Water Services as Critical Infrastructure

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INTRODUCTION

The functioning of modern societies has become more and more dependent on critical infrastructures, such as water services systems. Our societal well-being is fundamentally built on the reliability of these systems, and the services they provide are essential to the resilience of communities, i.e. the ability to cope and recover after crises [1], [2] . The co-evolution of infrastructures and society results in the fact that the convenience, safety, and healthiness of everyday life are bound to, and our societal processes rely on the access to, infrastructures and their impeccability. Societies are thus increasingly vulnerable to disruptions in these infrastructures. [3]-[5]

Many tools have been developed for water services operators to manage risks and to improve their operational capabilities in case of disruptions. For example, Water Safety Plans (WSP) and Sanitation Safety Plans (SSP) are now widely employed in the water sector. These tools, however, do not pay attention to serious disruptions of human origin (e.g. terrorism) but focus on the prevention of emergencies in circumstances that are controllable and knowable; cause and effect can clearly separated by analytical tools, and predetermined operating procedures can be applied [6]. In the ever more complex world where the functioning of our societies depends on highly interdependent critical infrastructures, it is debatable whether these conventional risk management tools suffice.

MATERIALS AND METHODS

Discussions presented here are based on KIVI (*Vulnerability of Critical Infrastructure and Operational Capability of Authorities*) project. The aim of the project is to enhance capacities in the anticipation of crises and create preparedness for disturbances among the respective authorities and service providers especially for situations that are caused by intentional or unintentional human acts. It specifically focuses on the examination of disturbances of critical infrastructure in urban contexts.

The project is based on the concept of comprehensive security as it has been defined in the Finnish Security Strategy for Society, according to which, securing of critical societal functions should be carried out in collaboration between the authorities, the business sector, and citizens [7]. The resilience of critical infrastructure is defined here as the system's ability to absorb disruption effects and to reorganize in order to maintain crucial functions, the most necessary structures and identity [8-9].

This poster is based on literature review and observations made throughout the project. The KIVI project has involved the development of a self-evaluation tool (stress test) for service providers, and the construction of an educational concept for police and other authorities. Regional preparedness exercises and a scenario-based workshop have functioned as a key source for the development processes. Much of the collected information is confidential or security sensitive. Therefore, phenomena discussed here are treated in a way and at a level that respects the requirements of enhanced security.

RESULTS AND DISCUSSION

Interdependency is a key characteristic of critical infrastructure referring to the mutual reliance of an asset, system, or network on an input, interaction, or other requirement from other sources in order to function properly [10]. The number, density and importance of interconnected networks have grown immensely. For example, ICT networks are entwined with practically everything nowadays. As interdependencies grow, the overall complexity is apt to increase, and have an impact on risks and vulnerabilities [11-13]:

- The potential of cascading and escalating effects is increased,
- New kinds of vulnerabilities are revealed that in normal situation are hidden in the interdependencies and the functionalities of various interfaces of systems,
- Possibilities for causing intentional harm and damage are also increased.

To sum it up, because of the interdependencies disturbances to critical infrastructure can be nonlinear and unforeseen. Therefore critical infrastructures are more vulnerable to systemic risks and the possibility of unpredictable and extensive failures [14]. As the development of these systems has been incremental, many of these interdependencies also develop incrementally, and have not been considered when the systems have been designed, built and developed. Hence, it is not clear how and which other systems a system is dependent on. Thus, the key issues when considering disturbances of critical infrastructure, are uncertainty and ignorance.

As the interdependencies can intensify disruptions, they are therefore a potentially interesting instrument for causing international harm, e.g. for terrorists [15], [16]. By exploiting critical infrastructure, terrorists can manifest and symbolize the vulnerability of social order. In this case, the operational logic would be completely different in comparison to cases with disturbances caused by a storm, malfunction, or human error. For example, intentional contamination of drinking water biologically or chemically would alter the systems producing public health and mundane convenience to a system spreading disease, death, mistrust, and fear in a way that would make it one of the most effective instruments for terrorism [17], [18]. From a mechanical point of view, the system would work perfectly, but its ultimate purpose and quality would have been manipulated.

RESULTS AND DISCUSSION (cont.)

Water services management, as the management of other critical infrastructures, has shifted ever more to the hands of highly specialized professional groups [19] . For water engineers, this expert approach has been based on prediction and control [20]. Through this fragmentation, the security and resilience of critical infrastructures are largely seen as an inter-organizational issues, something that can be managed separately from other systems. In a sense, it can be argued that this has enabled water services sector to develop ever more efficient procedures for risk management.

However, the problem is that connections to overall security have been weakened and false sense of all risks being under control is generated. At worst, water supply providers perceive it as a success if they do better in preparedness exercises than the surrounding community, whereas, it is quite clear that in real life it gives hardly any comfort or satisfaction if everything else in society collapses but water supply works. In regional preparedness exercises, participants representing different organizations keep going more or less as separate entities who, at best, communicate with each other. As a result, the responsibility for overall security and interdependencies remains vague.

A severe disturbance to critical infrastructure exposes unpredictable interdependencies and causes cascading effects that do not align according to the conventional structures and hierarchies of risk and safety management [21], [22]. In the development of KIVI educational concept, it has been concluded that rather than presenting exact operational guidelines, it is necessary to provoke learning by posing inconvenient and challenging questions. Furthermore, in the development process, the recognized key competencies are focused on the fostering of collaboration and enabling flexible, adaptable and post-bureaucratic operational models.

However, the current modes of operations are resistant to change. For example, in the development process of the KIVI self-evaluation tool, it has proved difficult to build a tool that would not give clear-cut answers and instructions on how to operate in a crisis. Furthermore, the thought of somebody intentionally harming critical infrastructure like the water provision system seems incomprehensible, and thus risk management is solely focused on the controllable and knowable.

CONCLUSIONS

- Strengthening the resilience of water services systems requires understanding that the traditional way of tackling vulnerabilities through identification, knowledge, control and management does not do the trick in a world of systemic and interdependent vulnerabilities.
- Authorities (e.g. police and emergency) need a better understanding of critical infrastructure systems and their interdependencies, i.e. understand their criticality.
- Future water leaders are encouraged to examine water services as a part of networked entity, further their understanding on interdependencies and develop competencies on collaboration.

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