cold feedback. Major crises may produce incidents and emergencies involving scenarios not always foreseen in crisis management plans. When this sort of "unframed" crisis management (Lagadec, 2008) occurs, post-crisis review and feedback are particularly valuable for optimising crisis management plans and procedures. Recounting and investigating the organisational scenario and the most influential events of a natural disaster as complex as that generated by the sequence of three hurricanes that hit the French West Indies between 5 and 19 September 2017 is a major challenge. It involves processing dense and closely interconnected information. A common flaw of feedback is the lack of integration of different perspectives on the same event. While a comprehensive post-disaster review requires narratives and witness statements alongside quantitative and geospatial data, the integration and analysis of all these data sources can be complex. New approaches (Harris and Li, 2011) and tools, as well as new uses of available tools (Brian Thoroman and Salmon, 2020) are thus desirable.

This work draws on an example of the ANR APRIL[1] project's results to present the specifications and use of a method under development at BRGM,[2] the "queryable category-based feedback knowledge graph" (ExG), which aims to improve the capitalisation of experiences. This used individual feedback sources to build an overall representation of occurrences, i.e. a model of real observed or lived events, when hurricanes Irma, José and Maria hit the French West Indies in 2017. Using the prototypal implementation of this method, the project established a comprehensive, multiperspective post-disaster review of the crisis, by pooling individual feedback sources into an overall frameset.

Literature review and theoretical framework

Covering the full workflow from the collection to the capitalisation of experience feedback on a practical and conceptual level requires a stack of tools for data production, processing, analysis and visualisation. The ExG method implemented by means of a set of prototypal tools within the scope of APRIL project was designed to produce and manage this workflow.

Existing tools implement different techniques for extracting structured text from narratives or unstructured text fragments. MAXQDA.[3], MonkeyLearn[4] and Atlas.ti,[5] are some example of solutions embedding AI to help tag, analyse and visualise results, including analysis of feelings. Another approach rely on adapting and customising pre-trained language models to the specific corpus at hand. CorText[6] is an advanced solution of this type usually used for bibliometrics applications. Even if these tools may boost and shorten the effort and time needed to construct the ExG database, they do not allow the semantic data processing and knowledge engineering required for our case study.

The knowledge management of experience feedback archives is currently performed by very different approaches, depending on the context, domain and objective(s) of the feedback collection. The ontology-based knowledge base may help deal with this issue (De Nicola et al., 2021). Looking for a solution rooted in this approach introduces the question of how to define the ontology of reference (Liu et al., 2013; Osman et al., 2021). To put this simply, the question is how to systematically adapt or transform the heterogeneous amount of information from retrospective experiences, consisting of narratives and other types of data, into structured datasets that are searchable and exploitable by computer aided methods, including machine learning technologies.

Building a "crisis metamodel" may represent the first step in creating a dedicated "crisis ontology" able to support reasoning mechanisms (Bénaben et al., 2008). These form the basis for the deduction of collaborative processes (Benaben et al. 2020). The objective is to provide an appropriate approach for context-agnostic crisis modelling, embedding reasoning mechanisms able to infer the relevant collaborative process among crucial actors and the critical paths of events and decisions involved in crisis management (Chehade et al. 2020). The ultimate goal is improving and adapting operational plans to typical "emergent behaviours" and groups (Quarantelli, 1995).

Other well-known tools for retrospective analysis and modelling of accidents occurring in complex sociotechnical systems are the AcciMap (Lintern, 2020), the HFACS (Shappell and Wiegmann, 2000), the STAMP (Levenson, 2004) or the FRAM (Hollnagel, 2012), and subsequent versions (e.g. Kaptan et al. 2021). These can be also used for feedback review and the retrospective analysis of natural and natural hazard triggered technological (Na-Tech) disasters (Hollnagel and Fujita, 2013) to formulate recommendations on safety improvements.

The ExG data collection and management method is complementary to these tools. In particular, its most innovative element is the approach to define a reference ontology for the conceptualisation and analysis of experiences.

Research objectives and design

The ExG aims to be a theoretical and operational framework for enabling the retrospective modelling of complex sociotechnical systems, to improve resilience. This work in progress describes the theoretical underpinnings and development of the ExG, and its prototypal application to accomplish the ambitious objectives of the ANR APRIL project: the analysis of the emergency response feedback collected two years after the hurricane season that struck the French West Indies in 2017. Different retrospective interviews of actors and decision-makers, about the two weeks of crisis and its aftermath, were aggregated. As they occupied different roles and hierarchical positions in

[1] Optimize anticipation and decision-making in extreme crisis situations to maintain the resilience of society.

[2] The French Geological Survey

[3] https://www.maxqda.com/

[4] https://monkeylearn.com/

[5] https://atlasti.com/

[6] https://www.cortext.net/

the various sites affected by the hurricanes, the corpus of interviews represented a multiperspective data source for a comprehensive review of the disaster, structured in a queryable graph.

The application of the method and implementation of the ExG prototype for this case study relied on a synergy of skills in human and social sciences, disaster management, and information and communication technology. The research design consisted of the steps shown in Figure 1.

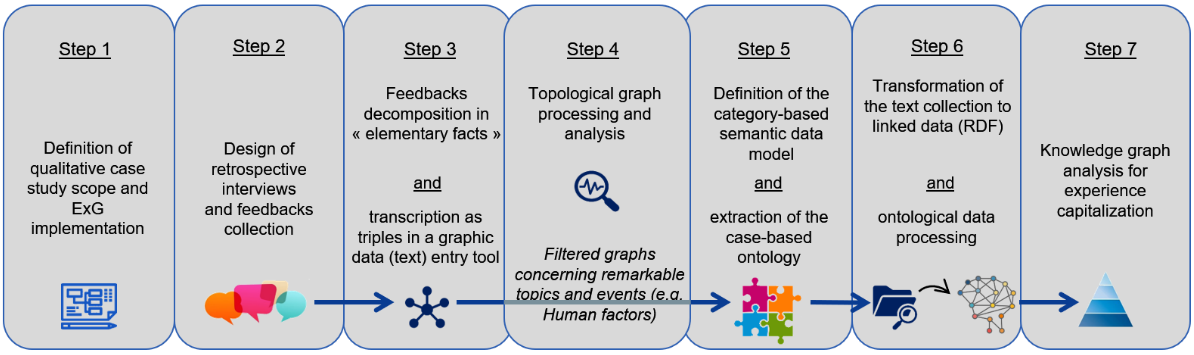

Figure 1. Overview of the research design, highlighting the implementation of ExG method and tool (RDF: resource description framework)

THEORETICAL METHOD AND PROTOTYPAL IMPLEMENTATION

We provide a theoretical description of the ExG method and prototypal implementation as part of the APRIL project. We focus mainly on the technical specifications of steps 3, 5, 6 and 7.

Structure of a graph-inspired syntax for individual feedback aggregation

Once the relevant information contained in the unstructured feedback corpus is identified, it must be translated into data, so that it can be manipulated and analysed in a reproducible way. The ExG method extracts simple sentences from the storytelling for easy processing and visualisation. For sentence segmentation, basic level expressions (Rosch, 1978) are preferred and the word order in sentences must be linear, with no embedding or distance relationships.

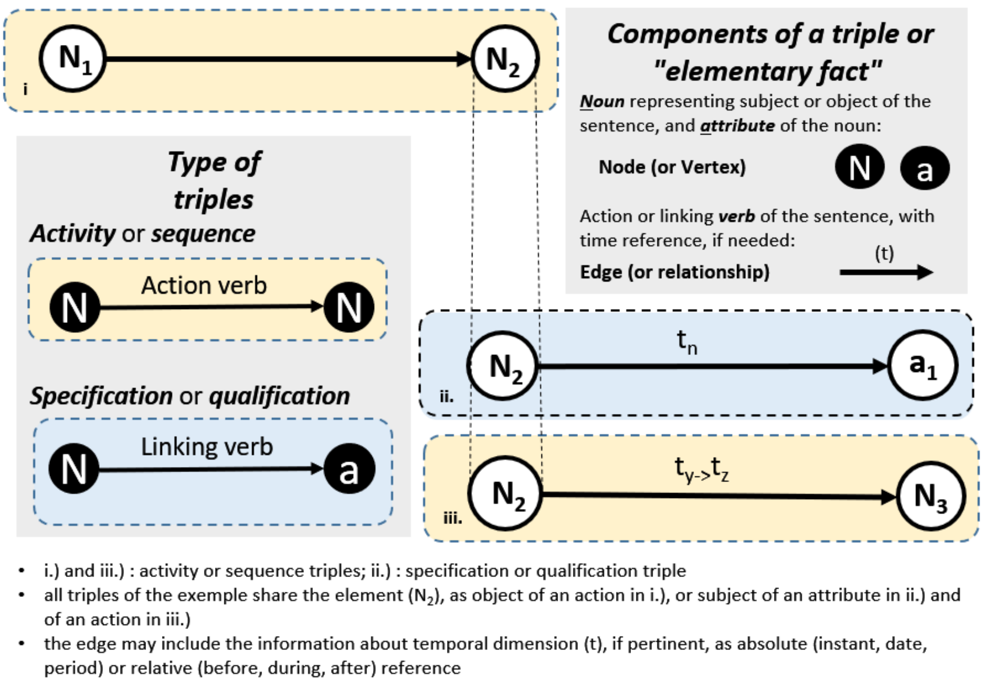

Figure 2. Syntax and usage of simple expressions representing “elementary facts” in ExG, for the structured transcription of a relevant sentence or piece of useful information contained in feedback

The subject and object terms of a sentence represent nodes connected by a verb (edge), or relation (edge), with which they constitute a triple (Figure 2), as in the sentence “The EDF staff (subject) secures (verb) the electricity grid (object)”.

This preliminary data structuring, based on the definition of a common syntax, has proven to be fundamental for the reconstruction of the overall experience, because it makes it possible to connect:

- heterogeneous data (qualitative, quantitative, geospatial, etc.); and
- identical pieces of information formulated using different terms, depending on the stakeholder.

It also facilitates the integration of further data (reports, official records, etc.) to complete the feedback review.

The term graph from each feedback source (the interviews in our case study) shows only the connections explicitly stated by the witness. We define these types of relations as “topological”, since they are the direct links, or “edges”, recognised by the observer among actors, emotions and events as being relevant to them. The individual topological term graph (or “topological graph”) is assumed to capture at least part of the mind map that the witness developed experiencing the crisis, necessarily biased by their role and position, as well as other factors “external” to the events, such as their background and past experiences.

Because of the common syntax, some nodes (e.g. “prévision intensité ouragan”) can refer to facts narrated by several sources, possibly in relation to different subjects, objects or attributes. Different individual topological graphs can be merged into a comprehensive multiperspective network (Liu et al., 2019) of the overall disaster. Although not to be considered a complete representation of everything that occurred, the resulting network contains distinct perspectives of the same events and should represent what really happened more objectively (Fauconnier and Turner, 2002; Smirnov and Levashova, 2019).

It is worth mentioning that at least the individual outputs of this transcription process should be submitted to the feedback author (witness/interviewee/reporter) for validation. They might disagree with some specifications, such as the role of certain players, or clarify certain sequences or actions. The validation of the overall topological graph is more challenging. It should focus on a multiperspective representation of a specific topic or event obtained by filtering and/or exploring the overall topological graph. A focus group of domain experts, who may have been directly involved in the disaster, but not necessarily contributing to the feedback corpus, should discuss and reach a consensus on this new representation. Validation at this stage should also concern the cover the definition of the case-based ontology discussed below.

Under the APRIL project, the ExG prototype tool for the data editing phase (Step 3, Figure 1) used open-source wiki-based “TiddlyWiki”[7] software, considered a valuable personal and collaborative learning tool (Fitzgerald, 2007). Using the plugin TiddlyMap[8] the relevant “elementary facts” were edited at the same time as the individual topological graph, resulting in an interactive network representation of the feedback. The authors also used the search and filtering functions of the software for the analysis of the overall graph (Step 4, Figure 1). They extracted event- or topic-specific graphs by integrating and connecting terms and relations from different individual inquiries, for:

- the validation of the overall interconnections of elementary facts collected in the feedback corpus;
- the definition of the categories inspiring the case-based ontological concepts according to the criteria described below.

Semantic data model criteria and case-based ontology requirements

For a comprehensive understanding and capitalisation of this rich, complex and multiperspective feedback corpus, the overall experience should be represented on a more theoretical level. We should be able to query the elements and relations contained in the overall topological graph of the feedback using more functional and conceptual definitions, and inference processing.

Hence, the pillars of the transformation of facts into conceptual instances, core specification of the ExG method, are:

1. semantic data modelling, for the definition of a case-based hybrid ontology (Debruyne and Meersman, 2012);
2. the ability to translate facts into “universals” (Bittner and Smith, 2004);
3. the production of the semantic network representing the ontological graph of the experience concerned

[7] https://tiddlywiki.com/

[8] http://tiddlymap.org/

by the overall feedback.

The semantic data model is strongly interconnected with the ontology definition strategy. Therefore, both have to be treated and resolved at the same time (Step 5, Figure 1).

Concerning the definition of the ontological concepts, we referred again to the general, basic principles proposed by Rosch (1978) for the formation of categories:

1. The task of category systems is to provide maximum information with the least cognitive effort.
2. The perceived world comes as structured information rather than as arbitrary or unpredictable attributes.

Our novel approach does not rely on an a-priori ontology, based on a literature review and generic theoretical knowledge of crisis management. In agreement with Furtado et al. (1996), our hypothesis is that the definition of ontological concepts should be considered as an objective-oriented, context-dependent process. Here, "concepts" represent perceived regularity among terms recording events or objects, designated by a label (Novak and Canas, 2005). Moreover, concepts should be organised to represent the experience from different perspectives.

This domain-specific ontology should consist of coarse granularity concepts that do not necessarily discriminate between relevant classes on their own. Instead, the combination of these concepts for the classification of a certain term (or short text) may define, by their intersection, an inferred class that represents its best semantic definition, or domain-consistent approximation. This will affect both the design of the semantic data model and the way in which the instances are classified.

The concepts are extrapolated and selected from the overall topological graph during the analytical phase (Step 4, Figure 2). Exploratory filtering in the wiki-based tool aims to discern new concepts and relations. The design of the ExG platform involves the integration of automated (Furth and Baumeister, 2013) and semi-automatic incremental building of ontologies. However, for this case study, the extraction of concepts and vocabulary, as well as the application of the rule set to transform the corpus terms into semantic instances, are performed by recursive wiki and RFD triplestore processing, or via interactive graphical exploration, as in the example discussed below.

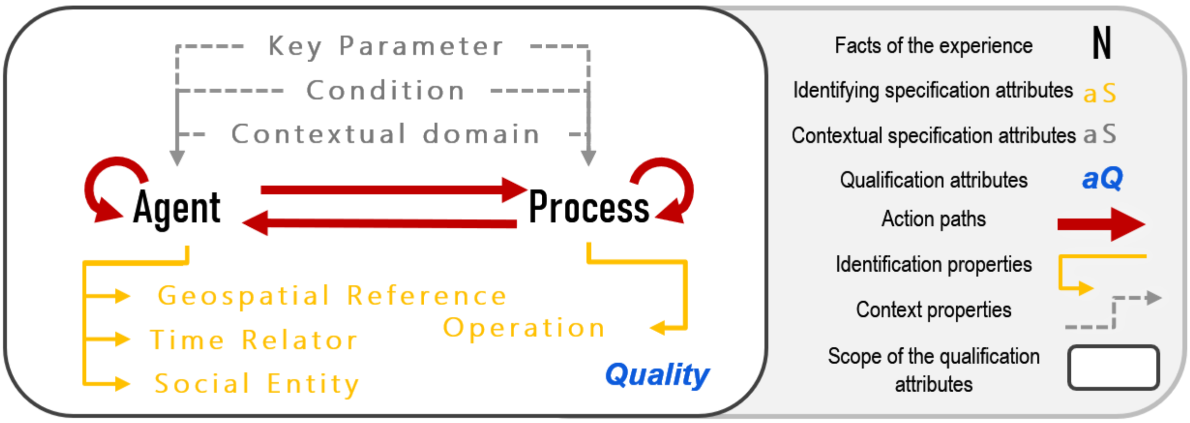

Figure 3. Theoretical representation of the semantic data model designed for the ExG method, chosen for the processing of feedback on the crisis management experience

The semantic data model affects the reasoning capability of the knowledge base (Keet, 2018). The ExG semantic model assumes a structured set of independent concepts and properties capable of describing remarkable processes constituting the experience of actors or "agents", events and attributes, useful for characterising and qualifying their instances for the aspects relevant to the application aim (Figure 3). The reference structure has been described as a "sketch data model" (Barr and Wells, 1995) because it is based on the category-theoretical notion of mixed sketch. In this context, a sketch is defined as a graph with imposed commutativity and other conditions; it is a way of expressing structure.

Using the wiki-based graphical tool embedded in the ExG platform, the domain expert defines (Step 5, Figure 1):

- the semantic data model suitable for the scope of the knowledge base, here a disaster management review;
- the ontology concepts, by analysing the information contained in the topological graphs.

The semantic annotation of nodes and edges

The classification process of any term contained in the overall topological graph includes checking which concepts are relevant and choosing the relevant class for each relevant concept (Step 6, Figure 1). To keep the ontology simple and adaptable to the context associated with a certain instance, the ExG semantic data model requires that each element of the topological graph is classified associating different concepts. Each object must be classified with at least one type of concept depending on its typology ("agent" or "process"), while all the types of attributes are optional concepts.

This workflow (Figure 4), from the graphical editing of elementary facts to the annotation of their terms by a dedicated ontological layer based on the aforementioned criteria results in the conceptual representation of occurrences by "universals" (Bittner and Smith, 2004).

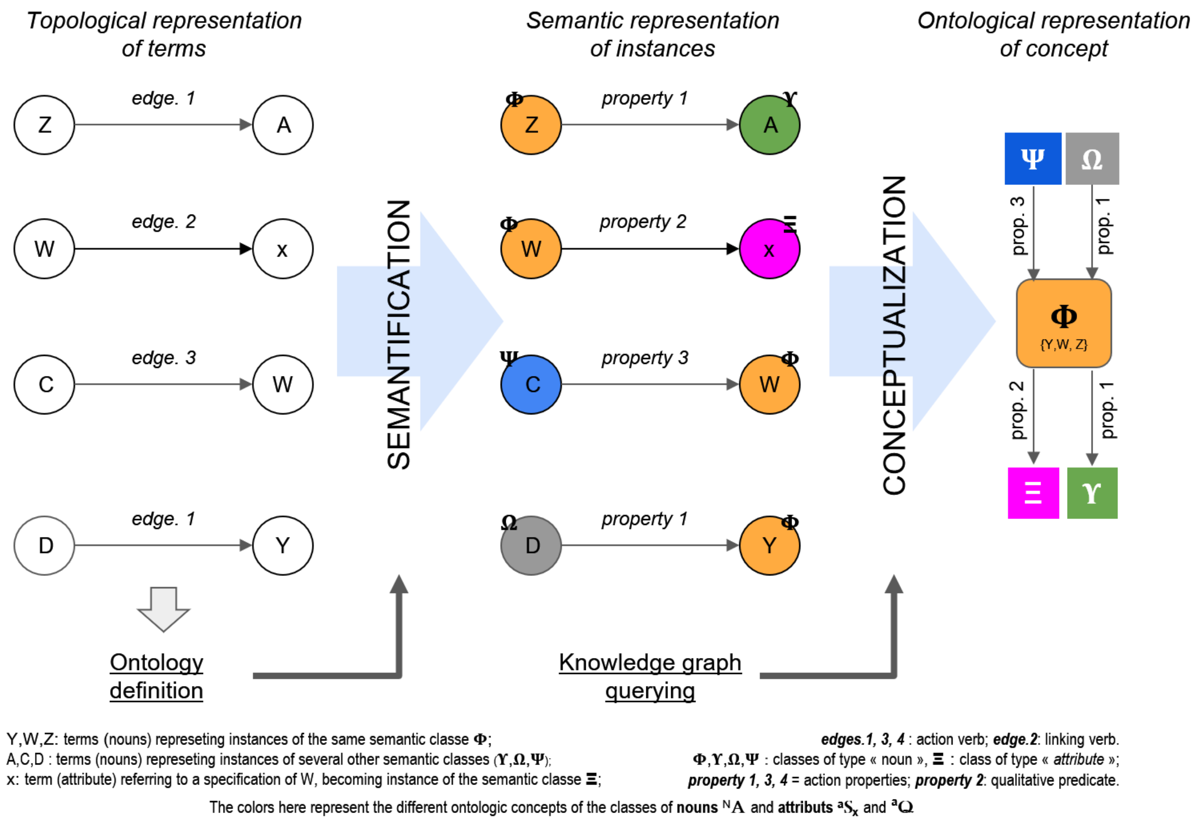

Figure 4: From facts to "theory": the conceptualisation of an experience.

ExG knowledge graph querying and exploitation

This theoretical representation of the experience requires validation. However, beyond checking if the contributors to the feedback corpus are able to recognise and describe the dynamics and general characteristics of their experience, the focus group should be opened to experts from different contexts and similar experiences, to verify if the generalisation is valid for a wider range of circumstances and issues.

We use SPARQL queries to extract specific outputs and to test the consistency of the ontological mapping of input data. At this stage of the workflow, the knowledge management system's inference capabilities can be better exploited to extract original insights less obvious at the case-specific level (Step 7, Figure 2). The goal being to improve disaster management, the conceptual representation of the overall feedback graph for this specific post-disaster review may be analysed considering other hazard types, similar risks and impact scenarios. The outputs may concern critical paths and emergent relationships, alternative scenarios, potential cascade effects, at an abstract level, but still grounded on the facts collected and structured in the topological graphs.

DEMONSTRATION: AN EXAMPLE APPLICATION

Case study data collection

The scope of the APRIL project, the literature on crisis management efficacy and resilience (Lagadec, 2008; Sphere Association, 2018, De Nicola et al., 2021) and ontologies for crisis management available in the literature (Liu et al., 2013; Wienen et al., 2017) fuelled initial discussions about this research (Step 1, Figure 1). The preliminary mind map of the scope of the inquiry was a term graph including the relevant elements connected by a preliminary selection of expected relations (according to expert judgement) (Figure 5).

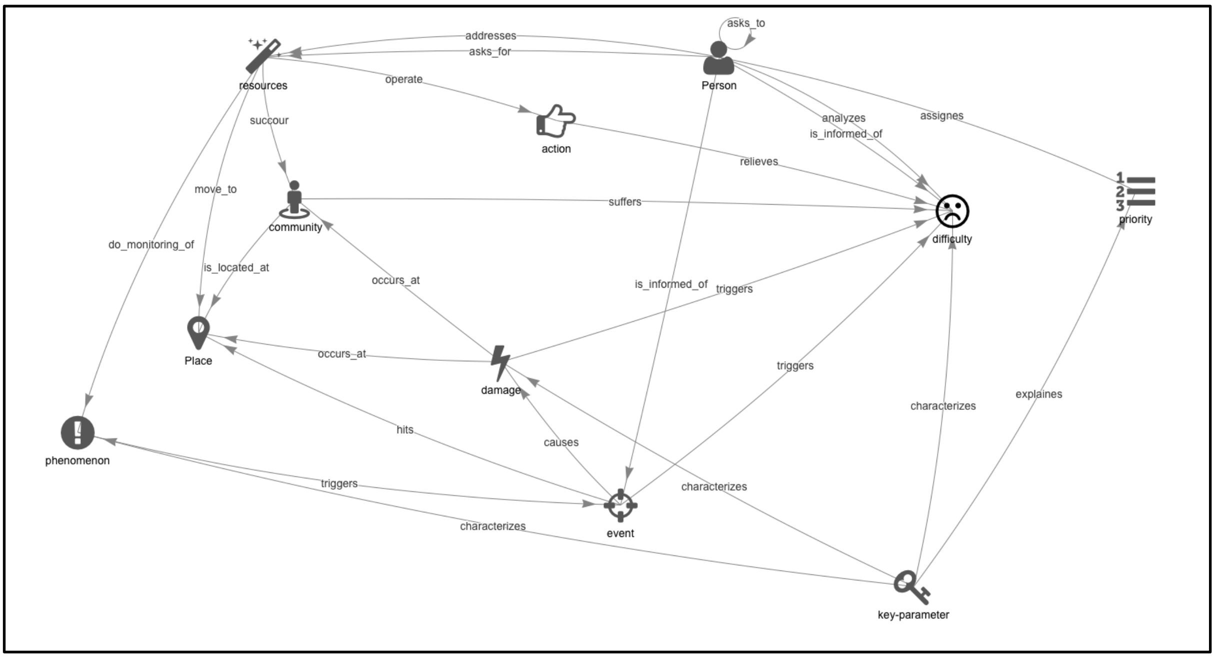

Figure 5. Initial term graph of the arguments and explanatory interactions defining the scope of the APRIL project research. These elements inspired the semi-structured interview framework and the feedback breakdown into "elementary facts" (Steps 2 and 3, Figure 1). Each symbol in the graph is tagged by its meaning.

At this stage, both arguments and interconnections describing the matter of interest are still considered not necessarily comprehensive, meaning it will still be possible to add to them during feedback collection. This early stage of the research workflow does not involve any formal ontologies or data structures.

The research consortium then discussed the design of the retrospective interviews and the selection of witnesses to obtain a comprehensive, reliable feedback corpus. This analysis was carried out by another workgroup, and its details are beyond the scope of this article. However, a list of interviewee roles during the events together with a short summary of the interviews are provided, showing the representativity of the feedback sources.

Forty-six crisis managers operating in different contexts during the 2017 hurricane season are the feedback sources for this major natural disaster. Figure 6 summarises their organisations and roles:

- public (Prefecture, national police force, etc.) and private (DAUPHIN TELECOM,[9] EDF,[10] etc.) services;
- officers at the local (Saint-Martin), departmental (Guadeloupe), zonal (Martinique) and national (CIC[11]) levels in the national crisis management plan;
- various levels of experience in crisis management, i.e. different levels of knowledge and understanding of events (no experience, training, field experience).

Two years after the events, most people having since changed roles and locations, they accepted a semi-structured individual interview to provide a multiperspective reconstruction. The meetings were between 75 and 180 minutes long and followed an adjustable script with open-ended questions, but still consistent with the mind map in Figure 5. The crisis managers were requested to do the following:

- Introduce themselves – their role, tasks, personal and professional experience,
- Share their own experience, focusing mainly on their own perception, instead of the documentary narrative,
- Detail the crisis highlights, as well as the actions carried out before, during and after the passage of each hurricane,
- Specify the sources and types of reference information for their actions and decisions.
- Describe the main difficulties they faced (i.e. domino effects, actions or decisions at different levels).

[9] Telecommunications facility manager for the French West Indies

[10] French energy supplier (electricity and natural gas)

[11] Interministerial Crisis Unit

- Describe their organisational framework for facing that crisis (partners, collaborators and direct contacts),
- Describe their perception of preparedness.
- Give their opinion about a tool for improving major disaster management (i.e. methodological or technical tool, etc.).

As the interviews and the graphical editing of the topological graph progressed, other topics beyond those in the mind map were emphasised by the witnesses, and found to be relevant for this research. These were human factors, such as:

- personal and professional experience, which may have a significant impact on personal crisis management skills, and may affect the decision chain; and
- feelings (i.e. stress, fear, uncertainty and trust), which may explain ineffective decisions or actions, and the biased understanding of positive or negative alternatives.

The significance of these factors and their relationships with other elements influencing the development of the crisis led us to include them in the preliminary mind map. But, even more remarkably, these complementary factors, though missing in the preliminary scope of the research, partly shaped the ontological concepts and influenced the design of the dedicated semantic data model at the analysis stage of the feedback corpus (Steps 4 and 5, Figure 1).

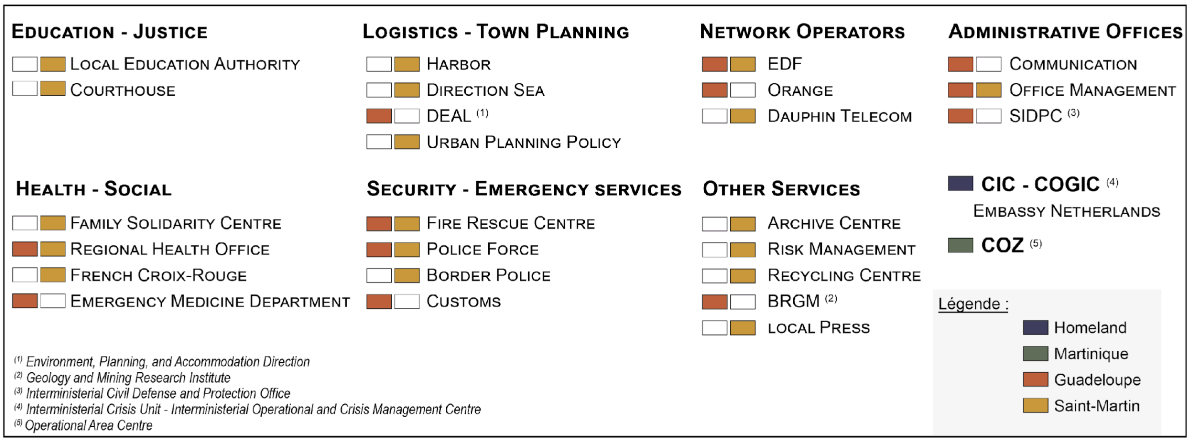

Figure 6. Public and private services represented by the interviewees

The experience feedback processing and topological graph analysis

To breakdown the information collected by the semi-structured interviews into "elementary facts", the components of the initial mind map in Figure 6 complemented by the arguments pointed out during the interviews, were used to recognise the relevant elements cited in the corpus and label the verbs in the triples. Any term (subjects and objects) added to the individual topological graphs was referred to a noun used in the mind map: resource, message, damage, etc. As the interviews were in French, the terms of the mind map were translated and used in this language, to reduce the risk of distorting the original information during processing. The elements were labelled to respect stakeholder feedback, i.e. something considered as a resource by somebody might be referred to as a need by someone else. All the triple elements were edited manually. During the data entry, the researcher was able to verify if any element was already present in the corpus by previous interviews, and reuse the pre-existing node, in case.

The homogeneous collection of individual topological graphs obtained by each interview generated a network of nodes and links providing a graphical representation of the collective experience of the disaster. However, the visualisation of the huge amount of interconnected "elementary facts" as topologically connected terms is useless. Relevant information and critical paths needed to be obtained by different techniques. To extract topic-specific portions of this multiperspective, integrated, but still raw, data collection, we used filtering criteria and interactive gradual exploration of the overall topological graph. In the first case, the result is a semi-automatic graph focused on specifics terms, whereas the manual selections of nodes allows investigate the possible "multi-hop" paths between two elements not directly connected. Using these two techniques for topological graph exploration, we implemented the analyses required for the follow up of the ExG implementation and those concerning real elements of remarkable facts.

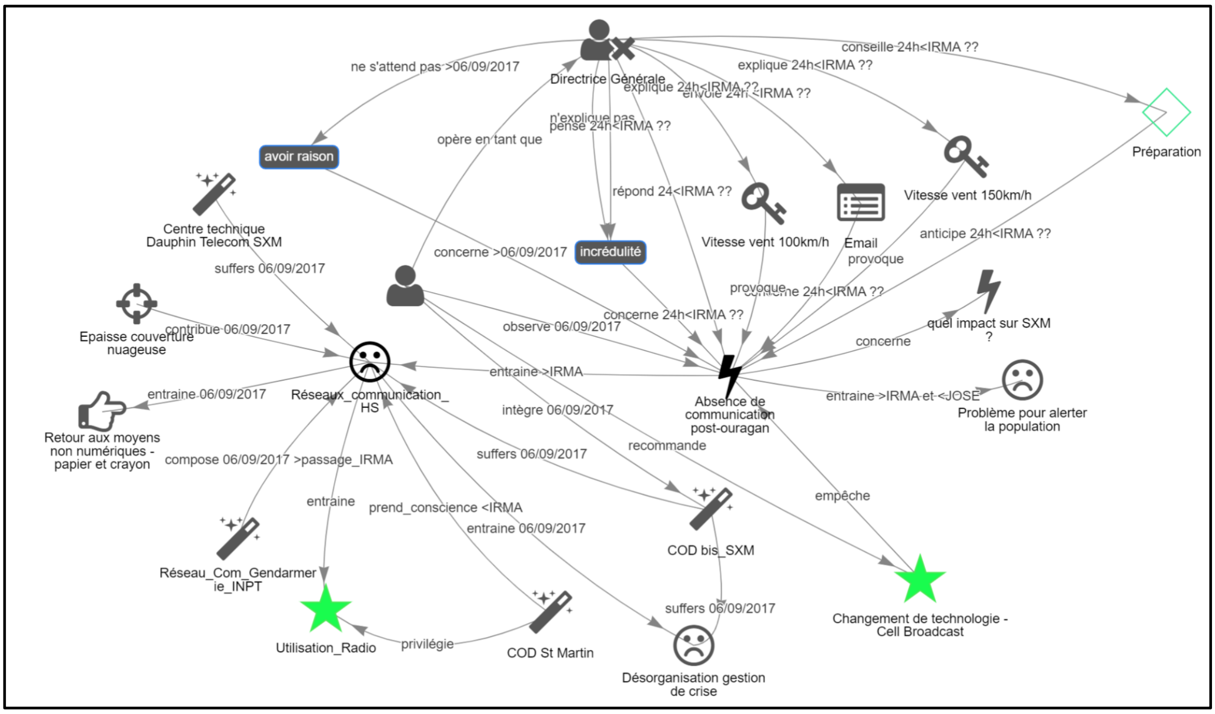

Figure 7. Topological graph based on specific nodes and their direct relations – automatic selection ("réseaux", "communication H.S" and "absence" before, during and after Irma)

Analysis of a topological graph: the "blackout" issue

To show an example of extraction from the overall topological graph of the 2017 hurricane crisis, we analysed the events of energy blackouts and communication breakdown, their precursors and major consequences.

The filtering consisted in selecting a set of labels for aggregating pertinent key nodes ("réseaux" for networks , "communication HS" for communication breakdown, and "absence" for lack –of communication and energy-) and their direct relations, over a specific period (before, during and after Irma) (Figure 7).

Starting from the aforementioned filtered graph, in the second approach we made a new graph saving only those nodes we retained as pertinent to the blackout and communications breakdown review, concerning the preparation phase before Irma struck (Figure 8). We repeated iteratively the filtering and the selection until refreshing the connected nodes did not upload any new items considered "relevant" to the question.

The resulting topological graph shows a message given by the director of the communication facilities manager (DAUPHIN TELECOM) about the possibility of a communications blackout, which other stakeholders disbelieved ("incrédulité"). This finding highlights a gap in the risk analysis of the entities responsible for the safety plan and disaster management.

This new graph shows an isolated cluster of facts concerning the energy facility manager suggesting the lack of critical communication before the Irma's strike. EDF, who did not attend COD meetings at that time, overlooked a crucial piece of information to the main coordination centre. It concerned a scenario of major disruption to the power service due to the hurricane, and the plan for an early deployment of a rehabilitation taskforce ("pré-positionnement renfort" in the Figure 8; the text in these last two figures is in French, as resulting from the transcription in the original language of the information.) for the electricity grid and the global communications networks at St. Barth and St. Martin.

If confirmed, the detection of this lack of information transfer is a critical issue for the effective hurricane preparedness and mitigation. Unfortunately, due to the challenges of the pandemic after February 2020, and the other research priorities of the consortium, the facts emerging from this analysis could not be validated with the contributors of the feedback corpus.

However, we investigated this particular circumstance in the knowledge graph, to verify whether other types of relationships that bridge the gap among notable actors of this crisis, emerged by semantic inference.

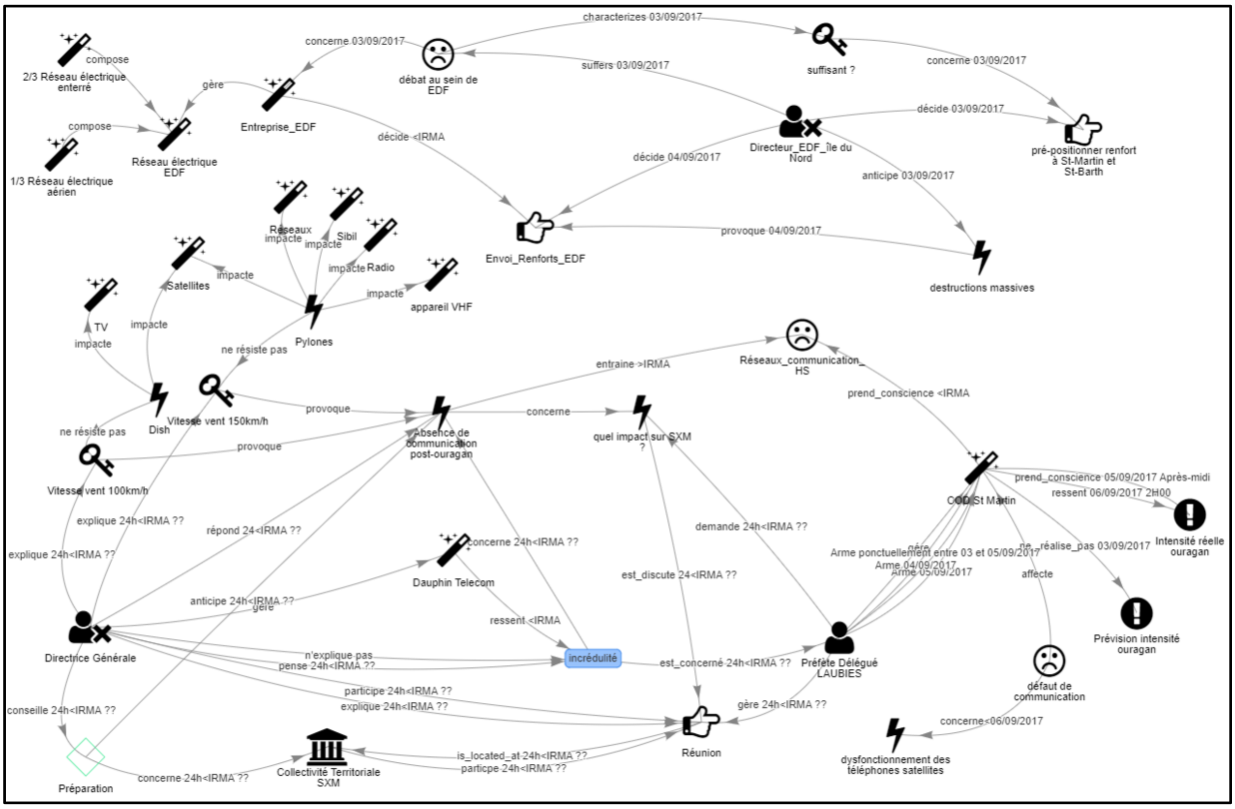

Figure 8. Topological graph based on specific nodes and their direct relations – interactive selection ("réseaux", "communication H.S" and "absence" before Irma)

Semantification and exploitation of the ontological mapping of the experience

After this analysis of the raw dataset, the authors defined the specifications of the semantic data model for the semantic description of the facts included in the overall topological graph. Complying with the principles outlined in the previous sections, the ontology of ExG for the APRIL project ensures the full coverage of the relations and entities analysed in Step 4, by means of 10 concepts, 2 for nouns and 8 for attributes. The concepts of reference or "types of concept" are (Figure 9):

- (Agent)Resource
- (Process)Event
- Condition
- Social entity
- Geographical reference
- Time reference (or Relator)
- Contextual Domaine
- Operation
- Key parameter
- Quality

A detailed description of each concept is beyond the scope of this work in progress. However, the annotations on Figure 9 show the Agent and Process concept classes, the types of concepts for the attributes, and explain that they are separated into "identity specific" and "context specific". According to the semantic data model of Figure 3, the combination of these types of attributes, other than their possible qualification, distinguishes between all the objects defined as agents and all the types of events retained as relevant to the case study.

Analysis of the experience knowledge graph: from facts to theory

To finalise this study case, the ExG prototype will be enriched with different SPARQL queries meeting the APRIL research objectives. For this work, we developed a semantic graph request to render a conceptual representation of the facts and information discussed in the analysis of the topological graphs shown above (Figure 4 and 5).

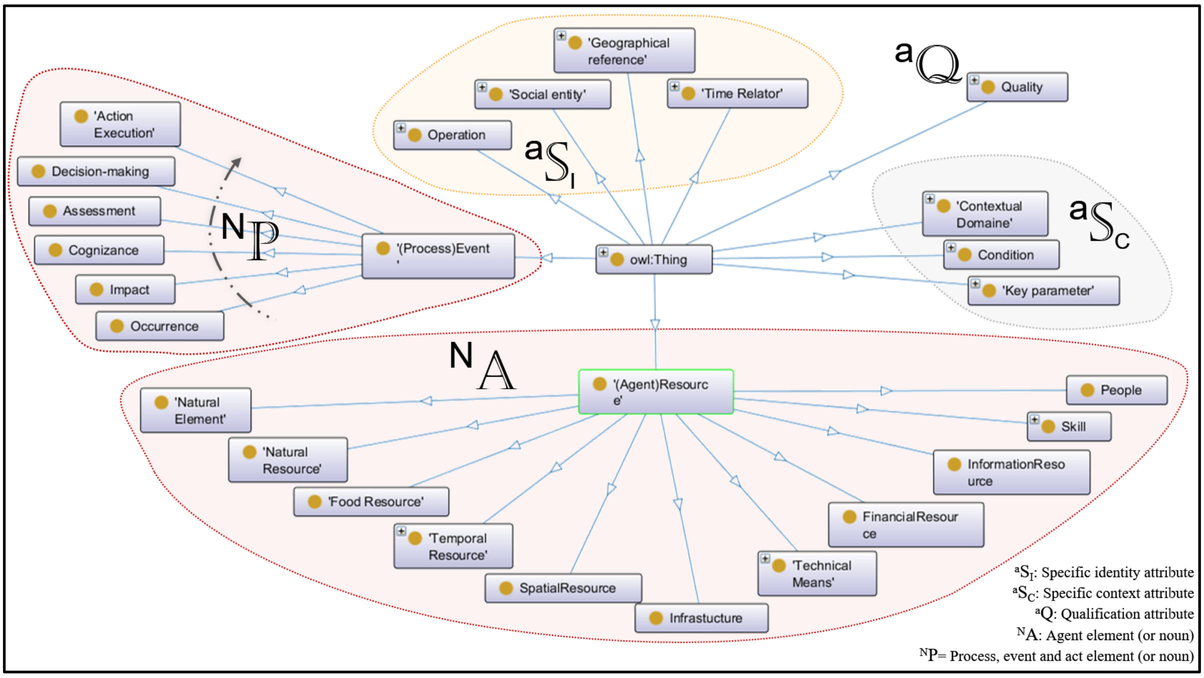

Figure 9. Graphical representation of the concepts constituting the ontology implemented by ExG, for the hurricane season post-disaster review. Two types of concept are expanded to show their classes.

The graph resulting from this SPARQL request (Figure 10) contains all the entities useful for describing the terms of the topological graph in Figures 7 and 8. These are "universals" that generalise the agent and resources, and their conditions, the events and activities, with their attributes. The ontological graph of the experience maintains an evidence-based real-life level that allows decisions to be taken and crisis management issues to be anticipated, even when indirectly linked to each other, such as the crucial importance of communications recovery for issuing warnings about the water supply. Figure 10 also describes the situation detected in the topological graph of Figure 8, of people aware of critical scenarios, but who might not be heard, nor exchange each other, before the disaster occurrence because they are not included in emergency response coordination meetings before the hurricane strike.

DISCUSSION

The analytical processing of the ExG ontological graph highlighted the critical paths of certain events, decisions or phenomena, as well as cascading effects (Figure 10). In this example, they revealed lack of relations, which slowed down or blocked the transfer of information crucial for good crisis management. The multiperspective representation of testimonies may suggest an improved plan for dealing with similar crises.

Finally, we obtained an abstract representation of the crisis, or a "metacrisis", including a model of relationships valid at a more general level than this specific experience, but still able to capitalise what really occurred in the past. The major value of such a dynamic and searchable representation of a post-disaster assessment lies in the capitalisation of a major disaster on more general perspective, improving the preparedness and effectiveness of the global crisis management system and increasing community resilience.

CONCLUSION

The "queryable category-based feedback knowledge graph" (ExG) that BRGM is developing and plans to test in different applications, is a knowledge management system designed to provide insights and learn lessons across the range of organisational management, decision-making and operational activities needed to achieve complex or critical objectives.

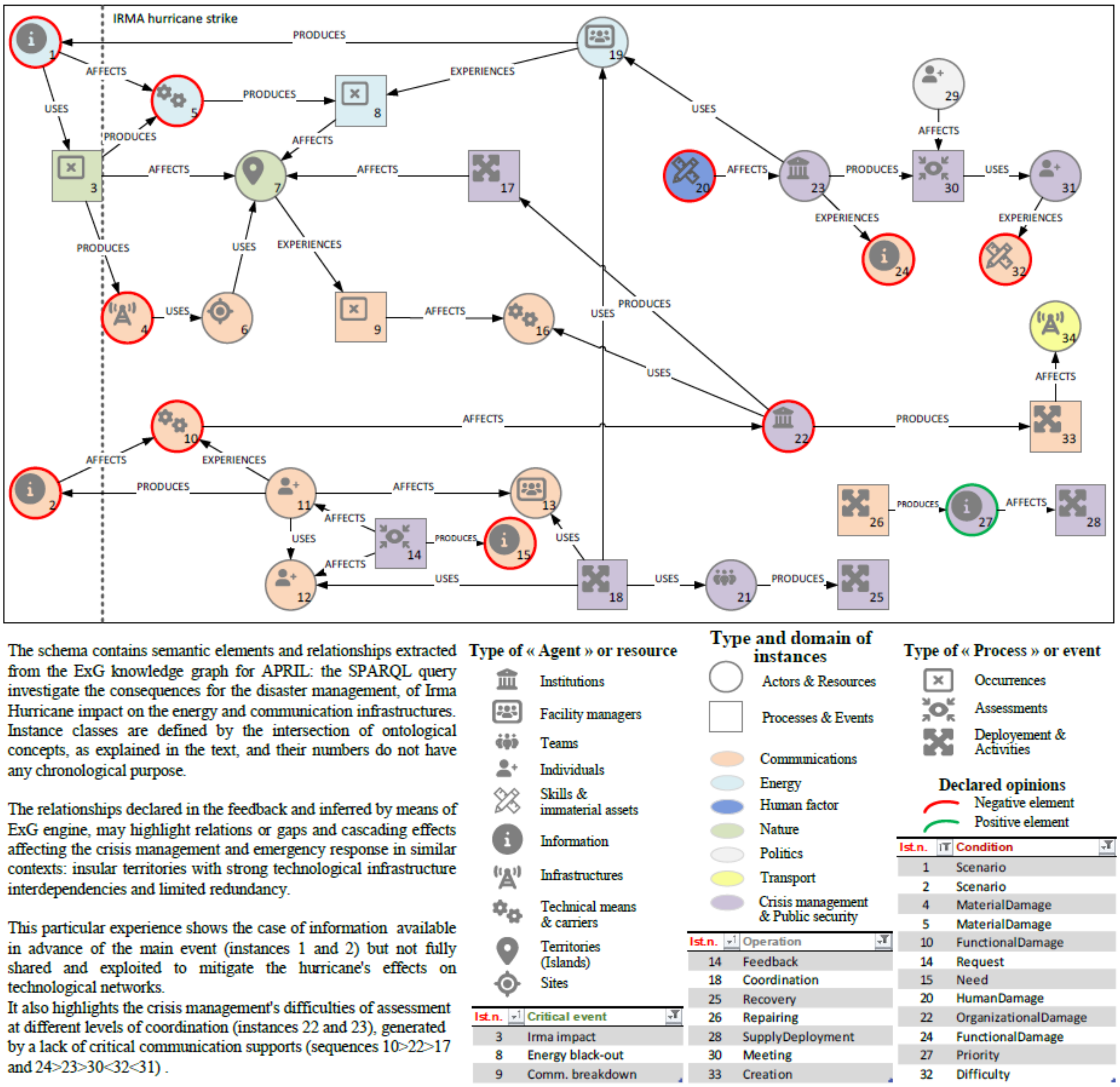

Figure 7. Ontological graph of the impacts and cascading effects on energy and communication networks affecting the crisis management: conceptual feedback and lessons learned from Irma hurricane at St. Martin

The different points of view, experiences and contexts, as well as the requirements for improving this type of crisis management were collected by about forty practitioners at different levels of decision-making in public and private safety services within French civil protection institutions. We used the ExG prototype to validate the workflow, the process implementation and the minimal user requirements.

We believe that, together with the new approach to a hybrid ontology definition and the original process of knowledge collection introduced by this article, the sketch data model provides a robust framework for the feedback inductive analysis promoted by the ExG method.

The roadmap of ExG finalisation aims to produce a platform for multiperspective design and continuous improvement of resilient sociotechnical systems. This consists of modules for managing the workflow from data definition to their final manipulation and analysis. The design of the ExG platform shall remain open and able to integrate several existing solutions for specific workflow tasks, if their output results compliant to the linked data engine and the core specifications of the method. Most developmental efforts should be instead invested in optimising the data conceptualisation, the semantically enhanced analysis and the representation of outputs for different applications.

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