

Project APACOS: Organizational and Socio-technical Context-Aware Adaptation of Emergency Plans (Adaptation des PIAns d'urgenCe au contexte Organisationnel et Socio-technique)

A French version of this document is available: <http://perso.mines-albi.fr/~benaben/APACOS/APACOS-FR.pdf>

I. Context and positioning

In France, the national government defines and frames crisis management procedures related to Classified Environmental Preservation Installations. In order to minimize the impacts of potential accidents, government and industry establish contingency plans. Based on alert pattern and risk assessment analysis, these plans describe the considered accidental scenarios and the human and material resources deployed to combat them. However, they may be inappropriate because of disturbances that modify the pre-established scenarios and make the proposed control strategy and the usual means of control ineffective¹. The result is a need for collective adaptation of procedures to the situation². Thus, (i) facing an unexpected event, the **dynamic configuration** of these plans is difficult to achieve while (ii) the exploding amount of heterogeneous, hybrid and uncertain data from the crisis ground complicates **information collection and processing** necessary for adaptive decision making. In parallel, new technologies are developed allowing the processing of real-time measurements and information. In an emergency situation, **time management** is a key element and it is thus necessary to provide support for decision making integrating this **time factor**^{3,4}.

a. Positioning

APACOS project aims to establish a methodological framework in an organizational and socio-technical context of dynamic configuration of crisis management plans according to the actual situation and its evolutions (observed or projected over time). Intended for the actors of the industrial establishments and the public authorities, this conceptual and operational evolution concerns the **preparation and response phases** of the crisis management lifecycle. APACOS responds perfectly to the roadmap of the Committee for the Safety Industrial Sector (CoFIS)⁵. The project involves practical collaboration with crisis management institutions and a clear focus on complex modelling, information gathering and processing issues at the methodological, organizational, social and technological levels.

b. Objectives

APACOS project focuses on the definition, the design and the realization of a decision support platform (methodology and software) dedicated to the dynamic reconfiguration of contingency plans. APACOS is divided into three main parts (Figure 1):

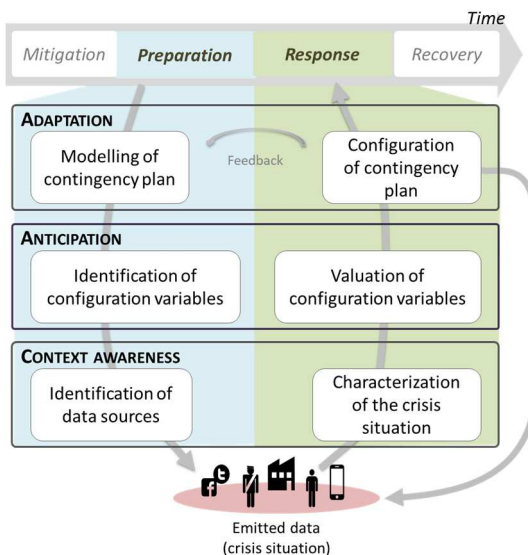


Figure 1. APACOS platform structure

1. **Context awareness:** The classified installation and its ecosystem are sources of heterogeneous data (meteorological conditions, behaviours, organization etc.) and of varied granularity. The data are emitted through sensors, social networks, field observations, etc. The challenge is to identify these data **sources** and to process the associated **data** in order to have a model of the crisis situation at a given time t .

2. **Anticipation:** Preparation phase consists of determining a relevant **set of variables** relevant to show and to predict the impact of a change in the crisis situation on the defined procedures, to adapt the crisis management plans. The variables cover a broad range of elements from **physical phenomena** (e.g. weather conditions) to **human, organizational, and social factors** (e.g.: time of year, load of work, rumour).

3. **Adaptation:** First, the study of contingency plans, of social and inter-organizational context of the response, of organizational means as well as of the inventory of hazard sources are necessary to perform a state of affairs and define a generic contingency plan. Then, a **coherent**

¹ SDSIE, 2015, *Guide méthodologique de l'anticipation dans la gestion de crises*, volume 1, p140

² Adrot, A., & Garreau, L., 2010, *Interagir pour improviser en situation de crise*. Revue française de gestion, (4), pp.119-131

³ SDIS82, 2013, *Schéma départemental d'analyse et de couverture des risques*, p81

⁴ MEDDE and METL, 2014, *le Guide de Gestion des Situations de Crise*, p37

⁵ http://www.gouvernement.fr/sites/default/files/contenu/piece-jointe/2015/12/feuille_de_route_cofis_2016-2017.pdf

and dynamic configuration of contingency plans **based on the socio-technical situation and its observed or anticipated evolutions** is available to end users for decision making.

The innovative nature of this project lies in the willingness to **make dynamic and adaptive** emergency plans **during the preparation and response phases of the crisis management**, but also to offer a **methodological, organizational and technological generic framework** suitable to any type of Classified Environmental Preservation Installations, in order to provide an appropriate response.

SYNERZIP-LH association, which brings together emergency response teams and industries (17 high threshold Seveso sites including LUBRIZOL, YARA, TOTAL), is responsible for Health, Safety and Environment governance of the **industrial Zone of the port of Le Havre** for technological risk Prevention Plans. It provides a set of industrial case studies to the consortium. The tool will then be tested and validated through **crisis simulation on this area**. For example, in the case of an accident occurring on a high risk site of the zone: if it comes out the site limits, it may require the confinement of civilians. Many factors are likely to weigh on the success of the response to this event. They can be of internal origin (unavailability of means which involves a reorganization of the actors) or external origin (climate change which exposes new population groups). Drift factors and their variability will be handled. This will test the players in terms of responsiveness and adaptation.

II. Project organization and overview of the consortium

This project will be coordinated by Nelly Olivier-Maget, assistant professor in Process Safety and Industrial Engineering within the Laboratory of Chemical Engineering (LGC) since 2008. Her research interests include the design of intrinsically safer processes, the risk assessments, the quantization under uncertainty as well as the fault detection and diagnosis. She has also achieved industry-recognized certification in project management. She has supervised 3 PhD theses, 3 post-docs, and has published more than 30 conference papers and more than 10 ISI publications. In addition, to achieve the APACOS objectives, the consortium brings together multidisciplinary expertise in digital technologies, engineering, humanities and social sciences (as shown in the table below). The steering committee is in blue.

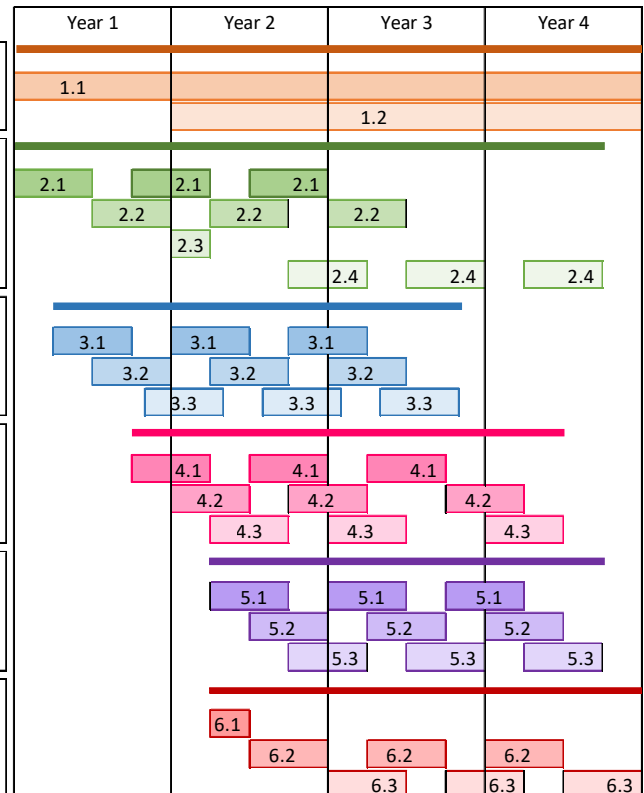
Partners	Actors	Skills relevant for APACOS project
LGC	Nelly Olivier-Maget	Assistant professor (AP): Safety, Diagnosis, Dynamic simulation, actor of ANR/PropreSur, ANR/PolySafe
	Anne-Marie Barthe	AP: knowledge management, actor of ANR/ISyCri, SocEDA, EUR/PLAY, DRIVER
	Nadine Gabas	Professor: Process safety / actor of ANR/PropreSur, leader of ANR/PolySafe
ARMINES / CGI	Frédéric Bénaben	Professor: IS for crisis management, leader of ANR/GéNéPi actor of ANR/ISyCri, EU/PLAY, EU/DRIVER
	Elise Vareilles	AP HDR: Configuration / actor of ANR/OPERA, ANR/ATLAS
INERIS	Nicolas Salatgé	Research Engineer (RE): web architecture and modelling / actor of ANR/ISyCri, ANR/GéNéPi
	Aurore Sarriquet	Engineer, Research and Studies, creation of contingency plan for industrials
	Franck Prats	Technical Advisor integrated analysis of risk, actor of EUR CascEff
	Emmanuel Plot	RE: human and organizational factors, design and operation of computing devices and virtual reality for risk management purposes
Paris Dauphine	Anouck Adrot	AP: Analysis of inter-organizational coordination in crisis situation, actor of ANR-DFG/INCA
SYNERZIP-LH	Jean-Michel Villeval	Lieutenant-Colonel, General delegate of SYNERZIP-LH association
Berger Levrault	Christophe Bortoloso	Research engineer (doctor of computer science)
	Mustapha Derras	Director R&I (provider of end users solutions)
MTES - SDSIE	Christian Despres	Head of mission, Service defence, security and Business Intelligence
Préfecture 76	Laurent Mabire	Office Manager, SIRACED -PC 76
SDIS 81	Florent Courrèges	Commander, Head of the logistics group. Fire and rescue service of Tarn department
Polytechnique Turin	Micaela Demichela	Director of the Centre for studies on safety, reliability and risk, in the Department of Applied Sciences and technology school, Polytechnic of Turin (Italy)
CEREMA Ouest	Hélène Dolidon	Engineer at the CEREMA West (actor of PREDIT/SIM-PeTra et ANR/GéNéPi)
University of Agder	Tina Comes	Professor, Centre for Integrated Emergency Management (CIEM), University of Agder (Kristiansand, Norway)

The risks and the associated measures have been identified for project APACOS:

Nature of the risk	Description	Measure
Organizational	Partner leaving the consortium	Unlikely risk, as the consortium consists of members who already worked in the past in funded projects (ANR, FUI, H2020, other)
Scientist	Difficulties in obtaining live data (sensitive area)	Very strong interest from institutional investors (via the Steering Committee) and industrials (via the INERIS), leading to the creation of a Steering Committee. Dissemination and communication among the public and private actors through the existing network.
Methodological	Uncertainty about the genericity of the framework for setting up emergency plans, Negligence of both anticipation and management in crisis management, Lack of use of the prototype by the organizations.	Follow-up and validation by the presence of experts within the consortium and the setup of a Steering Committee Presence in the consortium of human and organizational factors expert Consideration of organizational acceptance of the prototype and its relevance in view of the socio-technical needs

APACOS project is structured into **6 work packages**, subdivided into **18 tasks**. An **iterative** (3 iterations) development has been implemented (Agile method):

1 – Project management – LGC and partners
1.1 Coordination of the project
1.2 Dissemination of results
2 – Management of case studies – Paris Dauphine, INERIS, SYNERZIP-LH and partners
2.1 State of the art: collection and analyses of plans
2.2 Definition of validation scenarios
2.3 Prototype specifications
2.4 Definition of prototype tests with case studies
3 – Modelling of contingency plans – INERIS, Paris Dauphine, LGC and ARMINES
3.1 Inventory of hazard sources, analysis of organizations and social context
3.2 Identification of configuration variables
3.3 Modelling the effects of hazard sources
4 – Characterization of context – ARMINES, LGC and Berger-Levrault
4.1 Knowledge identification and formalisation
4.2 Data collection and interpretation
4.3 Characterization of the crisis situation
5 – Configuration of contingency plans – LGC, ARMINES, Paris Dauphine, Berger-
5.1 Data integration
5.2 Valuation of configuration variables
5.3 Configuration mechanisms of plans
6 – Prototype development – Berger-Levrault, ARMINES, LGC, Paris-Dauphine
6.1 Architecture choice
6.2 Specifications
6.3 Development, test and receipts



To carry out APACOS, a **48-months** project, the amount of the requested grant is **€ 604,000**.

Distribution between partners		Amount
LGC	Thesis (36 months) in partnership with ARMINES/CGI, Equipment and Operating expenses, Missions	200 k€
ARMINES / CGI	Post-doctorate (18 months) in partnership with LGC, Operating expenses, Missions	140 k€
Paris Dauphine	Post doctorate (18 months) in partnership with INERIS, LGC, Operating expenses, Missions	80 k€
Berger-Levrault	Trainee, Operating expenses, Missions	77 k€
INERIS	Operating expenses, Missions	82 k€
SYNERZIP-LH	Operating expenses, Missions	25 k€

III. Impact and effects from the project

Relevance regarding to the call for projects in general: ANR 2018 Work Program “Appel à projets générique”

- APACOS project inherits from different research works and funded projects (see Section IV). This provides APACOS project with a **certain level of maturity**.
- In addition, innovation related to interdisciplinary and exploitation of technological results previously achieved gives a priori to the project a TRL (Technology Readiness Level) estimated at **4**.
- Moreover, the project mobilizes various actors and operators who are **reference partners** in the field of crisis management (see Section II).

Relevance regarding to the Challenge 9 “Liberté et sécurité de l’Europe, de ses citoyens et de ses residents”

- A first element of APACOS that reports directly to the selected challenge concerns decision support during **of the crisis response phase**. Innovation into APACOS project lies on (i) **dynamic and consistent reconfiguration** of contingency plans (ii) with **crisis context awareness** achieved with ground data (iii) without ignoring **uncertain or incomplete data**, (iv) while seeking for the **highest possible genericity**.
- The project is based on **multidisciplinary skills** under digital technologies, engineering and social sciences: process agility, knowledge management and interoperability of the information systems, study of the human factor, ergonomics, interactions between humans and their environment, quality of coordination, organizational aspects, communication, fuzzy logic, systems modelling, process safety, treatment of complex events.

Relevance regarding to the Axis “Risques, gestion de crise quelle que soit son origine, résilience des systèmes”

- The first point to mention concerns the level of implementation of the APACOS proposal: a **crisis situation is stated** and depending upon its characteristics, **contingency plans shall be reconfigured** according to the current situation in real time.

- The second point lies in the **collection and processing in real time** of **big data** emitted by the ground (crisis situation, crisis cell, stakeholders, social networks, etc.).
- Finally, taking into account **human factors** and **organizational** is crucial to the modelling of the crisis situation in real time.

Relevance regarding to Orientation “Connaissance et anticipation des risques et des menaces”

- APACOS offers an **analysis of the physical, technological, human and social factors** with regard to the Organization and management in order to **develop indicators** for the **configuration of plans appropriated to the situation**.
- The contribution of APACOS lies in the demonstration of the interest of a tool of decision-making that incorporates **the human/ information technology interaction** in crisis management. This contribution will be demonstrated as a socially legally or economically by the validation of its use on the case studies provided by SYNERZIP-LH and end users participating in the Steering Committee.

Relevance to Orientation “Approche intégrée de la gestion de crise”

- APACOS offers an **acquisition and processing in real time** of data from different sources, in order to monitor the crisis situation’s evolutions, and to model the phenomena and behaviors into the plans. APACOS aims to implement an **integrated crisis management approach** by offering a framework and a tool for decision support taking into account the uncertainties and incomplete data.

In conclusion, the contribution of such a project for facility operators and public authorities lies improving crisis response in terms of responsiveness, efficiency and adaptability

The **dissemination and the use of the APACOS project results** achieved through this project will be of course provided at the academic level through, on the one hand, publications in A rank journals, and on the other hand communications in International conferences (ISCRAM, Loss prevention). The on-the-ground assessment of the APACOS platform will be considered through emergency exercises on classified installations. Finally, the levers needed to the maturation of the solution to consider a commercial development and deployment will be studied and considered by Berger-Levrault.

IV. References related to the project

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