*Driv*ing Innovation in Crisis Management for *E*uropean *R*esilience

D44.41 - Logistics and Assets Management Experimentation Report

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2.0	2016/02/29	ATOS	Quality check performed on this document

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List of Acronyms

Abbreviation / acronym	Description
CM	Crisis Management
SOS	System of Systems
EmerT	Emergency Mobility of Rescue Forces and Regular Traffic
SUMO	Simulation of urban mobility
ITS	Intelligent Traffic Systems
DoW	Description of Work
PFA	Psychosocial First Aid
SotA	State of the Art
SP	Subproject
DSS	Decision support system
EXPE	Experiment

Project Description

DRIVER evaluates solutions in three key areas: civil society resilience, responder coordination as well as training and learning.

These solutions are evaluated using the DRIVER test-bed. Besides cost-effectiveness, DRIVER also considers societal impact and related regulatory frameworks and procedures. Evaluation results will be summarised in a roadmap for innovation in crisis management and societal resilience.

Finally, looking forward beyond the lifetime of the project, the benefits of DRIVER will materialize in enhanced crisis management practices, efficiency and through the DRIVER-promoted connection of existing networks.

DRIVER Step #1: Evaluation Framework

- Developing test-bed infrastructure and methodology to test and evaluate novel solutions, during the project and beyond. It provides guidelines on how to plan and perform experiments, as well as a framework for evaluation.
- Analysing regulatory frameworks and procedures relevant for the implementation of DRIVER-tested solutions including standardisation.
- Developing methodology for fostering societal values and avoiding negative side-effects to society as a whole from crisis management and societal resilience solutions.

DRIVER Step #2: Compiling and evaluating solutions

- Strengthening crisis communication and facilitating community engagement and self-organisation.
- Evaluating solutions for professional responders with a focus on improving the coordination of the response effort.
- Benefiting professionals across borders by sharing learning solutions, lessons learned and competencies.

DRIVER Step #3: Large scale experiments and demonstration

- Execution of large-scale experiments to integrate and evaluate crisis management solutions.
- Demonstrating improvements in enhanced crisis management practices and resilience through the DRIVER experiments.

DRIVER is a 54 month duration project co-funded by the European Commission Seventh Framework Programme (FP7/2007-2013) under grant agreement no. 607798.

Executive Summary

The goal of WP 44 is to improve the capabilities of professional responders in terms of logistics, tasking and resource management by promoting, the cooperation and interoperability between organisations and the pooling and sharing of resources, both during preparation and response.

The present document is focused on the experiment regarding task T44.4 – *Bottlenecks & cascading effects*, **which aims at supporting crisis preparedness by evaluating the efficiency and capacity of storage and transport of resources. The analysis is performed that is focused on case building, modelling and developing scenarios for the supply chain and for the disaster relief supply chain. The analysis has the objective of unveiling bottlenecks and characterizing cascading effects impacting strategic transportation, resource management, pooling and sharing of stocks and transport means.**

This document includes the inventory results about tools presented during T44.4 session and in sessions related to other tasks which include features associated to T44.4. Main Results:

The main purpose of the task T44.4 is the development of an experiment around the logistics bottlenecks and processes, as well as resources management, when a disaster disrupts the logistic chain. Therefore, it is necessary to support a methodology and knowledge base to help supply chain crisis managers to identify the critical points of the chain and implement the appropriate decisions.

- **Although most of the tools have been considered as usable and relevant for CM, it seems that many of them do not fit very well for the tasking and resource management as described in T44.4, but are only related to its features in an indirect way.**
- **The tools that seem to better fit for T44.4 is the Delphi technique, as a generic task management tool, and the tools presented by WWU Anylogic & Humlog and DLR tools Keep Operational (Sumo-KeepMoving), UFLY and ZKI to develop necessary models and simulations around the resilience supply chain .**
- **Information sharing issues should be solved, as the different systems are in principle expected to use different communication mechanisms. Web services are considered a good candidate for the basic infrastructure for tool interoperability.**

It is necessary to take into account that tools usage should be aligned with a methodology. Processes, workflow and the specific methodologies followed by end-users in the CM domain should be analysed in order to achieve a common generic methodology. It can be presumed that next rounds of experiments should allow the definition of more complete and complex experiments with all stakeholders involved including realistic scenarios to give an approach to a real crisis situation.

With this aim, SP4 leaders decided to divide the experiment in two tasks, T44.4 and T44.5.

In task 44.4, it is foreseen to organize focus groups to assess a pan-European perspective from logistics stakeholders and public entities to elaborate gaps and recommendations.

The task 44.5 revolves around Transport and logistics support in crisis management, complemented with the Experiment 44 which will explore a logistic and traffic management tool suite that provides relevant information for crisis managers.

1 Introduction

1.1 Scope

The purpose of this document is to report on the experiment related activities lead by SP4 and more specifically by Task 44.4 Bottlenecks & cascading effects during the first period (before MS1). During the Initial Inventory of Tools conducted in November 2015, a specific session has taken place to present all tools that are related to Task 44.4. Selected tool features have been evaluated by a group consisting of project partners and end-users. The purpose of this methodology was not only the validation and presentation of tool related features, but also to develop ideas and concepts that enable interworking of different tools.

Task 44.4 is focused on exploring a logistics framework that provide logistics crisis managers to overcome problems associated with coordinated logistics operations and supporting crisis preparedness by evaluating the efficiency and capacity of storage and transport of resources.

The aim of the task is to explore the vulnerability of the supply chain and transport network in a crisis event.

The functionality of each tool available and the possible connection with this task is identified.

1.2 Document overview

This document contains the following chapters:

- **A first chapter presents the work done and results at SP4 level,**
- **A second chapter presents the results at Task level**
- **A third chapter introduces Task 44.4 and explains the methodology used for the** *Initial Inventory of Tools.* **Afterwards, all tools that have been presented during the Task 44.2 related session are presented. The chapter concludes with the description of the results from the** *Initial Inventory of Tools.*
- **A fourth chapter explains changes in T44.4 and T44.5, the renaming and new focus of this task.**
- **A final chapter provides the conclusions at Task level.**

2 SP4 Initial Inventory of tools

The purpose of D44.41 was to report on the experiment related activities associated to task T44.4 (Bottlenecks & cascading effects) during the first period (before MS1). These activities started at the beginning of the task in August 2014 and concluded with the release of D44.41 in February 2015.

The work performed in task T44.4 during this first period (before MS1) revolved around the SP4 Initial Inventory of tools that was held from Nov. 24th to Nov. 28th in Aix-en-Provence.

This work can be divided into the activities performed before, during and after the SP4 Initial Inventory of tools week, and includes the preparation (design + planning) and execution of the corresponding tool demonstrations and the analysis and evaluation of the corresponding results.

Before the SP4 Initial Inventory of tools

The work started with a face to face meeting held on June 30th in Madrid, focused on the organization of the T44.4.

This meeting was followed by task participant telcos where the progress of the corresponding activities was tracked and the planning of the firsts activities of the tasks were refined, including the preparation of the Inventory of tools and alignment with SP4 procedures.

During these meetings, the following activities were agreed and performed previous to the experimentation week:

- To collaborate in the preparation of the corresponding tool descriptions, tool features and tool evaluation sheets, which would be used during the experiments execution. For the tool features and evaluation sheets, a series of features, mapped to the SP4 WPs and tasks, were defined at SP4 level, in order to guide tool demonstrations and help evaluators assess how task-related features were covered by the corresponding tools.

- To agree and define the partners that were participating on the tool demonstrations and the roles they were performing. Each partner with effort allocated to T44.4 was assigned at least a role to be performed during the initial inventory of tools:
  - Experiment leader (by default the task leader): Coordinated the contributions of the participating partners and controlled the experiment execution.
  - Tool provider: Responsible of the tool demonstration.
  - Facilitator: Provided organizational support and guidance during the preparation (questionnaires) and moderated the execution of the experiments.
  - Evaluator: Controlled the alignment of the experiment set-up and execution with the pre-defined goals, observed the experiment from a neutral perspective and evaluated the results of the experiment by filling the corresponding tool evaluation sheets.

    In the case of T44.4, evaluators were both selected from task partners and end-users present in tool demonstrations.

- Each tool provider to:
    - provide a presentation that include a brief description of the tool they were showing during the SP4 Initial Inventory of tools and an overview of the demonstration they were going to perform.
    - assess which features were covered by their tools and fill the tool descriptions and tool features sheets with the required information.
    - check that the tools were conveniently allocated in the agenda for the Initial Inventory of tools and interact with the corresponding T44.4, WP44 and SP4 leaders in order to provide feedback and refine the agenda.
    - assess and inform platform providers about the specific technical requirements for the tool demonstrations.

Previous activities were controlled and supervised by the corresponding task, WP and SP4 leaders.

In the particular case of task T44.4, six tools were involved. In addition to those listed above, the following activities were required from each of the corresponding tool providers in order to prepare the demonstrations:

- Develop a demonstration script focused on demonstrating the way in which their tools covered the features they were supposed to support.
- Prepare presentation slides that support the tool demonstrations.

During SP4 Initial Inventory of tools

The demonstrations were divided into several sessions corresponding to the SP4 tasks. There were also some bilateral demonstrations of tools to other partners and presentations aimed to introduce DRIVER to end users.

The experimentation week finished with a wrap-up meeting were preliminary conclusions were drafted and ideas for the following rounds of experiments were gathered (feedback on methodology and organisation, ways to group the different tools for future experiments, end users involvement, interests of platform providers, etc.).

The general summary and conclusions of this experimentation week are factored out in a common document, D41.1.1 – Initial Inventory of Tools SP4 level experimentation report ([1]), applicable to all deliverables D4x.y1, including the present one.

After the SP4 Initial Inventory of tools

The main activity regarding T44.4 after the SP4 Initial Inventory of tools was the preparation of the D44.41 report were a summary of the related demonstrations and an assessment of the gathered feedback was included.

As consultation with Logistics Stakeholders and public entities and the Experiment on Transport and Logistics support do not have the same focus it was decided to divide them in two tasks:

T44.4 Coordination and Collaboration Public/Private logistics entities and end users. The task leader remains in CITET.

The other new task T44.5 Transport and logistics .This new task is lead by DLR and it is included in the amendment of the project.

3 Task experiment report

3.1 Introduction

Task 44.4 aims at supporting crisis preparedness by evaluating the efficiency and capacity of storage and transport of resources. The analysis is focused on case building, modelling and developing scenarios for the supply chain and for the disaster relief supply chain, with the objective of unveiling bottlenecks and characterizing cascading effects impacting the strategic transportation, resource management, and pooling and sharing of stocks and transport means. For the design of scenarios, commonalities between both supply chains under study will be exploited as much as possible. The task will also produce specifications for simulation-based scenarios.

This task takes into consideration the outputs from task T41.2 (State of the Art), reported in the corresponding deliverables Error! Reference source not found.Error! Reference source not found. d Error! Reference source not found. as well as those from tasks T42.1 (Architecture Design) and T45.3 (Structured Information Exchange), which are reported in Error! Reference source not found. nd Error! Reference source not found. respectively.

Understanding

- Response scenarios characterization: Input T44.1
- Definition of contingency plans (framework protocol):
    - Compiling information: current situation
    - Delphi (stakeholders meetings: public institutions and private)
    - Technical analysis
- Elaboration a recommendation lists:
    - Validation of the documentation obtained
    - Identify new needs to take in consideration
- Output: T44.5 (Evaluation of the proposed solution)

Work methodology

In the next flowchart, we introduce the steps that are necessary, first to collect information to have a starting point and then to define recommendations to establish action protocols.

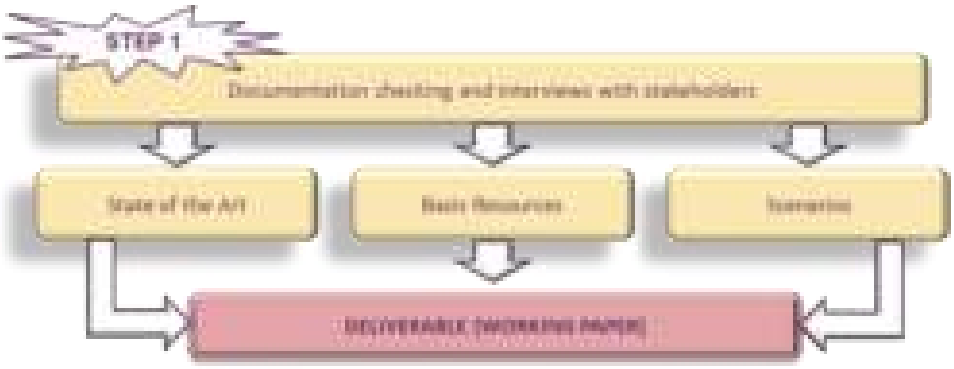

Figure 1. Work methodology 1

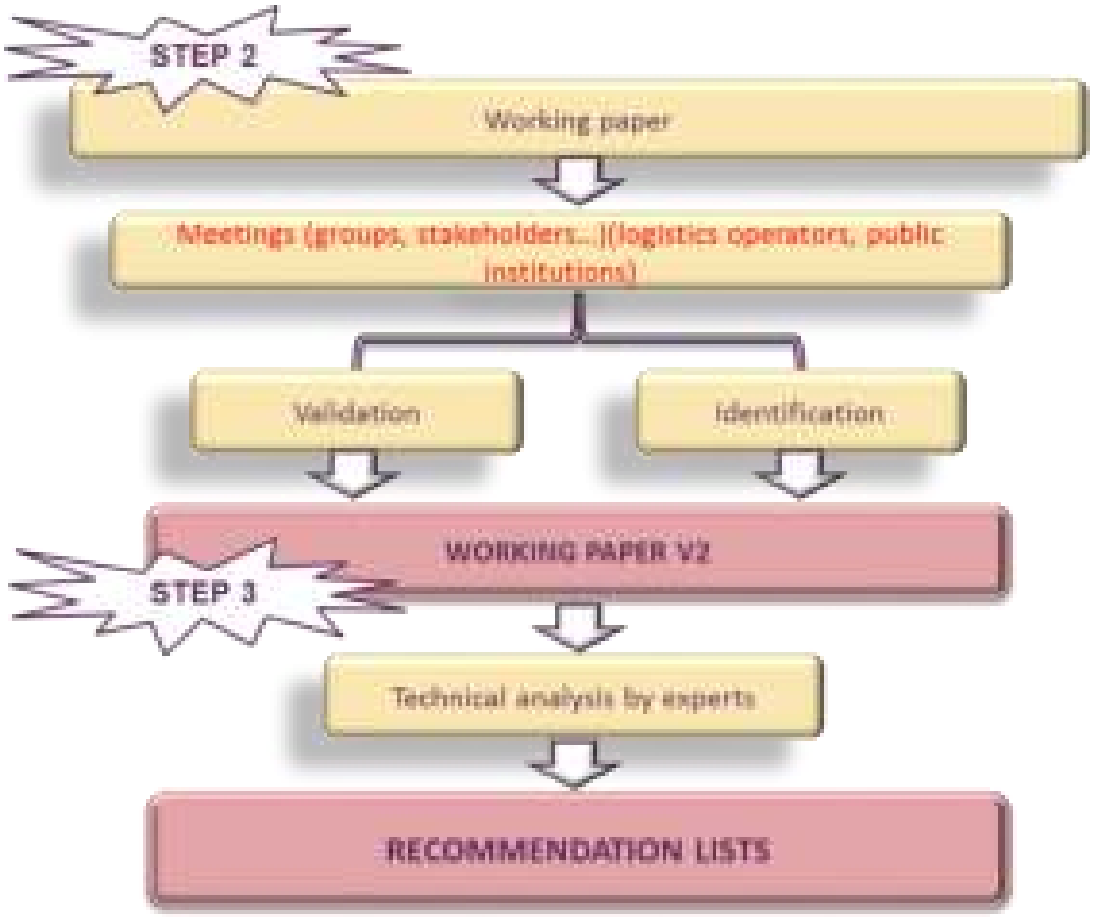

Figure 2. Work methodology 2

3.1.1 Evaluation sheet structure

The task related features are summarized in the following table:

Task	Feature	Sub-feature	Tool specific implementation
T44.4	Definition of	Modelling	< description per tool >

Bottlenecks & cascading effects	Scenarios	Simulation	
	Bottlenecks Analysis	Characterization	
		Decision Support	
	Cascade Effects Analysis	Characterization	
		Decision Support	

Table 1. Evaluation sheet structure

Features and sub-features were graded according to their relevance, maturity, potential and usability (see the Explicit feedback tables provided for each tool in sections 3.3.2 to 3.3.5). The following criteria were applied:

- Relevance was graded from 0 (none) to 3 (fully).
- Maturity was graded from 1 (basic) to 9 (proven),
- Potential was graded from 0 (not at all) to 3 (fully)
- Usability was graded from 1 (none) to 3 (fully).

The grades shown in the tables correspond to the average of the grades provided by the evaluators.

3.2 Tools involved

The following tools were presented during the 1st round of experiments in the task 44.4 session:

Tool	Provider	Session	Evaluators
Anylogic	WWU	T44.4	Dirk Stolk (TNO), Julia Zillies (DLR), Carsten Dallaf (DLR), Hector Naranjo (GMV)
It is a multi-method (discrete event, agent based, system dynamics) simulation tool. The main functionality for DRIVER will be the run of discrete event based simulations. For this purpose the process models generated with HumLog[em] will be applied using its model reporting function. Within a specific simulation environment several scenarios and network settings will be simulated and compared in order to identify and cope with bottlenecks and cascading effects. Depending on available data from end-users also agent based simulations can be considered in order to simulate and improve the inter-organizational logistics performance of all involved actors within a specific disaster relief scenario. Anylogic provides an environment to simulate humanitarian supply chains visualizing the material and information flows.			
Delphi	ATOS	T44.4	

Tool	Provider	Session	Evaluators
It is a widely used and accepted method for gathering data from respondents within their domain of expertise. **Delphi technique is designed as a group communication process that aims at conducting detailed examinations and discussions of a specific issue for the purpose of goal setting, policy investigation, or predicting the occurrence of future events**			

Table 2. Tools Description

Other tools that have been evaluated in other session but mentioned for this task:

Tool	Provider	Session	Evaluators
SUMO	**DLR**	**T43.2**	**Klas Laveno (MSB), Nitschke Halbach (THW), Adam Widera (WWU), Adrien Mangiavillano (POLE) and Firefighter officer (POLE)**
SUMO: Simulation of Urban Mobility **This is an open source Microscopic Traffic Flow Simulation which allows modelling of intermodal traffic systems including road vehicles, public transport and pedestrians. Furthermore, Transport and traffic Information, Routing, Traffic Simulation, Interaction with ITS (Intelligent Traffic Systems) and Emission modelling is involved.**			
PROCeed	**ITTI**	**T43.3**	**Dirk Stolk (TNO), Julia Zillies (DLR), Carsten Dallaf (DLR), Adrien Mangiavillano (POLE),** **C. Christmann (FHG-IAO)**
PROCeed is a computer system which prepares its users for proper decision-making in crisis situations. It enables creating and running all kinds of simulation applications and can be used as an interactive decision-making training game, as well as a tool for multi-variant analysis			
EmerT	**DLR**	**T44.2**	**Adam Widera (WWU), Klas Laveno (MSB), Nitschke Halbach (THW), Adrien Mangiavillano (POLE),** *Firefighter officer* **(POLE)**
Web based traffic tool for rescue forces. It provides traffic visualization and prognosis, simulation for decision support and traffic situation and prediction plus decision support for logistics operation: **Data platform of traffic data acquisition from multiple sources, fusion and quality assessment.** **Provision of a coordinated operational picture of the traffic system for mission control.** **Decision support tools for rescue forces towards logistics operations and the general mobility of inhabitants in case of disasters or major events**			

Tool	Provider	Session	Evaluators
U-Fly/3K	DLR		Non evaluated (presented in ATOS Madrid meeting in march)
U-Fly is a ground control station (GCS) for Remotely Piloted Aircraft (RPV). The capabilities include mission planning and evaluation for single RPAS or swarm formations. Within this specific experiment, the system for airborne information gathering is able to provide up-to-date airborne imagery data to support the modelling and the simulations of the different tools. Presented in ATOS Madrid meeting,			

Table 3. Tools Description in other session

3.3 Inventory results

3.3.1 Tools feature coverage overview

As a summary, Table 4 and Table 5 below show how tools addressed in this deliverable cover features of task T44.4, according to the analysis carried out in this chapter. Note that the following colour code has been used:

- *White* **for features/sub-features not covered by the tool according to the tool provider.**
- *Light green* **for features/sub-features that are covered according to the tool provider but** were not properly demonstrated taking into account evaluators' feedback and the **considerations in the analysis above.**
- *Dark green* **for those features/sub-features fully covered and demonstrated in the Initial Inventory of tools.**
- *Yellow* **for those features/sub-**features only partly covered according to the evaluators' **feedback and the considerations in the analysis above.**

The table 4 shows all tools presented during the task 44.4 session.

dark green=FULLY COVERED and DEMONSTRATED; light green=COVERED ACCORDING TOOL PROVIDER BUT NOT DEMONSTRATED, yellow=PARTLY COVERED, white=NOT COVERED		Task session	Task 44.4: Bottlenecks & Cascading effects	
		Tool supplier	ATOS	WWU
		Tool name	Delphi	Anylogic
Task	Feature	Sub-feature		
T44.4	Definition of Scenarios	Modelling	Fully	Fully

Bottlenecks & cascading effects		Simulation		
	Bottlenecks Analysis	Characterization	Fully	Fully
		Decision Support		
	Cascade Effects Analysis	Characterization	Fully	Fully
		Decision Support		

Table 4. Tools Feature Coverage

The table 5 shows those tools presented in other sessions during the 1st round of experiments.

dark green=FULLY COVERED and DEMONSTRATED; light green=COVERED ACCORDING TOOL PROVIDER BUT NOT DEMONSTRATED, yellow=PARTLY COVERED, white=NOT COVERED		Task session	T44.2: Tasking and capacity monitoring	Task 43.2: : Airborne Sensor Processing	Task 43.3: Crisis dynamics & early warning
		Tool supplier	DLR	DLR	ITTI
		Tool name	EmerT-Portal	SUMO	PROCeed
Task	Feature	Sub-feature			
T44.4 Bottlenecks & cascading effects	Definition of Scenarios	Modelling		Fully	Fully
		Simulation			
	Bottlenecks Analysis	Characterization	Partly	Fully	Partly
		Decision Support	Not demonstrated		
	Cascade Effects Analysis	Characterization		Fully	
		Decision Support			

Table 5. Tools feature Coverage (other sessions)

As a result of this first evaluation of the Initial Inventory of tools, we can conclude that the necessary features are fulfilled by the several tools: Delphi, Anylogic, SUMO, PROCeed and partially in the case of EmerT-Portal.

The Initial Inventory of tools will be followed by the 2nd Round of Experiments, which is expected from Sep 2015 to May 2016. This second activity will use the outputs and feedback from the Initial Inventory of tools and will again involve the corresponding planning, design, preparation and execution of the corresponding experiments with a deeper involvement of end-users and platform providers. In this round of experiments, clear objectives and research questions will be defined in coordination with the community of stakeholders of the corresponding platform providers.

3.3.2 Anylogic

The grades shown in the table correspond to the average of the grades provided by the evaluators.

- Relevance was graded from 0 (none) to 3 (fully).
- Maturity was grad**ed from 1 (basic) to 9 (proven).**
- Potential was graded f**rom 0 (not at all) to 3 (fully).**

3.3.2.1 Explicit feedback tables

The following table summarizes the feedback gathered from the evaluators regarding the tool features associated to T44.4:

Feature	Sub-feature	Anylogic WWU	relevance	maturity	potential	Suggested improvements / comments			
						GMV	ARM	DLR	DLR
Definition of Scenarios	Modelling	Creation of multi-paradigm simulation models (process based, multi-agent based, system dynamics)	2.5	8	2	Uncertainty could be included in the models using system dynamics	Not so clear	-	-
	Simulation	Discrete event-based and continuous simulation							
Bottlenecks Analysis	Characterization	Logistic resources	3	8	1	Is this applicable to other Tasks? Is this Applicable during the Crisis and not only before? How could be implemented the Interaction with other tools?	-	-	-
	Decision Support	Parameterized simulation experiments and comparison of results							

Table 6. Anylogic Evaluation

The following table includes the evaluators' conclusions about the tool (i.e., their overall impression and their opinion on usability and potential position **of the tool within the DRIVER System of Systems)**

	H. Naranjo (GMV)	ARM	DLR	DLR
Overall impression	The functionality provided by the tools is very useful but the main difficulty is in the definition of an accurate model	-	Commercial tool, well known software	Powerful tool to determine efficient logistic strategies, stochastic, making approaches could help to address uncertainties
Usability 2.5	The difficulty to define an accurate model can make the usage of the tool difficult (or useless in other case)	-	-	Good and clearly structured
Position within the DRIVER System of Systems	This suite of tools would be very useful to define the contingency plans that will be required to plan the tasking in the SOCRATES-Suite. Additionally information provided by the tool should be also considered during the response phase so define tasks that would allow to tackle the identified bottlenecks and cascading effects.	-	Usage and combination with other driver tools. E.g. TOOL SUMO	interacting with traffic simulation systems proper use of the tool required training (expert tool??)

Table 7. Anylogic Conclusion

The grades shown in the table correspond to the average of the grades provided by the evaluators. Usability was graded from 1 (none) to 3 (fully).

3.3.2.2 Statement of the tool provider

The evaluations reflect the relevance, potential and maturity level of the tool for the DRIVER project. The manually transferred process models of HumLogEM are only part of the whole simulation model in Anylogic. The process models are used to represent organization-specific practices of the relief chain actors. In some cases they are expressed as state charts, in other cases they have to be translated as possible relations between sources and sinks. Due to this complexity, an automated translation of process model into the simulation model is not recommended. The accuracy of models itself is managed in two different ways: (1) a high accuracy of process models is ensured through the application of the reference model (see also the evaluation of HumLogEM); (2) the accuracy of the whole simulation model is ensured through the design and application of a dedicated simulation study following the VDI guideline 3633 (The Association of German Engineers) containing a dedicated evaluation.

3.3.3 SUMO

The grades shown in the table correspond to the average of the grades provided by the evaluators.

- Relevance was graded from 0 (none) to 3 (fully).
- Maturity was grad**ed from 1 (basic) to 9 (proven).**
- Potential was graded f**rom 0 (not at all) to 3 (fully).**

3.3.3.1 Explicit feedback tables

The following table summarizes the feedback gathered from the evaluators regarding the tool features associated to T44.4 in other sessions:

Feature	Sub-feature	SUMO DLR	relevance	maturity	potential	Suggested improvements / comments			
						WWU	MSB	THW	POLE
Definition of Scenarios	Modelling	Importing street networks and demand data to model street traffic	3	7	3	-	-	-	-
	Simulation	simulating traffic jams as well as rerouting effects and changes in demand							
Bottlenecks Analysis	Characterization	showing effects of jammed streets	3	7	3	-	-	-	-
	Decision Support	scenario modelling (what happens if I block road X instead of Y)						not for THW but for the police	
Cascade Effects Analysis	Characterization	incorporating movement of special vehicles	2.5	7	3	If understood correct the consideration of special vehicles like heavy weight transports is proceeded in EmerT, but not sure here	I cant see relevance to cascading effects.	Very important for THW	-
	Decision Support	routing advice (see EmerT)							

Table 8. SUMO Evaluation

The following table includes the evaluators' conclusions about the tool (i.e., their overall impression and their opinion on **usability and potential position of the tool within the DRIVER System of Systems)**

	WWU	MSB	THW	POLE
Overall impression	As mentioned also by the audience SUMO seems to have a high maturity level (the estimation of the evaluator is based on the information of the tool provider in the evaluation sheet, i.e. 7, although some features seems higher than this) but especially a very high relevance for many other tools. Both network planning and operational tools can benefit from SUMO outputs	Seems very useful to most cases where traffic simulation is needed.	-If you can obtain info on the change in for example the stability/load capacity of bridges, it would be very beneficial. E.g.: normally a bridge can handle 8 t. After 5 hours of flood exposure, it can handle 3 t. -If you can get info on the status of gas stations (do they still have gas, do the pumps function, are they flooded…	-
Usability 3	The only limitation to be considered is the required setup time in terms of new data (esp. transportation network).	-	-	-
Position within the DRIVER System of Systems	As mentioned above SUMO can be understood as a tool that can both process data/results from (e.g. EvacuAid) and to other DRIVER tools (e.g. AnyLogic).	Useful as a service to other tools that need to complement with traffic simulation.	-	-

Table 9. SUMO Conclusions

3.3.3.2 Statement of the tool provider

The grades shown in the table correspond to the average of the grades provided by the evaluators. Usability was graded from 1 (none) to 3 (fully).

Most of the evaluators come from a different research field, so it was not easy for them to assess all features comprehensively. The evaluators focused on the practical applications. Nevertheless, the evaluation was well done and valuable for the tool provider and task leader. All evaluators express their good overall impression of the tool and see the usefulness for most cases where traffic simulation is needed. The required set up time and input data (like transportation network, traffic demand) was considered as a limiting factor for a quick transfer to a different area. An additional demand was to check if this tool can be used as a service to other tools that may require traffic simulation.

Further comments apply to very specific and detailed first responder tasks which could be supported by the tool.

3.3.4 EmerT

3.3.4.1 3.3.4.1 Explicit feedback tables

The grades shown in the table correspond to the average of the grades provided by the evaluators.

- Relevance was graded from 0 (none) to 3 (fully).
- Maturity was grad**ed from 1 (basic) to 9 (proven).**
- Potential was graded f**rom 0 (not at all) to 3 (fully).**

The following table summarizes the feedback gathered from the evaluators regarding the tool features associated to T44.4 in other sessions:

Feature	Sub-feature	EmerT DLR	relevance	maturity	potential	Suggested improvements / comments			
						WWU	MSB	POLE Firefighter officer (POLE)	THW
Definition of Scenarios	Modelling	[see DLR SUMO]				-	-	-	-
	Simulation	[see DLR SUMO]							
Bottlenecks Analysis	Characterization	Journey/Trip time analyses for blue light driving operations	3	6		-	-	-	-
	Decision Support	[see DLR SUMO]							
Cascade Effects Analysis	Characterization	[see DLR SUMO]				-	-	-	-
	Decision Support	[see DLR SUMO]							

Table 10. EmerT Evaluation

The following table includes the evaluators' conclusions about the tool (i.e., their overall impression and their opinion on **usability and potential position of the tool within the DRIVER System of Systems)**

	WWU	MSB	POLE	THW
Overall impression	Very promising, useful and mature tool that could be used for various transportation planning tasks in the logistics domain, the set up time has to be considered	This tool seems very mature and rich in functionality.		-interesting tool primary for planning events -seems difficult to use in an ad hoc crisis, as people will behave in an un-/ less predictable or hard to predict manner -good for evacuation forecast and evaluation and strategies
Usability 3				
Position within the DRIVER System of Systems	The output is of high interest for all logistics related tasks, many other tools can benefit from EmerT results.	I think it will be very central in Driver especially if its information content can be shared with other tools. All "other common operational picture" / "situation assessment"		

Table 11. EmerT Conclusion

The grades shown in the table correspond to the average of the grades provided by the evaluators. Usability was graded from 1 (none) to 3 (fully).

3.3.4.2 Statement of the tool provider

Most of the evaluators do not have a detailed traffic research background and come from different research fields. Therefore, the evaluators focused on the practical applications. All evaluators expressed their good overall impression of the tool and emphasized the tool as very mature and rich in functionality. The usability is voted with fully (3). The evaluators underlined that the tool is able to provide many information and tools for the planning of big events and other critical events. The tool additionally opens the opportunity to evaluate crisis management strategies, like evacuation scenarios. The output is ranked as 'high interest' and 'very central in DRIVER'. The evaluators see the sharing of information with other common operational **picture and situation assessment tools as a very important constraint for this tool.**

The integration of the tool output in the DRIVER common operational picture is one of the tool provider's aims.

3.3.5 Proceed

3.3.5.1 3.3.5.1 Explicit feedback tables

The grades shown in the table correspond to the average of the grades provided by the evaluators.

- Relevance was graded from 0 (none) to 3 (fully).
- Maturity was grad**ed from 1 (basic) to 9 (proven).**
- Potential was graded f**rom 0 (not at all) to 3 (fully).**

The following table summarizes the feedback gathered from the evaluators regarding the tool features associated to T44.4 in other sessions:

Feature	Sub-feature	Proceed ITTI	relevance	Maturity	potential	Suggested improvements / comments			
						FHG-IAO	MSB	DLR	DLR
Definition of Scenarios	Modelling	Modelling of the alternative courses of the crisis situations including shortages, cascading effects and bottlenecks.		3	8	-	-	list view is rather unintuitive	-
	Simulation	Simulation of the predefined alternative scenario of the given crisis situation				-	-	-	-
Bottlenecks Analysis	Characterization	Built in models dedicated towards identification/tracing of shortages or any vital processes disruptions		3	8	-	-	-	-
	Decision Support	Datasets delivery being a based for decision making process				-	-	-	-
Cascade Effects Analysis	Characterization	Built in models dedicated towards identification/tracing of incidents' chains and consecutive processes disruptions.				-	-	-	-
	Decision Support	Datasets delivery being a based for decision making process							

Table 12.Proceed Evaluation

The following table includes the evaluators' conclusions about the tool (i.e., their overall impression and their opinion on **usability and potential position of the tool within the DRIVER System of Systems)**

	FHG-IAO	MSB	DLR	DLR
Overall impression	good tool for simulating complex scenarios	Simulation tool for training flood, epidemics, chain of supply. This tool seems to be unique in the SP4 and fills a gap. It is also possible to expand with more models. Not to be used in an operational situation.	Both scenario creator and player seemed professional, but functionality was presented very shortly. I did not get the info if there will be a "score" or something. Is there any logic in the tool that calculates a performance based on decisions and actions?	Interesting tool that can also be used for training.
Usability 3			The first training tool so far, so very important!	Several features have not been shown in the demo, but the tool seems to be interesting to SP4/5/6
Position within the DRIVER System of Systems		Any types of scenarios that have to be done in the pre planning phase.		SP5 - trainings! Scenario design, proof of logic of scenarios

Table 13. Proceed Conclusions

The grades shown in the table correspond to the average of the grades provided by the evaluators. Usability was graded from 1 (none) to 3 (fully).

3.3.5.2 3.3.5.2 Statement of the tool provider

PROCeed is a generic environment for creating and replaying event-based interactive CM scenarios. It is not dedicated by itself to bottleneck and cascade effects analysis. However, using PROCeed Designer and PROCeed Engine a user can model and simulate such kind of effects incorporating them into the scenario.

3.4 Selected tools

According According to the evaluator's conclusions and the interaction with other task we can see a **first approach with this chart, with the use of the tools methodology in the different phases.**

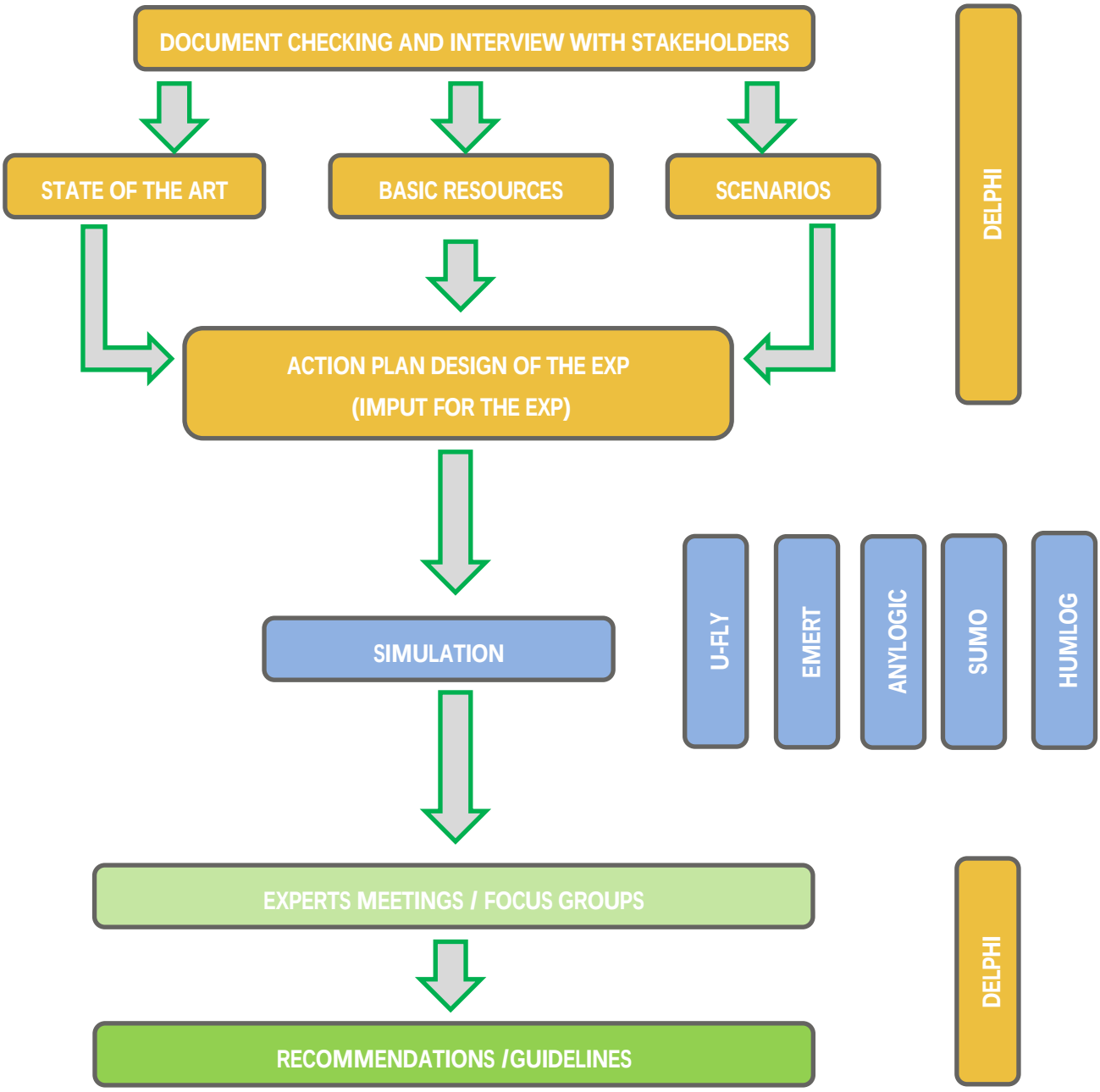

Figure 3. Use of the tools

4 Analysis of the Tasks

The purpose of D44.41 was to report on the experiment related activities associated to task T44.4 (Bottlenecks & cascading effects), as consultation with Logistics Stakeholders and public entities and the Experiment on Transport and Logistics support do not have the same focus it was decided to divide them in two tasks. For this reason is necessary establish Public-private partnerships and the connexion with the Transport and logistics support to be prepared in times of disaster. The flow chart below represents the connexion and content of the necessary tasks.

T44.4 Coordination and Collaboration Public/Private logistics entities, based on covering the gap about how the collaboration should be organized. Based on the Initial Inventory of tools, some of the evaluated tools are selected for the performance of the task.

T44.5 Transport and logistics support related to the performance of the supply chain design and planning, the strategic transport and efficient transport routing. In a crisis situation the assistance of professional logistics crisis managers is required. As before, other set of tools evaluated on the Initial Inventory of tools will be configured and deployed for the associated task.

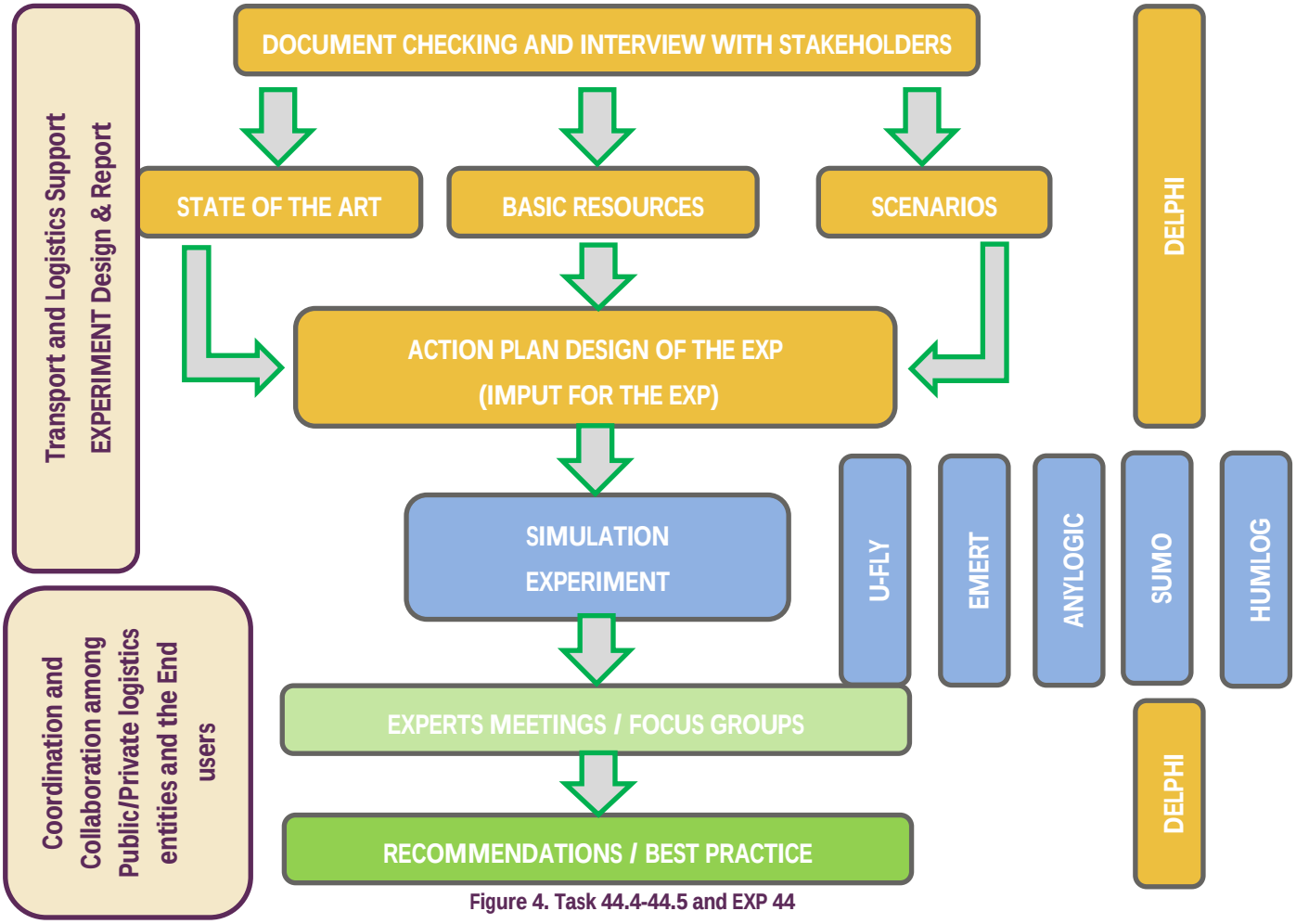

Figure 4. Task 44.4-44.5 and EXP 44

The connection between this task is because not always the public entities has the resources and experience necessary to capable of withstanding a catastrophe by contributing to the development of a response logistics framework.

4.1 Coordination and Collaboration P/P logistics entities and end users

A gap has been identified about how the collaboration among stakeholders should be organized. The gap results from a lack of an action protocol to cooperate between logistics companies and the government in these cases. Thus the task aims as well at how to leverage public-private partnerships between public actors and the logistics companies to be prepared and collaborate in the community resilience in times of disaster. Involving different actors to work together by sharing processes and distribution channels demands a vision that goes beyond mere logistics (moving goods from point A to point B). It requires a supply chain management approach to effectively coordinate performance, eliminate redundancies, and maximize efficiencies in terms of costs and speed.

Based on the Delphi technique, a set of recommendations and guidelines will be elaborated from the results of workshops with groups of experts, stakeholders and a focus group. Delphi is used to conduct a systematic analysis of how both 'local and global supply chains' and 'performance chains in disruptive situations' support crisis preparedness by evaluating the efficiency and capacity of storage and transport of resources. The analysis is focused on case building, modelling and developing scenarios for the supply chain and for the disaster relief supply chain, with the objective of unveiling bottlenecks and characterizing cascading effects. Delphi will be used for pre-empirical work, providing use cases.

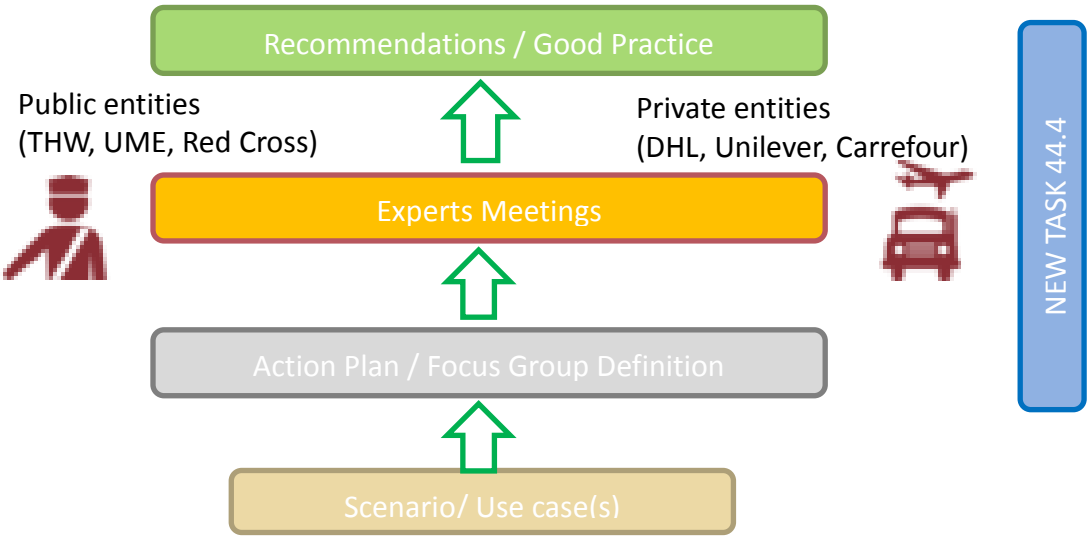

Figure 5: New Task 44.4

4.2 Transport and logistics support

This task will deal with different supply chain, logistics and transport management topics that are related to the performance of the supply chain design and planning, the strategic transport and efficient transport routing. These topics will be addressed during different phases of crisis

management. In a crisis situation the assistance of professional logistics crisis managers is required.

4.3 EXPE 44: Transport and Logistic Support

SP4 aims to support the bridging of various identified gaps in Crisis Management. The overall objective of *Transport and Logistics Support* is to highlight and illustrate the benefits of the logistic and traffic management tools during the planning and response phase for crisis managers.

Experiment 44 will deal with different supply chain, logistics and transport management topics that are related to the performance of the supply chain design and planning, the strategic transport and efficient routing. These topics will be addressed during different phases of crisis management whereby the assistance of professional logistics crisis managers is required. Therefore, different tools that are able to model and simulate several relief chain setups are provided in order to measure the performance and to identify bottlenecks and improvement potentials. The whole relief chain from procurement up to the distribution in the last mile will be illustrated.

The scenario will be based on a river flooding event in the city of Magdeburg, capital of the Federal State Sachsen-Anhalt in Germany. After continuous rainfall over several days the major rivers and its tributaries of Southern and Eastern Germany have reached their banks and are in danger of flooding adjacent areas. The city expects the prospect of a major flooding of large parts of the city area and has started emergency preparations for the event. The civil protection agency identifies the endangered areas and affected population as well as the critical infrastructure of the city.

The scenario will play out as a table top exercise where a series of simulated use cases will provide insights in identifying bottlenecks, cascading effects and improvement potentials by analysis of current logistic and traffic situation as well as by simulating the transport of resources. The conducted simulations will also give evidence concerning e.g. the efficiency and capacity of storage and transport of resources. This information is required to support crisis preparedness, and the evaluation can support the crisis preparedness.

The scenarios will cover - but are not limited to the following situations:

- The provision of drink/food supplies for confined population in affected flooding area and the evacuation of endangered persons.
- After warnings of the Civil Protection Agency parts of the population try to leave the affected area on their own which puts additional pressure on the road network in a critical emergency situation
- A transformer station in danger of being flooded has to be secured by sand bag dams. The critical situation will intensify as a shutdown of the plant affecting the city's power supply.
- The Establishment of a sandbag packing station including the logistical arrangements for necessary resources (heavy duty vehicles, sand, bags, packing machines, staff, etc.)

DLR and WWU will provide IT-Tools (displayed in the picture: KeepOperational, U-Fly, ZKI, HumLog) for the experiment whereby each tool will bring its contribution and the benefit from working on different levels will be tested and evaluated.

There will be no physical connection between the simulation tool-suites of DLR and WWU. The connection between the solutions will be realized by using the one's information output as input for **the other tool and vice versa.**

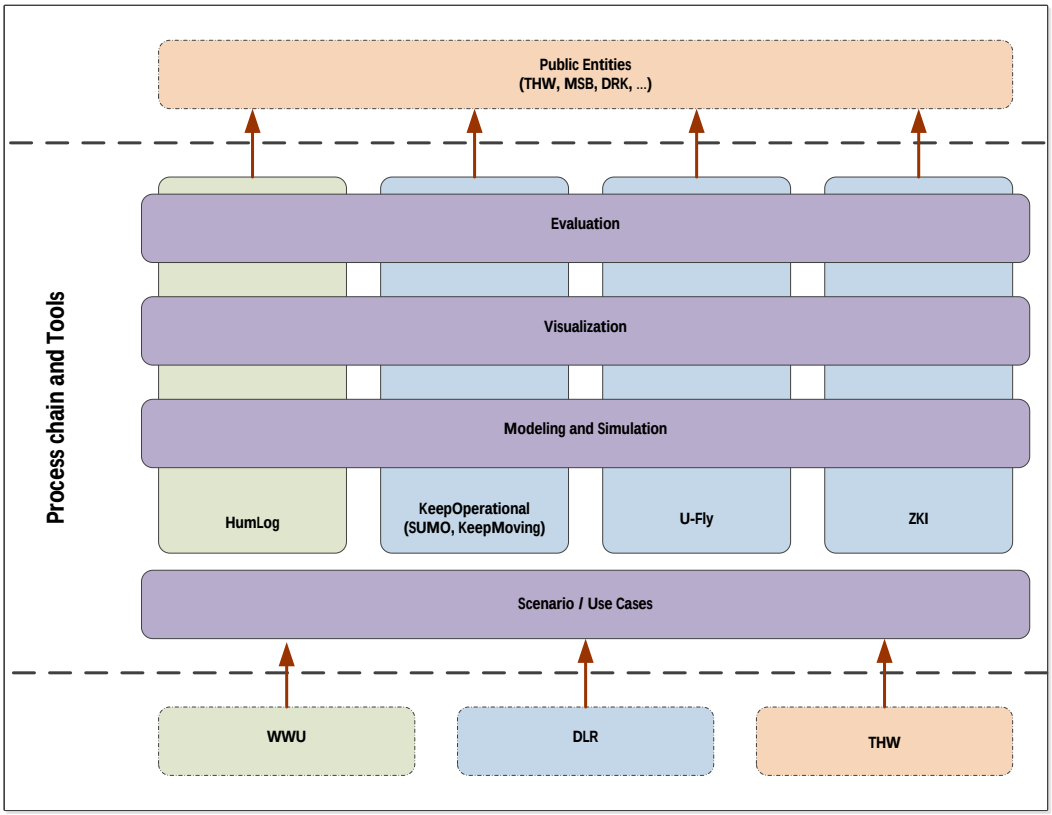

Figure 6: EXP44 Transport and Logistic Support

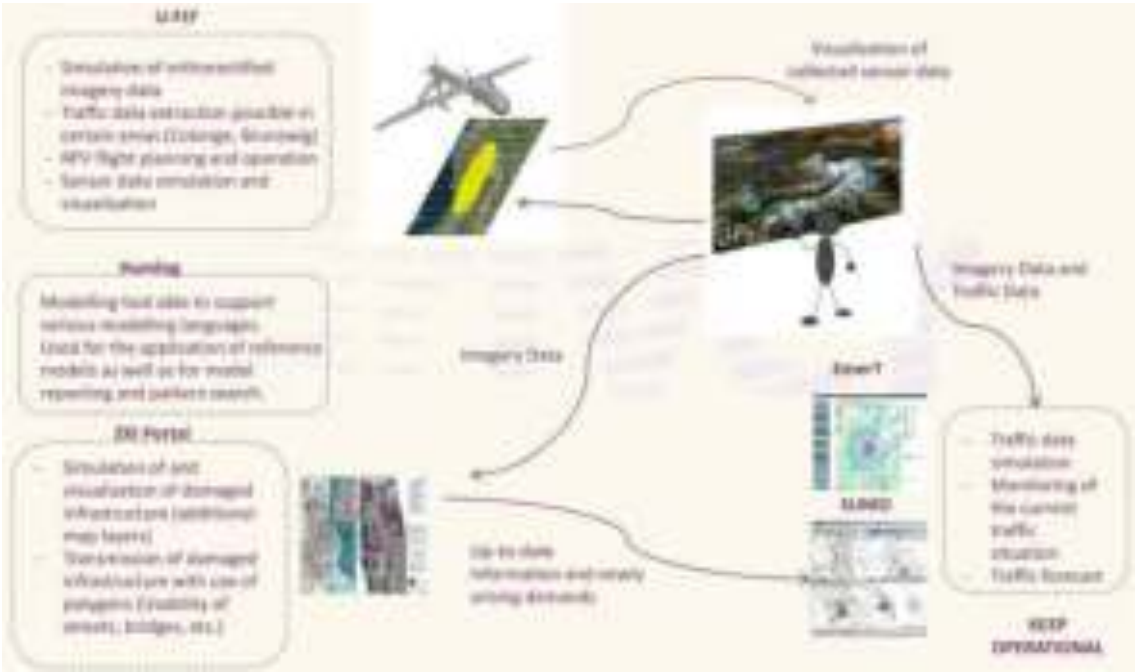

Figure 7: EXP44 Involved Tools. Transport and Logistic Support

- **HumLog (em)**

It is a modelling tool able to support various modelling languages. It can be used for the application of reference models as well as for model reporting and pattern search.

- **Anylogic (Evaluated in Chapter 3.3.2)**

It is a multi-method (discrete event, agent based, system dynamics) simulation tool. The main functionality for DRIVER will be the run of discrete event based simulations. For this purpose the process models generated with HumLog[em] will be applied using its model reporting function. Within a specific simulation environment several scenarios and network settings will be simulated and compared in order to identify and cope with bottlenecks and cascading effects.

- **U-Fly/3K Camera System**

U-Fly is a ground control station (GCS) for Remotely Piloted Aircraft (RPV). The capabilities include mission planning and evaluation for single RPAS or swarm formations. U-Fly receives aerial sensor data, processes and evaluates sensor data, and dynamically adapts RPAS missions to newly received information. Within this specific experiment, the system for airborne information gathering is able to provide airborne imagery data to support the modelling and the simulations of the different tools. In EXPE44 U-Fly simulates an RPAS flight to provide aerial images.

- **Keep Operational**

Keep Operational is a web-portal developed of the German Aerospace Center (DLR). With Keep Operational it is possible to visualize the current traffic situation using different traffic sources and to provide routing information for emergency services. The traffic data can also be used as basis to simulate and predict traffic and for supporting the decision process for traffic management actions in case of an incident (e.g. routing advice, scenario modelling, display of aerial images, current traffic situation). Keep Operational also involves SUMO - a microscopic and open source road traffic simulation.

- **ZKI**

The Center for Satellite Based Crisis Information (ZKI) is an 24 hours / 7 days operational service for the rapid provision of satellite and airborne based crisis information. ZKI creates all information in its Service Lab at the Earth Observation Center in Oberpfaffenhofen and provides all derived information such as flood masks and flood maps (2D and 3D) via web services or other pre-defined interfaces. In Expe 44 ZKI is providing flood masks (vector data) and flood maps (2D and 3D) as well as information about number and length of affected infrastructure (e.g. roads, buildings).

Other tools coming from the test-bed could be added if suitable. The identified platform to develop the experiment is provided by THW.

The expected outcomes are:

- **a logistics framework that will assist decision makers in identifying and reacting coherently to future and emerging threats and crisis situations, including the elaboration of recommendation actions to logistics stakeholders and public entities**
- **a transport management tool suite that will assist decision makers in managing efficiently the required rescue logistics and the nearby traffic flow even under extreme conditions, thereby enabling emergency services to rapidly reach the locations where they needed.**
- **a demonstration of the usability and added value of the tools provide for end user (emergency services).**

5 Conclusion

This document describes the necessary collaboration between public and private organizations in case of a crisis. The aim is to elaborate recommendations on how to use resources efficiently in the context of identified problems appearing in the supply chain. The focus is hereby set to bottlenecks, cascading effects and other important vulnerabilities for the supply chain resilience.

Based on the analysis of tools in the first round of experiments, the tools with the greatest potential regarding the objectives of the experiment in WP44 were determined and integrated into a joint scenario. The experiment aims to identify potential bottlenecks and cascading effects on the supply chain in a crisis. Therefore, the tools Anylogic, Humlog, Keep Operational (Sumo-KeepMoving), UFLY and ZKI will be used to model and simulate the logistics processes in order to identify and analyze these effects.

The main purpose of the utilization of the Delphi technique in this experiment is to support the preparation and validation of use cases, related to the collaboration between private and public entities (not always the public entities has the resources and experience) and to contribute to the development of a logistics framework. With the foreseen results from applying this technique logistics crisis managers could be supported in solving problems associated with coordinated logistics operations and crisis preparedness by evaluating the efficiency and capacity of storage and transport of resources. This public/private collaboration happens in all countries and it is a good opportunity to explore initial recommendations on public/private collaboration.

As the Experiment on Transport and Logistics support in crisis management and the consultation of Logistics Stakeholders do not have the same focus it was decided to divide them and make two separate tasks for the different activities.

The experiment 44 will be executed to explore different supply chains and the vision and roles of the stakeholders providing insights in improvement potentials, in order to measure with the performance of First Responders and the next steps in the crisis management.

Finally, the results of the different use cases simulated in experiment 44 and the recommendations obtained from the expert meeting to improve the response in case of crisis will be analysed and consolidated.

Main results will be considered not only to improve the involved tools, but also to feed into design and planning of subsequent experiment.

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