The European Maritime Simulator Network –
A Technical Test Bed for Future Innovation

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Abstract

This paper describes the technical setup of the first civil maritime distributed simulator network. It will describe the challenges and how to face these from a technical, an organizational and business perspective. We will discuss the use of EMSN as a test tool for Sea Traffic Management, the task it was considered a necessity for. The scalability of the network and its potential growth will be described from a technical perspective and we will look at different alternatives of governance. We will describe how it can be used for testing new services, complex traffic situations and other future potential uses, like multi bridge training, online simulations of port approaches or interdependent team training. We will finally conclude to what EMSN is providing and what it is not intended for.

1. Introduction

The MONALISA project and its successor MONALISA 2.0 (www.monalisaproject.eu) want to improve safety and efficiency of sea transport by developing a Sea Traffic Management System. Sea Traffic Management wants to make sea traffic data available in real time to all interested and authorized stakeholders. This shall result in applications that can access this data and perform safety relevant operations like issuing navigation warnings, informing crews about weather and traffic conditions or enabling negotiation of safe routes. Such applications will also have economic and ecologic effects when optimizing routing and resulting in lesser environmental impact of participating vessels. To get a sustainable and practicable Sea Traffic Management System, a holistic approach was chosen to cover organizational, legal, business, information and technical aspects. With concepts and technologies being developed and defined during MONALISA, need arose to test and evaluate these before they can be integrated and put at work.

2. General Concept and Test Bed Requirements

Testing newly developed procedures and technologies as in MONALISA 2.0 needs a test and evaluation environment. A simulated environment has been chosen to avoid testing new equipment and procedures on live platforms at sea. This does reduce costs and limits risks to a minimum, where exposition of personal and material to the risks of live trials can be totally eliminated. Wear and tear of used equipment can be limited to lab conditions since its durability is not to be tested during the MONALISA 2.0 project. Cost advantages are covered in more detail in chapter 3.3.

Given the fact that only simulators could provide a safe and cost effective way to test and evaluate all new Sea Traffic Management procedures and their outcomes, it was at hand that existing simulation equipment should be used which was available at the sites of MONALISA and MONALISA 2.0 project members. Connecting all participating members and their simulators could create a test- and evaluation environment which can perform all needed tests and distribute its results immediately.

This does initially look like a technical challenge, but at a second glance the scale and diversity of the systems and people involved give an idea on administrative and economic challenges as well. The following requirements had to be met to deliver a fully qualified test bed.

- Capability to test and evaluate all relevant procedures and technologies developed during the project
- Support of all existing hard- and software infrastructures, including interfaces
- Support of in-exercise communication equipment

- Inclusion of all subject matter experts which are located at various sites across Europe
- Communication and management support for exercise and trial preparation, supervision, debriefing and evaluation

3. Chances and Challenges

3.1. Technical

3.1.1 General Aspects and Prerequisites

Using simulators for testing, training or evaluation purposes usually needs a dedicated simulation system. Those systems are specific and therefore limited by definition regarding their capabilities and usability. To cover a broader bandwidth of use cases you could either create a new and more generic simulation system, or you could find a way to connect existing simulation systems to leverage their capabilities in a combined manner. Therefore from a technical point of view networking of existing simulation systems was the most effective approach for a possible solution in MONALISA 2.0. This did limit initial investment in system development and operator training. In comparison to a newly developed simulation suite, existing systems could be (re-)used after minor adaptations and operators are already trained and in place.

To meet the requirements of complex scenarios with dozens of simulated interacting entities, a single and independent simulation system would not be sufficient, since its lack of scalability and flexibility which was needed for a scale and geographic distribution as in MONALISA 2.0.

3.1.2 System of System Approach

A system of systems approach (SoS) was chosen to meet all requirements. Using several independent systems in connection as a whole new system can be most efficient. Careful task dependant selection of complementary systems will result in synergies from added functionalities. In a simple example, connection of one or more ship handling simulators (SHS) with a vessel traffic service (VTS) simulator can train both crews independently in a common way or together as interactive team training. It has to be noticed that using elements standalone or as part of a system of systems approach is complementary and does no substitute each other.

The use of a system of systems approach has several advantages since it supports a variety of aspects that need to be taken care for the EMSN. Managerial independence, *Maier (1998)*, of each element or sub system does reduce infrastructure management needs at EMSN management level. Since all simulators of the EMSN are owned by different project members they are already under local management regarding maintenance, scheduling or safety supervision. Local regulations, laws or infrastructural specifics (i.e. voltage) are dealt locally by local system management. Operational independence, *Maier (1998)*, is closely related and points to the fact that you can benefit from existing operator personnel.

The initial set of simulators being used by MONALISA 2.0 participants, came from three different simulator providers with different interfacing capabilities. It is trivial to show that a common interface was needed to connect all of them. Heterogeneity of systems, *Delaurentis (2005)*, as described here is no problem in a system of systems, since all elements are connected by a standardized middleware. Such a connection can be spread over very long distances, which also addresses the next aspect.

Geographical distribution of systems is another key in this approach. In fact it is a key requirement of the test bed that distributed resources, subject matter experts and stakeholders are connected for cooperative work during the whole test and evaluation phase. Nowadays a distributed system can easily be made available using available networking technologies, i.e. over the internet. The implementation is shown in detail in chapter 3.1.3.

Interdisciplinary teams and studies, *Delaurentis (2005)*, are also part of the MONALISA 2.0 project where i.e. human factors are studied when people are exposed to new technologies and procedures of the project. The availability of interdisciplinary observations is a direct outcome of the heterogeneity of the super system. If a ship handling simulator is connected to a ship engine simulator which can simulate the exhaust production, you can directly observe environmental impact of different manoeuvring or routing. Green shipping studies for instance can benefit from such systems.

Given the available resources and obvious advantages of a system of system approach regarding the set preconditions an Acknowledged System of Systems design was selected to build the European Maritime Simulator Network. That means that it has recognized objectives, a designated manager, and designated resources for the SoS. However, the constituent systems retain their independent ownership, objectives, funding, and development and sustainment approaches. Changes in the systems are based on cooperative agreements between the SoS and the system, *Dahmann and Baldwin (2008)*.

3.1.3 Infrastructure

The chosen system of systems approach calls for a standardized interfaces which can even spread over several layers, *Maier (1998)*. To keep complexity and technical risk as low as possible, already existing standards have been investigated. IP based internet connections were found to be the best transport channel to exchange needed data, since all participating sites already had existing internet connections available.

Required data to be exchanged would be voice, data from Sea Traffic Management applications, data from administrative and simulation management as well as simulation (object) data. Sea Traffic Management applications represent a compiled or perceived view into a simulated world. This view is called "perceived truth". Data describing an uncompiled "true" value of a simulated asset is called "ground truth", *Jensen (2009)*. The difference is made clear when thinking of a simulated ship. The simulated true position is calculated and distributed (ground truth). A connected radar simulation received this true position, simulates measurement errors and outputs a perceived picture with a slightly different view into the world (perceived truth). All these data domains can be seen as different logic layers inside the network, Fig. 1. This approach of different domain layers separates data in a semantic and technical way. It can be used as a general approach for simulation networks. Technical separation is achieved in terms of different formatting and encoding, but can be extended by separating these data domains into several physical or virtual networks where needed. This might be useful in large networks with huge data load, where data management and load balancing is easier in separated nets.

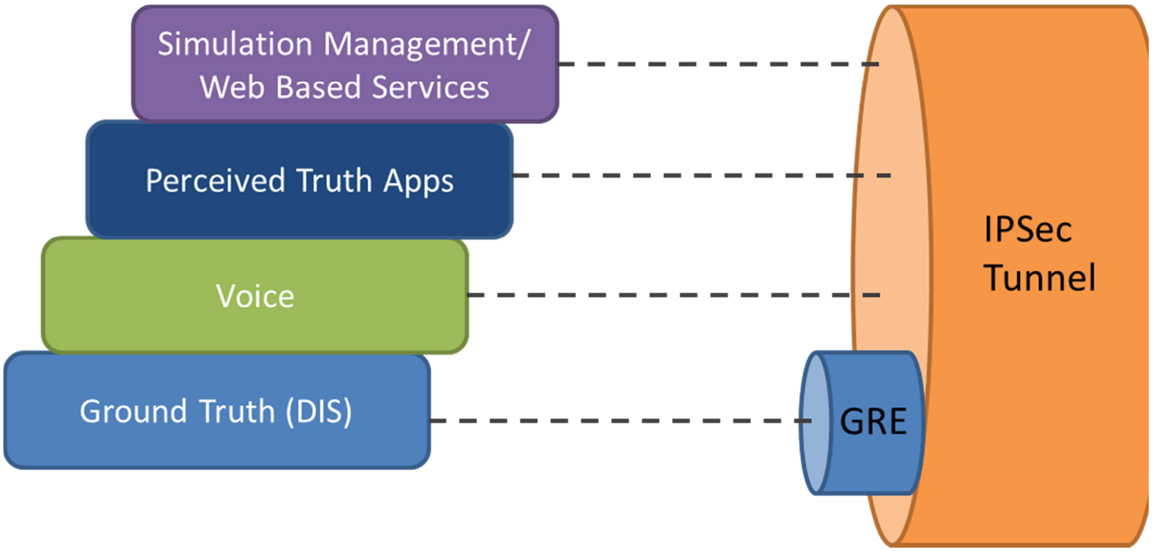

Fig. 1: EMSN domains

Voice can be easily encoded in Voice-Over-IP (VoIP) formatted data to be sent over an internet connection. All planned Sea Traffic Management and simulation management applications did use standard TCP/IP connections. Implementation was therefore considered trivial for these data types. Simulation data in contrast still had to be transformed into a standardized format to be accessible to all different simulators. “These standards, sometimes referred to as middleware, will most likely be built on distributed object and messaging frameworks”, *Maier (1998)*. Following this approach, an existing IEEE standard “Standard for Distributed Interactive Simulation - Application Protocols” (DIS), *IEEE (1996)*, had been chosen and agreed upon between all simulation providers taking part in MONALISA 2.0. DIS data is sent via broadcast or multicast packets, which is not allowed over standard internet connections due to its nature of routing and transportation. To be able to transport it over an internet connection it had to be encapsulated into a GRE/mGRE tunnel. IT-Security and privacy is established through an encrypted virtual private network tunnel (VPN).

Once we defined what kind of data needs to be transported and how this data is organized, we have to specify how the network layout has to be designed. For EMSN a typical Hub-Spoke-Configuration with its star shaped topology was chosen. Every participant connects its applications and simulations to a local networking device that works locally just as a normal local hub that connects all local systems. When connected to the internet it automatically connects to a specified hub and works as a router and spoke regarding all in- and outbound traffic. The remote connection to its specified hub over the internet is secured by an encrypted IPsec connection spanning a huge virtual private network (VPN). When a second spoke connects to the same hub in the same manner, local applications connected to spoke 1 can communicate with local applications on spoke 2. They virtually share the same network which makes the actual distance in between them transparent to all applications. In terms of network communications it actually makes no difference if the applications reside inside the same lab or are separated by thousands of kilometres. (In fact networking delays may apply, depending on the network and its quality in between. EMSN applications did experience networking delays of a typical maximum of 200ms which was appropriate and did not affect the quality of the consuming services.) To all connected applications the spanning technologies are transparent and connected devices at remote spokes appear in the same network, just as if they were connected locally.

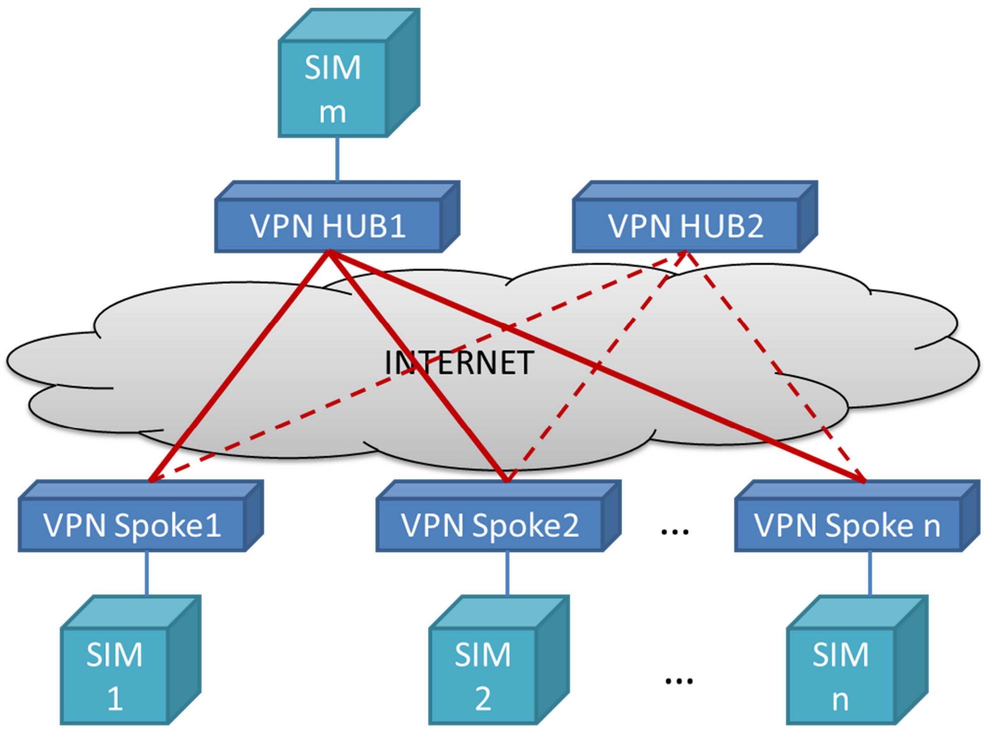

Fig. 2: General EMSN infrastructure

Since all spokes connect to the same hub to be able to communicate to each other two major problems arise and need to be addressed. At first it becomes clear that the hub device is a single point of failure. In case the hub device fails for any reason communication between spokes immediately becomes unavailable. To overcome this issue a second hub is prepared for hot standby. If hub 1 fails, spokes automatically establish a connection with hub 2 to handle all traffic over hub 2 from now on. Depending on configuration of hubs and spokes this failover strategy can even be refined in a way that connections to hub 2 are readily prepared even though hub 1 is fully operational. This configuration is useful if no delay shall occur in case a failover has to be done. There are even a few more failover strategies possible with the chosen network design, including falling back to spoke to spoke communication. The chosen strategy should always fit to the intended applications and available infrastructure.

A second possible problem is hub performance. As it could be seen in Fig. 2, all communication has to pass hub 1. This means that hub 1 needs a robust and performant hardware as well as a stable and performant internet connection. Especially when the intended network has to connect many spokes performance of the hub is important. Choosing the right hub is very important because saving a few hundred euros in favour for a smaller category can often end up buying a better one at a later stage. Saving time for troubleshooting or dealing with performance issues will easily cost more than a more performant hub. More detail on economic aspects of managing a simulation network will be given in chapter 3.3. Keeping redundancy in mind it is strongly advised to have hubs of the same type. Due to minimized troubleshooting and configuration management same spoke types are also strongly encouraged.

Internet connections are generally available today where the traps are found in technical details. As from a general view it can be said that bandwidth, latency and stability are the most important features to look at. Detailed advice and descriptions can only be given when number of devices and types of intended services and their data are known. Therefore specific advice is left to an analysis of required connection services needed. To give a general idea on what can be expected, it can be said that connection of 2 modern ship handling simulators with usual voice communication could even be done with modern mobile 3G and 4G networks. This implies that no video is transmitted over the network. Simulator networks are usually larger and need a dedicated DSL connection. At spoke sites a standard DSL internet connection can sufficient where upload bandwidth can be significantly lower than download. This is ok since spoke sites usually consume more data from the network than they deliver. Hub sites instead should have a synchronous line where upload and download bandwidth are both high. If synchronous lines are unavailable at a planned hub site, focus should then be on an upload rate that is performant enough to cover the planned amount of data.

As distances get larger, network latency times will grow. If timing sensitive applications or services are planned, fast lines and supporting measures like optimized routing and quality of service (QoS) support should be taken into consideration, especially if satellite connections are involved.

3.1.3 IT-Security

Whenever IT systems are planned, IT security has to be taken into consideration, especially when exposing systems and services to the internet security measures are mandatory. The EMSN does use the internet as backbone for its data transportation needs. To keep data and involved systems away from possible threats various precautions haven been taken from which some important shall be listed here.

Data exchanged should be subject to confidentiality and authenticity. There are even more aspects to cover in IT-Security but this description shall be limited to these and how they were addressed in EMSN. At first authenticity has to be made sure before any other type of data is exchanged. You can imagine this process with someone ringing at your door. The first thing you will do is checking who it is by looking at the visitor or asking for identification over the intercom. Once you identified the visitor you automatically decide what role he has and what information you might want to share or not. A similar process has to happen in a distributed network. Each simulator site is given an authorization key which will identify it as authorized participant when trying to enter the network. Once this authorization procedure was successful, opening a secure and confident line of communication is started.

Confidentiality of data is usually achieved by encryption. Sender and receiver of a communication line have knowledge about an encryption/decryption scheme and corresponding code which shall not be known to unauthorized participants. This is done using a Virtual Private Network, where an encrypted line is established between two authorized participants. Once this line is created, data will be encrypted at sender side and decrypted at receiver side. EMSN does use VPN enabled routers to establish such secured lines of communication automatically.

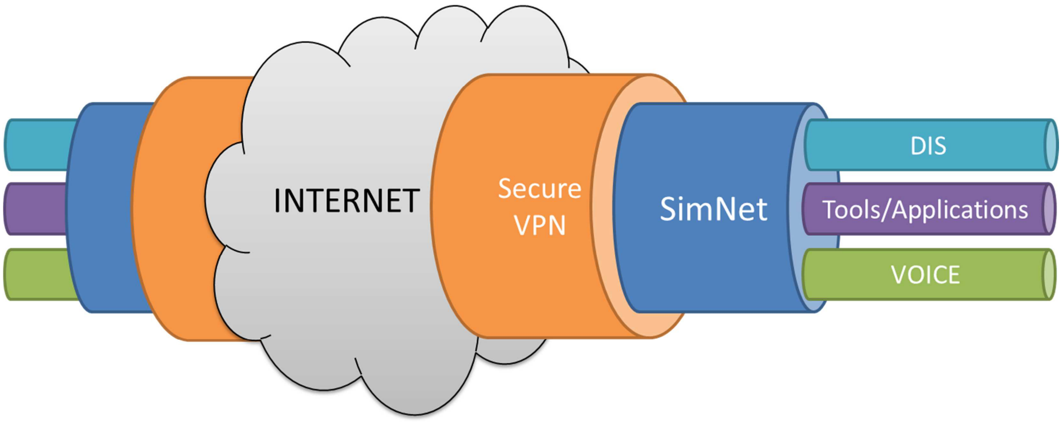

Fig. 3: EMSN layers

Further IT security measures were also taken to protect local IT from unauthorized access from other parts of the simulator network. Firewalls and authentication procedures protect local networks and their content behind spokes. Even though participants of a simulator network want to share data across a common network, they might not want to share everything and not give away control of their systems. Especially since the network is designed to be easily extendible, it is very important that each participant is assured that local data remains under local control.

3.2. Organizational

Organization and management gets more important as the complexity of a system rises. A complex system like a network with its nodes spread across a whole continent is an organizational challenge, which needs a dedicated management system. This management system needs to recognize and answer challenges that come when working with remote work places, from different cultural backgrounds in different time zones with different knowledge and infrastructure.

Due to the nature of a distributed system of systems, management will be divided in two levels, where there is a general simulation network management at SoS level and local management at each simulation site as seen in Fig. 4.

Simulation network managers will have a general management role and will be responsible for funding, outbound communication and commercial tasks.

Technical support manager instead is responsible for all technical questions, network design, security and performance. This management role is i.e. responsible for connecting new sites to the network and changing network configurations. Network coordination managers work project oriented in a way that they coordinate availability of resources and overall performance for specific programs and projects.

Local management at each site in comparison is focused on management of local resources and the delivery of agreed resources and their performance towards the SoS level.

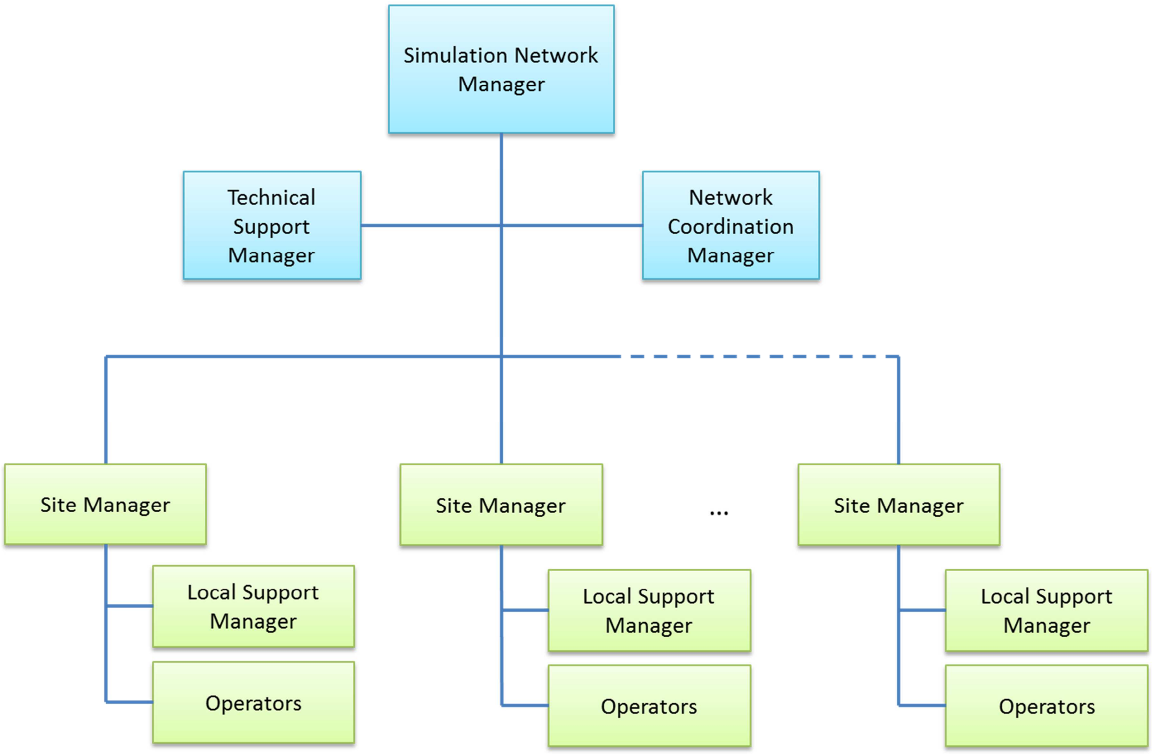

Fig. 4: Sample simulation network management structure

From a functional point of view such a management system can be broken down into four operational fields.

- Management of Objectives
- Management of People
- Management of Time
- Management of Subsystems

3.2.1 Management of objectives

Before you can start planning and undergoing tests and exercises, you need to define what you want to achieve. This will result in a list of objectives that have to be reached. An objective defines a single goal to achieve, i.e. to test if a specific procedure has a significant advantage over a different procedure in a specified situation. Using business analysis tools and methods can help to define, document and manage these objectives.

Requirements engineering offers a very good approach to cover many aspects of managing objectives. In a first identification process, new objectives are identified, defined and documented. During analysis phase, these objectives are checked (i.e. for redundancy) against each other. Objectives have to be categorized and prioritized. This will be very useful if objectives have to be cancelled at a later stage in the project due to restricted time or funding. Stakeholder conflicts might exist and should be resolved in this analysis phase, too.

Once all objectives are clear - a planning phase is started in which all steps and measures are planned which shall achieve the objectives. This will typically result in a test- and evaluation plan. If the simulator network is intended for training purposes, a training plan is created accordingly. The planning process does not only cover the list of objectives but also takes into consideration what resources are available at what times to achieve these objectives.

The next step is a validation if all objectives are fully covered by the planned activities. After these steps a management process steps in that continuously cycles through these steps.

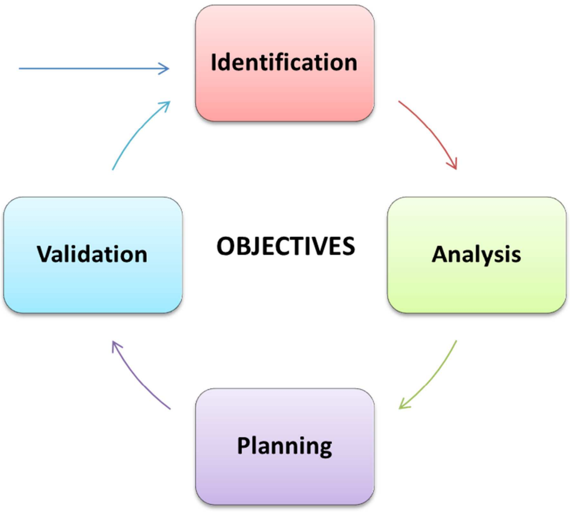

Fig. 4: Management of objectives

It is advisable that managers of distributed simulator networks continuously track objectives and their status. Requirements engineering is a common process which is known to many project managers and supported by a variety of tools which will help them to do so, especially since new objectives will arise and existing ones will change. But whatever tool has been chosen to support this process, active communication of objectives, their status and discussion of conflicts is a key to a successful simulation network management.

3.2.2 Management of people

Managing people was a task that was needed even before division of labour was developed by humans. From these days on a huge experience doing this task has been summed up, written down, discussed and even been subject to politics, art and cultural work. Industrialization during 19th century gave it an extra boost and most universities deal with human resource studies and social sciences. Our societies are based on social life where the success of everybody as well as for the whole society depends on how well people interact with each other. Even though it seems undoubtful that a lot of knowledge exists in this wide field, it is often the most challenging task of a manager to get people to do what is needed to get a task done. This is often due to the fact that most managers do not get a profound training on how to deal with people. This paper will not give a complete plan, but highlight a few topics which can help managing teams in a large scaled simulation network in comparison to local teams.

There are three major aspects that differ from managing teams locally or in a distributed environment – social and intercultural competence, communication and geographic distribution itself. At first there is geographic distribution which is implicit in this comparison. Managing a local team means that you usually have immediate direct access to your team members. Managing remote team members therefore is more time consuming resulting in generally longer project duration and higher percentage of team management. This is due to the asynchronous way of communication in remote teams in comparison to a more often synchronous communication in local teams and needs to be reflected in all project planning phases. Local team members come from a more homogeneous background which leads to a more common communication basis. Local team members can interact in a more empathic way, due to the fact that they already know themselves much better. Remote team members may not even meet face to face at all.

Working with third party languages as project language might also lead to difficulties in communication. Remote team managers have to make sure that all parties of a communication process have a common understanding of what is to be understood. Failed expectations are frustrating and will reduce willingness to cooperation, which is vital for every successful team.

Availability of team members may not lie in responsibility of managers of simulation networks. EMSN has been setup as an acknowledged system of system, where the super system level accepts local responsibility for availability of team members for work at SoS level. Resource planning is due to agreements between these levels and usually cannot be enforced. Remote managers may find it frustrating if needed personnel is unavailable for a certain timeslot which makes early planning and pro-active communication indispensable.

The major conclusion is that communication is the key to successful management of people. It needs a manager who is aware of all team members, their backgrounds and stakes to successfully lead a remote team.

This can get even more complex when people from different time zones have to collaborate, which leads to the aspects of management of time. You might have to make people change their daily habits to meet timeslots that can fit an international team. Some might need to get up early or stay up late to take part in online meetings or meet deadlines. Managers of super scaled simulation networks have to be aware that this can mean a lot of stress to each participant since this way of collaboration is usually uncommon. Paying respect to the needs of people is even more important in such a socially heterogeneous working environment.

Tools can support managing remote teams. A huge suite of collaboration tools is available. A distributed simulation network should have an agreed set of common ways and tools of communication. Both synchronous (phone, video conferences) as well as asynchronous ways (email, online portals, project sites, etc.) should be available. It is important that it is an agreed pool of communication tools to make sure that common communication channels are used instead of a self-organized set of tools. This way it is made sure that team members are available for contact in a dedicated way. Such a communication pool should be revised from time to time. If different ways of communications are used more often by team members, this may point to a demand which is not covered by the agreed set. But again agreed discipline should be maintained if agreed tools cover communication needs.

Despite all the hard times that can happen when managing peopling, it can also be the most rewarding task for manager.

3.2.3 Management of time

It has already been stated that remote teams need a more anticipatory management due to a more often asynchronous way of communication. To support a better management of time, all team members should be dedicated to an agreed style of discipline when it comes to keeping timelines. It is absolutely vital for a successful simulation network like the EMSN that all team members pay respect to the efforts of each other. It can be helpful to agree upon a code of conduct, especially if all members will work together in a very independent way.

Simulation network managers will have to plan way ahead of time, revise these plans continuously and communicate every change of state. Various tools and methods are available to support these. Like having an agreed set of communication tools, a common time planning procedure should be agreed to every participant has access to. Once timelines have been set, they need to be communicated and continuously revised and updated. Communication of complete time plans are encouraged since it will help to understand complexity and interdependencies between tasks and milestones. It will also help to communicate what impact a missed timeline would have. The use of early reminders can help to keep team members informed and alerted about their tasks.

In conclusion it can be said that communication again is the key to success. This is very important to understand since often communication is reduced to save time, which would have an opposite effect for management of large scaled simulation networks.

3.2.4 Management of Subsystems

Systems of Systems like the EMSN have two levels of responsibility. Most of the responsibility for resources lies at subsystem level, since resources like simulators are owned by the participating members of a simulation network. Only minor resources (and responsibility for it) reside at super system level, mainly resources for overall management and coordination. This has an advantage for a manager of a simulation network who just has to make sure that a required subsystem is made available by a party due to agreement. It is usually up to the owner of the subsystem to make sure how it is achieved. The disadvantage is that simulation managers in return have to make independent agreements with these owners and still meet a common goal. Having communicated such a common goal will improve cooperation and availability of resources.

Simulation network management has to assure that all required assets are available to meet the agreed objectives by making agreements with all system owners. The use of standards does help to include heterogeneous systems. EMSN would not be possible without reliable and standardized interfaces like Virtual Private Networking (VPN), *IEEE (1996)* (DIS), or even TCP/IP which drives the data on the internet. Heterogeneous simulation systems will usually use different data sources as input and will produce different types of data as output. Consistency of data needs to be addressed to make sure that system behaviour is as expected and results are valid. Simulation exercises will need a common ground of data for both objects and environment. Management of a simulation network has to make sure that such common data is available to all participants.

The use of standards might lead to adaptations to existing systems in case they do not already meet these. These adaptations are less expensive than new systems and ensure a future extension of the whole system at all.

3.3. Economic Aspects

Creating a complex system like EMSN with all its subsystems from scratch would be very costly while still bearing the technical risk of a new development. Therefore it was obvious to use existing simulation systems and connect those to a larger network. To get a realistic view on the overall costs of a simulation network, each case has to be investigated individually. But for a general overview a few assumptions can be made.

Two major costs can be defined, which are initial readiness investments and runtime costs.

3.3.1 Initial investments

In case existing simulator equipment does not already feature agreed standardized networking interfaces like DIS, *IEEE* (1996), or HLA, *IEEE (2010)*, such capabilities have to be integrated at an initial cost. For today’s modern simulation systems, this should be possible at about 10% of the initial price of a simulation system. This figure is a rough estimate and your mileage may vary significantly depending on the size and complexity of your system. Also the amount of features implemented will have an impact.

Installation of performant internet connections and required networking hardware is the second position on the list of initial investments for a simulation network. This can range from a few hundred to a few thousand euros, depending on the size of the targeted simulation network.

Investment for communication equipment and collaboration tools is the last but not least since we have already seen how important communication is for the success of the simulation network. Those costs vary depending on the agreed set of communication tools. Small sized simulation networks can easily be organized using free or least cost communication tools like email, phone, skype or any of the various online project management tools. Due to the vast amount and variety of such tools, it is left to the reader to choose the ones that fit in terms of functionality and budget. As for the EMSN email, phone, teamspeak and projectplace (www.projectplace.com) have been chosen as appropriate.

3.3.2 Runtime costs

Once everything is at hand and a simulation network starts working, runtime costs will be generated. Due to the nature of the chosen system of systems approach it is important to differ between costs at subsystem level and costs at SoS level. Usually they are separate legal entities and therefore independently responsible for these different costs.

Most of the costs during runtime of the network will sum up at subsystem level where the simulation systems reside. Simulator sites are responsible for most of the hardware and personnel by far where they will have to plan resources for test or training sessions, maintain the systems and operate them during exercises. Additionally normal runtime costs for site infrastructure, system consumption and replacements occur. It is very important that these costs are estimated at forehand according to the agreed test plans. Handling of these costs and possible compensations are an important part of agreements between subsystem and SoS level. Unclear responsibility for these costs and possible claims for compensation are a serious risk for the success of a large scaled simulation network and should therefore be dealt with accordingly.

At system of systems level runtime costs are easy to plan. The general manager of the whole network, technical support manager and network coordinators will sum up to most of the cost at SoS level. Only minor hardware and infrastructure costs will occur, usually only equipment for primary and backup hubs, high performant internet connections and a small set of monitoring hardware (PCs or laptops).

4. Outlook and Extendibility

The European Maritime Simulator Network has been designed to be flexible and easily extendible. This has been made sure due to the chosen system of systems approach, topology, technologies and the consequent use of standardized hardware and interfaces. Such an approach also pays respect to cost and risk minimizing at the beginning, where most of the participating parties did not have substantial experience in running and managing a large scaled simulator network. While experience grows and members of the EMSN discover the capabilities and chances of such a network, ideas are spread and network enhancements can be made step by step. Parts of the network can be used independently or in parallel to running operations if approved. The system of systems approach supports such independent operations resulting in a boost of efficiency while it is still strongly advised to agree upon parallel operations to avoid unwanted interference.

Given the general infrastructure and know-how the European Maritime Simulator Network can unleash its full potential in the future by adding new members and supporting new applications. Once a new member has a network enabled simulator it can easily join with a minimal set of networking hardware. Basically it is as easy as plugging a networking cable into a box (EMSN spoke router) which is connected to the internet. By using standards wherever possible, the entry barrier is kept extremely low which shall open the door for as many as possible interested parties.

Possible new applications can be all successors of MONALISA 2.0 as well as training cooperation, or commercial services. Simulator operators could offer simulation services like risk analysis, naval design or maritime consultancy services to interested parties. At the first time a commercial simulator network at this scale is available to interconnect different types of simulation to test, evaluate and train interdependent chains that have not been evaluated before. Optimization of logistic chains or onboard communication procedures for instance can now be brought to a new level. All kinds of IP-based connections can be realized using the EMSN in a secured, monitored and supported environment. This gives a great flexibility to all kinds of new applications. There only few technical limitations like bandwidth and router performance but even those can be scaled. The network can change its size instantaneously as needed where new members can commit for an intermediate amount of time only if wanted. This gives a great flexibility in terms of predictability of budget and commitment.

5. Conclusion

Setting up a simulator network like EMSN needs four things: Network enabled simulators, appropriate infrastructure, know-how and a good reason. The last one was given by the subjects of MONALISA and MONALISA 2.0 who defined the need for a test bed to test and evaluate their concepts, procedures and applications. The other three prerequisites were provided by the participating members of MONALISA 2.0. Thanks to the great team play within this project the EMSN became a success story. Other than expected a large scaled simulator network like the European Maritime Simulator Network is not a technical challenge at all, but a challenge of collaboration. Once the network is installed it is totally up to the participating parties to make good use of this powerful platform. It is like a technical (play-) ground to test and evaluate new ideas and to train what has been proven to be worth. Whatever is built upon this ground has to be thought, agreed and collaboratively implemented first. Therefore management of such a simulator network using strong communication skills is the key to success. Good management of assets, time, people (and their stakes) will keep the parties together and form a community. This is the most essential part of the network.

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