## Rapport självständigt examensarbete

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<th>Kurs: Masteruppsats i försvarssystem</th>
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<td>Kurskod: 2FS003</td>
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<td>Handledare: Eva Lagg</td>
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**Titel:** The Total Defence Boardgame: Using Game Based Learning to introduce systemic understanding of Swedish total defence

**Sammanfattning**


Studien har en designvetenskaplig forskningsansats och använde Arnold and Wades systemstänks matris som grund för spelets lärandomäl. Utvecklingen av spelet bygger till stor del på metodik hämtad från serious gaming, krigsspel och spelpedagogik.

Resultatet av studien var att ett antal punkter av intresse för spelutveckling kopplat till komplexa system identifierades. Bland annat så stärkte resultatet idéen att använda spel som pedagogiskt verktyg. Studien påvisade även vissa svårigheter med spel och komplexa system, där ibland utmaninger kopplade till att skapa ett spel som rättvist avbildar även de dolda relationerna inom ett system.

**Keywords:** Systems thinking, Defence systems, Totalförvar, Totaldefence, Tabelltop games, DRSM, Game based learning, Education, GBL, defence systems, försvarssystem.
Titel: The Total Defence Boardgame: 
Using Game Based Learning to introduce systemic understanding of Swedish total defence

Abstract
This report examines how games can be used to communicate and teach complex system structures. In collaboration with the total defense research institute, a game is being developed to introduce operational analysts to the Swedish total defence. The target group for the game lacked both experience in systems thinking and total defense, which is why the game was considered a good method to test.

The study has a design science research approach and used Arnold and Wade’s systems thinking matrix as the basis for the game's learning objectives. The development of the game is largely based on methodology taken from serious gaming, war games and game pedagogy.

The result of the studies was that a number of points of interest for game development linked to complex systems are identified. Among other things, the result strengthened the idea of using games as an educational tool. The study also demonstrated certain difficulties with games and complex systems, where sometimes challenges were connected to creating a game that fairly depicts even the hidden relationships within a system.

Keywords: Systems thinking, Defece systems, Totalförsvar, Totaldefence, Tabeltop games, DRSM, Game based learning, Education, GBL, defence systems, försvarssystem.
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ago.
1. Introduction

In the view of a systems thinker, there are systems everywhere, and without understanding of the system and its environment, little can be said about the functions of internal entities of said system. (Lawson, 2010). We are living in a complex world that increasingly challenges the human capacity to understand and manage interdependent and puzzling issues, issues that appear to become more common and more complex as science pushes the frontier of yesterday’s impossible. It has become increasingly clear that these challenges require a holistic perspective both to be understood and to be solved.

1.1 The problem

In Swedish law (1992:1403) om totalförsvar och höjd beredskap, total defence is defined as “the preparations and planning required to prepare Sweden for war.” Total defence is also described in the same law as all activities that should be conducted in society during the highest level of preparedness or war. The total defence consists of both military defence and civil defence. In accordance, the Parliament, the government, governmental authorities, municipalities, private enterprises, voluntary defence organizations as well as individuals residing in Sweden are all part of the total defence. The concept is also closely connected to Swedish crisis preparedness and response system, as the two systems both serve to create security for Swedish society (Utredningen om civilt försvar, 2021). To better understand the concept, one might consider the concept of total war.

The term total war was coined during the interwar period between the first and second world war. It was first made popular when used by the German general Erich Ludendorff in his book “die totale krieg” where he examines the reason for the German failure of the first world war. Ludendorff argued that this new form of war included not only the military but required the whole of society to mobilize in the event of war (Honig, 2011). In Sweden discussions of total defence began during the second world war as a response to the total war; although some aspects of total defence have historically been part of the Swedish system before the concept was named (E. Andersson et al., 2021)

During the 90s, parts of both the civil and military defence was dismantled due to the calmer geopolitical situation around the Baltic Sea. After the Russian annexation of the Crimean Peninsula in 2015 the total defence planning was reactivated and have since been given growing attention.

The total defence system consists of a large number of actors, technology and relationships that makes it difficult to overview the system. According to multiple studies (Asp & Fors, 2018; Lindgren & Ödlund, 2015) the actors within the total defence need knowledge of, and be able to identify these different entities in order to make efficient decisions. Swedish Civil Contingencies Agency also stress the need for actors to see themselves and their response to a situation as a part of a larger system (Gemensamma Grunder För Samverkan Och Ledning Vid Samhällsstörningar, 2018).

A study from 2021 concluded that the growing ambition of the total defence will result in challenges regarding staffing within the organisations connected to total defence (Olsson, 2021). Many of the tasks within the sector require not only knowledge about the total defence but also other skills (i.e. information security, operational security). This duality of skills often requiring organisations to train new employees within one or the other. As the total defence grows there is a risk that governmental organisations start to compete for individuals within the same limited workforce (Olsson, 2021). Olsson concludes that a quickly growing total defence ambition may lead to suboptimization if the need for educated personnel cannot be balanced between different actors and the availability of such personnel.

Systems thinking, being an interdisciplinary research field (or meta perspective) have been applied in a vast number of fields (Skyttner, 2001). Topics of military development, political science,
and security are no exceptions and systems thinking has been proposed as a promising venue for solving complex problems (Yoon et al. 2017), dealing with the twenty-first challenges (Binkley et al., 2012), improving leadership skills (Palaima & Skaržauskiene, 2010)(Palaima & Skaržauskiene, 2010), development of innovative technologies (Grissom, 2006), understanding and analysing military utility (K. Andersson, 2018), improving operational analysis (K. Andersson et al., 2015); and so on. The personnel needed and their ability to see both the system and their own expertise creates an overlap between what knowledge is needed of the total defence system and general systems thinking. Following the reasoning of Jaradat (2015) about systems thinking and governance, a general system thinking perspective and ability should help individuals to better understand the total defence and quicker develop the specific knowledge needed as different actors within the system.

Multiple studies have explored and advocated for the benefits of integration of systems thinking in both higher and lower education (e.g. Richmond 1991; Wheat 2007, 2008; Frank and Kordova 2013; Pavlov et al. 2014) (Elsawah et al., 2022). There have also been multiple studies on how to educate people in systems thinking with different approaches and various success. Jensen (2014) found that students that had received formal training in how to model systems, where no more likely to use such models to solve a problem than students that had not received such training. She suggests that this could be due to lack in the students (with training) experience of using models rather than just model system structure. Akcaoglu & Green (2019) found that middle school students that were introduced to (computer) game design through 11 one hour sessions advanced their problem-solving capability and systems thinking compared to their peers. Assaraf & Orion (2005) developed a junior high school program “The blue planet” consisting of multiple types of learning experiences (laboratory and outdoor learning inquiry- based activities) and found that through instruction that is carefully sequenced (hierarchically) systems thinking can be taught. Kali et al., (2003) found that a short (4-hour) learning activity helped students advance in their systems thinking. Their result also showed that general awareness of the holistic aspect of a system does not necessarily foster systems thinking. Hung (2008) finds that educating students in system theory and allowing them to practice systems thinking have positive effect on their systems thinking ability.

The purpose of this thesis is by using the methodology and structure of design since research (DSR) explore tabletop1 games as a part of a solution to the problem of how to both quickly and efficiently introduce the Swedish total defence system to individuals without prior knowledge about the system and systems thinking. The aim of this thesis is (therefore) to design an artifact with the theoretical framework of systems thinking and game-based learning to suggest one possible solution to the problem of making the complex system of Swedish total defence comprehensible and accessible for individuals without formal training in either systems thinking or the total defence system.

1.2 Design science research
Design science research (DSR) have been utilised in a large number of different disciplines and is commonly used within the information systems (IS) discipline (Thuan et al., 2019). IS focus on information systems where information technological (IT) often is an inherent part of studied system, Within the systems science for defence and security field, security is instead the unifying concept. Both fields stemming from a systemic perspective, overlap is expected and is why the theories and methodology successfully used within IS should most likely be suitable within the field of systems science for defence and security. The paradigm of DSR focus on creation of artefacts in order to both explore problems and solutions (Thuan et al., 2019) why it is suitable for this thesis where the goal is to create an artefact, There are however multiple different methodologies and recommendations on how to perform DSR.

This thesis employs the design science research methodology (DSRM) suggested by Peffers et al (2007). Their method developed foremost for development of IS, is adaptable and useful for other

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1 Tabletop games and board games are used synonymously within this thesis.
DSR undertakings and offers straight forward gradience throughout the process. Peffers et al methodology consists of six activities:

Activity 1: Problem identification and motivation. In this chapter the reader have been introduced to the motivation of why a solution is needed to the growing problem of shortage of individuals with combined competencies consisting of both systems thinking, knowledge of the Swedish total defence and special competencies.

The second activity consists of defining the requirements of any solution and explore other solutions and artefacts that relate to the identeified problem.

Activity 2: Define the objectives of solution. Within chapter two the problem is partitioned into three aspects of the design of an educational game with emphasis on systems perspective. The first aspect, Systems thinking relies on a definition and suggestion on how to evaluate systems thinking by Arnold and wade (Arnold & Wade, 2017). The second aspect focus on the system in focus (the Swedish total defence). By aggregating previous work regarding knowledge is needed within the system, with stakeholder discussions at FOI. A set of learning objectives where developed. The third and last aspect is the artefact itself and requirements derived from previous knowledge of educational tabletop games.

The third activity is the design and development of the artefact. Peffers et al recommended that this activity is split int sub activities using a suitable model for what artefact one is designing.

Activity 3: Design and development. The third chapter consist of the development both processes used for development of the game, and the development of the game itself. Using a combination of three methodologies (Duke, 2014; Lukosch et al., 2018; Nicholson, 2011) a suitable design process given the limitations and constraints of the study is produced and applied. The latter part of chapter three displays parts of the artefact and highlights various design choices made during the development.

The fourth activity consists of demonstrating the artefact and how it aims to solve the problem, During the demonstration the researcher may choose to collect data for the fifth activity of evaluation the artifact.

Activity 4: Demonstration. During the development of the artefact multiple playtests were conducted with different audiences to get rapid inputs during the design. A final play session was held with eight players, the session and its outcome can be found in chapter four.

Activity 5: Evaluation. The game was evaluated by the use of semi-structured interviews where the different game aspects and learning goals were explored. The results of these interviews can be found in chapter four and the following discussion can be found in chapter five.

The sixth and concluding activity is the communication of the results. Peffers et al suggests that one design the communication to fit the media of communication ad to expectations of structure of whoever is the intended audience.

Activity 6: Communication. Due to the novelty of design science research for most of the expected readers of this thesis (students and teachers at the Swedish defence university) a structure following the activities of Peffer et al was selected as to help the reader understand the different steps of the research process. The structure is intended to make the work more transparent and contribute to the quality and evaluability of the research.
The study takes a design and development centred approach, where the ‘tabletop games for education’ represent an artefact not yet used or thought of as a solution to the named problem. The initialisation of the study were therefore not in the first activity but in the third. Pettfers et al (2007, p. 56) states that “there is no expectation that researchers would always proceed in sequential order from activity 1 through activity 6. They may actually start at almost any step and move outward.” The game and this essay have been developed within the structure of a master’s degree project at the Swedish defence university and the project have been conducted in cooperation with The Swedish Defence Research Agency (FOI). The project is part of the effort of FOI to explore and evaluate new methods to use within their activities.

Figure 1 DRSM Process Model (Peffers et al., 2007, fig. 1)

2. Learning objectives and project requirements

The objectives of solution derives from three different aspects of game design. Part of the goal is to achieve a systems perspective on the total defence, the first group of learning objectives and requirements is therefore gathered from literature on systems thinking. The second group of learning objectives stem from knowledge needed according to stakeholder within the total defence system. The third and final set originates form game design and the game-based learning literature.

The targeted audience of the total defence game are firstly and foremost people with little or no prior knowledge of the total defence system. Some knowledge of the Swedish governmental system is expected as the targeted audience at the very least is expected to have completed a Swedish high school education. The educational goal of the game is therefore formulated at a level that requires little or no prior knowledge about the Swedish defence system or system thinking methodology.

Designing a game for education is about a balance of complexity, enjoyment, and learning (Abdul Jabbar & Felicia, 2015; Luis Garcia-Barrios et al., 2016; Pelser-Carstens, 2019). Making an all-inclusive comprehensive list of educational goals might be appealing as the teacher want to broaden the knowledge of the students as much as possible. The problem with such an approach is that in the case of complex systems (such as the total defence) such a list would most likely cause the game to become much too complex for the players to understand and enjoy, thereby defeating the purpose of

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2 Social sciences 1 And History 1 is part of the education that are compulsory in all Swedish high school programs (Läroplan, Program Och Ämnen i Gymnasieskolan - Skolverket, n.d.) These to subjects should give the audience basic knowledge about the Swedish model of governance and administration.
the learning activity. In this study and the developed game however, the aim is that the players from comprehension about the complexity of the system, therefore there a balance much be reached between educational goals connected to the total defence, complexity of the model and the ability to learn. Making the game to simple won’t allow the students to explore the complexity of the total defence, making it to complex will most likely lead to a learning activity more focused on learning the game mechanics instead of fulfilling the educational goals.

The first and second step of the game design structure developed in chapter 3.1.1 is introductory analysis of the system of interest and constructing a design document containing learning objectives. The aim of the introductory analysis is not to create a complete systems model but creating a mental model of the system to understand the language of the system and early try to find any bias or misconceptions. Three types of sources were identified and used during this step. Publications from FOI and CTSS, information made readily available by governmental agencies created with the aim to introduce citizens to the total defence. Documents created by governmental agencies designed to be used by other agencies. The last group mainly consist of laws, regulations, and responses to suggestions of such laws and regulations. During the initial analysis stakeholders from FOI was included mainly as a source of information and to find material.

After the initial reading it was decided that focus of the game should be on the civil part of the total defence. The reason for this decision is that the intended user, the operation analyst is expected to gain knowledge about the military part of the Swedish total defence as they work within the military system. Knowledge connected to civil defence therefore seemed to be harder to come by. Since the research question did not require a specific system such a delimitation was deemed to be within the scope of the research project.

2.1 Systems thinking

The underlying idea of systems thinking might be as old as Aristoteles argument; that the whole is more than the sum of its parts (Checkland, 1981, p. 75). But it was not until the 1980 the concept by authors such as Checkland, Forester and Richmond began to form as a scientific paradigm. The original source and meaning of the concept have been debated (Arnold & Wade, 2017; Checkland, 2000; Monat & Gannon, 2015) and there are no commonly accepted definition of systems thinking as of yet.

Monat and Gannon (2015) preform a review of the most widespread systems thinking literature to identify common themes of systems thinking. From their research they suggest that systems thinking is trilateral and consists of (1) a perspective, (2) a language, and (3) a collection of tools. Their definition is useful as it can help to identify different aspects of systems thinking, the usefulness is however limited when using such a multiplete definition as it provides little guidance on what to exclude. Would for example any new tool that allowed researchers to study systems be part of Monat and Gannons System thinking or is it limits to the tools developed prior to their study. In either case the result would be problematic as it would not be the definition that sets the boundaries of the concept.

Arnold and Wade (2017) have a somewhat different approach to systems thinking and define it as a skill. Arnold and Wade argues that the definition of systems thinking should be viewed as a goal-oriented system and therefore need to be subjected to what they explain is a systems test. The test is described as relatively simple and consists of three “things”: Purpose, Elements, and Interconnection. They perform this test on multiple definients from systems thinking literature (to some extent same literature as Monat and Gannon (2015) but mostly not) and find that all definitions fail the test. Arnold and wade suggest the following definition that they argue at least can succeed in their test and therefore is better the other examined.

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Filip Brolin
“Systems thinking is a set of synergistic analytic skills used to improve the capability of identifying and understanding systems, predicting their behaviours, and devising modification to them in order to produce desired effects. These skills work together as a system.”

(Arnold & Wade, 2017, p. 675)

Monat and Gannon critique Arnold and Wade for creating the systems tests as a requirement without a good argument for why it would be important (Monat & Gannon, 2015, p. 17). Describing systems thinking as a set of skills is however useful since as skill is something that may be developed. Neither definition might be perfect, but for the purpose of this thesis Arnold and Wades definition is useful.

**Systems thinking as a skill**

The “set of synergetic analytic skills…” that “…work together as a system” have been defined and grouped into four categories by Arnold and Wade; Mindset, Content, Structure, And Behaviour. Each category are divided into subcategories that make up a total of nineteen different skills with an individual can be more or less mature in (Arnold & Wade, 2017)

As will be discussed in chapter two, Design and development, creating an educational game requires finding balance between playability, enjoyment of play and educational purpose. As to not make the design process to lengthy, nor the game too complex for playability within the time restrictions four of Arnolds and Wades subskills were selected to be incorporated in game design.

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<tr>
<th>Subskill in Arnold and Wade</th>
<th>Description by Arnold &amp; Wade (2017)</th>
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<tr>
<td>1.2 Consider the whole and Parts</td>
<td>“A systems thinker considers both the “forest and the trees” (Richmond, 1994). An appreciation for both the wholes and parts, simultaneously, is a critical systems thinking skill (Richmond, 1993; P. Senge, 1990; Stave &amp; Hopper, 2007).”</td>
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<td>2.3 Differentiate and Quantify Elements</td>
<td>“Understanding and differentiating between the elements in a system, such as their properties, types, and natures, are critical to understanding systems (Plate &amp; Monroe, 2014; Stave &amp; Hopper, 2007). Differentiating types of stocks, flows, and variables as described by Plate and Monroe (2014) and Stave and Hopper (2007) is a part of this skill. In this case, stock refers to any storage or resource pool within the system. Stocks could range from physical, like the amount of water in a bathtub, to abstract, like the trust level in a relationship between two people. Flows are changes to stocks, such as information flows, energy or material flows, or even decision-making flows.”</td>
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<td>3.1 Identify relationships</td>
<td>“Recognizing that two parts of a system are related in some way is a basic systems thinking skill (P. M. Senge, Kleiner, Roberts, Ross, &amp; Smith, 1994; Squires et al., 2011; Stave &amp; Hopper, 2007). Relationships are often called interconnections, or just connections. Increasing levels of maturity in this skill are demonstrated by the ability to recognize increasingly non-obvious, more complex and less visible connections.”</td>
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<td>4.3 Respond to Changes over Time</td>
<td>“A key systems thinking skill is the ability to effectively respond to changes in a system over time (Waters &amp; Waters, 2014), rather than treating a system as an unchanging entity. If an effective strategy is discovered, it can be easy to continue to apply the same strategy to a system repeatedly. However, systems can change in significant, strategy-breaking ways. A systems thinker needs to continuously evaluate whether a given strategy is still valid, or whether system behaviour has become fundamentally different due changes that have occurred over time”</td>
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To capture an opportunity of practising and maturing these skills the following requirements on the artifact was developed:

The Attract must be or contain; a system of different parts (1.2) that are distinguishable by someone untrained in systems thinking.

The different parts need in turn represent different types of entities and flows (2.3) that have both outspoken and non-obvious relationships (3.1).

The system need to evolve and change over time in a manner that challenges the user to adapt their understanding and develop new strategies to evaluate the system (4.3).

2.2 System specific.

In 2015 FOI explored by request from MSB what knowledge-needs actors within the total defence considered important both for their own organizations and for others in within the system. In 2018 CTSS was given the task to formulate learning objectives for civil defence education. Both studies relied on interviews and surveys with governmental actors as source material. The developing learning objectives for the Total Defence game takes its starting point from the results of these two studies. The learning objectives have later been discussed with experts at FOI both on game design and total defence to ensure their validity and suitability for the project.

Lindgren and Ödlund (Lindgren & Ödlund, 2015) used interviews and surveys sent to three groups identified as important by MSB, MSB personnel who were part of different total defence development projects; County administrative boards and central governmental agencies were approached with surveys. A limited number of municipalizes, other governmental agencies and actors were also sent the surveys. Ten county administrative boards took part in a workshop exercise with the same subject as the survey. Lindgren and Ödlund presents the need for education prioritized according to the actors. Recurring between the three groups are need to understand who are the actors and who do they work together within the total defence. What do different levels of level of preparedness. mean for different actors mission and objectives. Law related to level off ?? And the toral defence. Both MSB and the central administrative agencies highlighted the knowledge of how to work with classified information. The county administrative boards where the only actors that lifted knowledge about flows of a non-information nature. The result of the study includes both the educational need in the manor of what sort of education are needed for whom and what knowledge is needed.
Asp and Fors (Asp & Fors, 2018), similar to the FOI study used a mixed method of interviews, surveys and workshops. They also included document analysis in their study. One of the referenced documents is the study form FOI described above so some overlapping of results is to be expected. The aim of Asp and Fors is to examine what knowledge different groups need. The examined groups are defined as; Everyone, this group is considered to be everyone living in Sweden, the general public; Many, the group “Many” includes everyone that have an assigned task in the event of heightened readiness. This is however not exclusive to individuals that have a declared wartime posting but anyone that have a task that is connected to total defence and/or have a task that need to be solved in wartime; Few, the group “Few” is divided between the subgroup decision makers and experts.

Educational goals for the first group, “Everyone”, focus on basic knowledge about the different parts of the total defence and reasoning behind why we have a total defence and potential threats to Swedish society. “Many” need to be able to work with secure information, both in aspects on how to safeguard information and identify such information. They also need to be able to relate threats to grey zone conflicts (implying that they need some knowledge of what is grey zone), their knowledge of actors within the total defence needs to be greater than the knowledge of everyone in aspect of not only naming actors but also have some knowledge about different actors’ responsibility within the total defence. Finely, sense individuals of the group “many” all are part of organisations within the total defence they will require some knowledge about their own role and the role of their organisation.

The two studies highlights that the need for knowledge is very broad for someone who will work with total defence. The following themes were identified in both studies; Threat knowledge, Shared conceptual framework/language/methods, Knowledge of bot Swedish and international law that effect the system, knowledge of who are the actors within the total defence, how to work with sensitive information, dependencies within the system and within society, goals and objectives of the total defence in order to create a coherent approach, and what effects and requirements the systems creates on an individual level.

Both studies also discussed the specific knowledge needed to succeed in as a specific actor within the system, that is the knowledge not everyone of the system needs but is needed within the system. See table 2.1 for a full list of learning objectives and themes.

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<tr>
<td>Threat</td>
<td>Better understanding of different threats to Sweden.</td>
<td>Give examples of what attacks on Sweden can look like. Relate to different threats and grey-zone conflicts. Explain the current consequences threats against Sweden can have for the own organization.</td>
<td>Psychological defence - Information operations - Propaganda Modern conflicts and internationalization - Current threats against Sweden - Modern wars - Gray zone problems - Nuclear weapons / CBRN</td>
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5 Translated from Swedish
<table>
<thead>
<tr>
<th>Shared conceptual framework/Language/Method</th>
<th>Law</th>
<th>Actors within total defence</th>
<th>Sensitive information</th>
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<tr>
<td>Create common operating picture based on given frames. Describe the methods / tools that are available for planning and management. Be able to apply the methods / tools that are available for planning and management. Name different total defence actors responsibilities. Relate to different actors responsibilities.</td>
<td>Knowledge about law and regulations concerning different levels of preparedness Knowledge about international law</td>
<td>Better understanding of who are the actors of the total defence</td>
<td>Knowledge about information security and confidentiality.</td>
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<td>Locate checklists for secure management of sensitive information. Identify what information is sensitive. Use secure communication systems for handling and sharing sensitive data.</td>
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<td>Security protection - Information security - Communication system - Physical security</td>
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**Psychological defence**
- Information evaluation

**Responsibility of total defence actors and collaboration**
- Functions / structures for collaboration and situational awareness

**Security protection**
- Communication system

**Constitutions, management and governance**
- Sweden's political and administrative system - Total defence legislation - International law - Differences from crisis preparedness

**Total defence**
- Why do we have a total defence - Total defence elements The functionality and dependencies of society - Private-public collaboration

**Responsibility of total defence actors and collaboration**
- Responsibility and role for security authorities, the Armed Forces, municipalities and county councils as well as business
| International examples | Knowledge about other countries total defence systems. | Give examples of how society comes to function at heightened readiness / war. | The functionality and dependencies of society  
- Society's vulnerability  
- Mutual dependencies  
Modern conflicts and internationalization  
- International agreements and collaborations |
|------------------------|------------------------------------------------------|------------------------------------------------------------------|------------------------------------------------------------------|
| Dependencies           | Knowledge and understanding of internal and external dependencies. | Describe how a coherent total defence planning should be conducted. | Responsibility of total defence actors and collaboration  
- Coherent total defence planning |
| Coherent               |                                                      |                                                                 | Security protection  
- Personnel safety |
| Organization specific  | Identify one’s own organization’s responsibility and role at heightened preparedness and war  
Evaluate how your own organization solves tasks during heightened preparedness / war  
Contrast the own organization’s responsibilities and role in heightening preparedness and war against others.  
Describe the individual role and own tasks at height preparedness and war. | Actor-specific  
- The organization's own planning for heightened preparedness and war:  
  o Responsibility and role  
  o War placement of personnel  
  o War organization |
| Individual             | Identify how the duty of serving within the total defence can affect the individual.  
Give examples of things that are good to have in the household’s crisis box.  
Name warning systems that exist for to alert the population. | The individual  
- Responsibility and role  
- Home preparation  
- Everyday life during heightened preparedness and war:  
  o Psychosocial impact  
  o Population protection |

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6 Totalförsvarsplikt
2.1.1 Identified themes and learning objectives.
The themes identified have been discussed with experts both on game development and the total defence to identify what themes were suitable as learning objectives for a tabletop game. This resulted in the following learning objectives.

Actors within total defence

*The players should be able to name important actors of the total defence and their main responsibilities.*

This could in some aspects be seen as the main objective of the artifact as the ability to understand a system one need to have at least basic knowledge of how it consists of different entities, being able to only name actors and their responsibilities are not in itself enough of a learning objective. Such knowledge alone does not provide any understanding of how these parts “or actors” are a whole.

Threat

*The players should be able to give some suggestions off different threats that could occur during grey zone conflict and discuss what effect these threats may have on different levels of society.*

Threat identification and knowledge was deemed important in both studies. Adding some kind of threat is often useful in cooperative games as a driver to force player action (i.e. spreading fire in Flashpoint Fire rescue. Or zombies in Escape: Zombie City).

Shared conceptual framework/Language/Method

*The players should after the game have some basic knowledge of the conceptual framework of the total defence after playing the game.*

The game would have to use language in some form to communicate the knowledge, it is important that the artifact does not contribute to conceptual confusion. This learning goal works therefore both as a learning goal and a requirement on the game.

Law

*The players should have basic knowledge about some of the laws regarding total defence and preparedness after playing the game. The players should also have knowledge and be able to describe some of the special laws that come into effect once decided by the government. (Fullmaktslagarna)*

The structure of the Swedish total defence builds on the Swedish governmental structure. Both are governed by law and regulation. The decision to focus on law within the game was made as a method to introduce the responsibilities of different actors and show how they traced back to regulation.

Dependencies

*The players should after the game have some ability to reason about dependencies in society and between actors.*
2.3 Board games and Game based learning

Board games have in recent years had a resurgence both within entertainment industry and as an educational tool (Bayeck, 2020). Much of the research on learning through games gather under the concepts of Game Based Learning (GBL), there are however no consensus on what games are to be included in GBL. Some authors treats the concept of GBL as having the same meaning as serious games (SG) (Angafor et al., 2020). Al Fatta et al., (2019) states that GBL is a subset of SG and that SG are by definition limited to digital games. Other authors separate the two concepts and include board games within GBL but not within SG and some states that tabletop games are a part of SG (Pelser-Carstens, 2019). Gonzalo-Iglesia et al., (2018) suggests that the different concepts reflect different perspectives on the same subject. Regardless of if one includes tabletop games in GBL and SG, the use of tabletop games within education is both a well-used and increasingly researched topic.

A multidisciplinary review of boardgame and learning made by Rebecca Yvonne Bayeck in 2020 shows the width of how games have been successfully used and tested as a educative tool. The review capturing both studies on kids and adults. Bayeck examines studies written in English and peer review with the common nominator of tabletop game-based learning. Multiple studies showed that using boardgames to introduce kids to mathematics had positive results on their mathematical skill and numerical knowledge. Multiple Studies showed how education of medical students benefited from tabletop games as students that had learned with games both performed better at knowledge test conducted soon after the game session as well as at later tests. Chemistry, engineering, physics, astronomy, finance, language, are al subjects within which Bayek found studies supporting the usefulness of games for educating.

Gonzalo-Iglesia et al., (2018) Examined the use of noneducational games in higher education and found that students enjoyed games as a break in the regular teaching routine. The students reported that the use of games made them more motivated and resulted in higher level of engagement. Wonica (2017) argues that the unique attributes of boardgames as easily transportable, cost effectiveness and accessibility make them ideal as tools for education. Studies have shown that games can be used to foster; creativity (Gonzalo-Iglesia et al., 2018); conceptual thinking (Turchi et al., 2019); management skills (Mohd Yusof et al., 2016) among others. There are also examples where tabletop games have been used to train for different types of crisis response (Angafor et al., 2020; Brugh et al., 2019). Finally a type of tabletop games that have a history of being used both for analysis and education is wargames, ever since the development of Prussian Kriegsspiel (German for wargame) in the 19th century its been a common feature of many states military officers' education (Baird George P. et al., 2009)

2.3.1 Game based learning and systems

GBL have also been used as a method to examine and communicate systems thinking and perspective, Garcia-Barrios et al (2016) use boardgames to educate about the relationship between the use of pesticide, different insects and the produce of coffee-farms. The relationships between these entities are described by Garcia-Barrios et al as a complex environmental system. During the development they found that students that had both played their games and attended a lecture on the subject performed better in test, and where able to a larger extent identify and remember direct and indirect relationships within the system compared to students that only attended the lecture. A follow-up study using a developed version of the game Garcia-Barrios et al (2017) invited coffee-farmers to a tournament were they got to play the game. The later study proved the game to also be successful as a tool to educate the farmers about the system and the effects of different pesticides and insects had on each other and the output of farms. The game helped the farmers to gain a systemic understanding of their environment and different roles within the complex environmental system.

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7 Games that are not designed with learning as its main objective.
Ross et al (2014) explored the use of tabletop games as a method to introduce engineering students to systems engineering. The concept showed promise and were enjoined by the students but effort to collect data from the game sessions proved to be challenging and resulted in plans to reproduce the game as a as a computer game. The computer game is said to have been completed sometime after 2014, but to this day no new results appears to have been published (Systems Engineering Advancement Research Initiative - SEAri at MIT, n.d.).

There are many different perspectives on games and how games are a good educational tool. But since different games often includes diverse types of game mechanics it is difficult to compare what it is that leads to learning within different games. A general consensus is however that games that manages to emotionally and cogitatively engage players will lead to a stronger learning experience (Abdul Jabbar & Felicia, 2015). Games often achieve this through a multitude of different methods, allowing players to overcome challenges, have discussions, a sense of winning etc have all been proven to improve learning (Abdul Jabbar & Felicia, 2015; Forrest III & Peterson, 2006; Luis García-Barrios et al., 2016; Miller & Cooper, 2021; Nicholson, 2011; Turchi et al., 2019)

From the literature on GBL, the following requirements have been constructed:

(P3) The game should be playable and educational for multiple users of different backgrounds.

(P4) The game should be enjoyable and inspire to discussion among players.

And

(P5) The flow of the game should not be overwhelming to the player but invite them to continue playing.

In addition to these goals, it was decided with the stakeholders at FOI:

(P2) That a single game session (introduction, play and evaluation) should be no more than two hours.

2.4 Ethical considerations

Myers and Venable (2014) have created a set of ethical principles for design science research in information systems. The principles overlaps well with the recommendations of the Scientific Council's recommendation of good research practice (Vetenskapsrådet, 2011), but goes a step further and questions how the created artifact can be used and whether it is ethical in itself. There are six ethical principles in their list, each discussed below.

The first ethical principle is “The public interest”, the development of the total defence game should not harm any stakeholders. Trying to solve an important problem of the growing total defence is in the public interest, it is however important to consider how the artefact could be misused or how the information gathered to crate the artefact may be harmful to the system it portrays. Only publicly available information was used to create the artefact, care have also been taken not to aggregate\(^8\) information in such a way that it could be harmful to Swedish society or any of the stakeholders of the total defence system.

Informed consent has been achieved; during playtesting by inviting people to freely take part of playtesting, informing them that all suggestions may be taken into consideration in continues development and that observations about playability and similar observations would be collected during the playtest. Before the final game session each respondent was informed of how the information from the

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\(^8\) According to (Försvarsmakten, 2011, p. 45) non-security-classified information may also need to be security-classified if it is collected in a way that can lead to new knowledge.
interviews would be used and that they had the right to at any time withdraw their consent to be part of the study.

Privacy, the artifact does not collect or save any information about the players as it is a tabletop game with no legacy mechanics. At the request of one (or more) respondent the quotes from the interviews have been anonymized, the collected data have been used and stored with security and privacy in mind.

This thesis aims to honesty and accurate share the outcome of the design research, Therefore the rulebook, the interview guide and game design document are attached as appendix A, B and C to the thesis. And a description of the game can be found on pages 18-23.

Property an agreement between the author of the thesis and FOI have been reached and signed before the project began.

The artifact is not safety critical, the quality of artifact relates to objective of solution K2, using a language and tools identified within the total defence system rather than formulating new tools and entities. The different parts of the game is as much as possible linked to source material and invites players to search for information further.

### 3. Design and development

Archaeology and anthropology studies have shown how games contributed to moulding of the world, transfer of knowledge and perspectives between people for multiple millennia ((BAYECK 2020) Boardgame-geek (the largest internet forum for boardgames) list more then 136 000 games (Browse Board Games | BoardGameGeek, n.d.). There are an abundance of different methods of game design and game design for learning. This chapter begins with an introduction to three methods that was explored during the development of the artefact, a combined method of these three are then produced and utilized.

#### 3.1 Design method

Game based learning refers to the use of games to encourage learning, such encouragement can be done with the use of games specifically designed with a learning objective in mind or with a game where the learning is a by-product of playing the game (Pelser-Carstens, 2019). When designing an educational game Nicholson (2011) suggest that one can either adopt an existing game or design something new. He suggests that the challenge of the former approach is to match a game to the educational purpose, this is however suggested as easier than designing a new game. Once the decision to design a new game have been made, Nicholson presents a four-step process.

The first step is to create a “design document” consisting of “targeted learning outcomes”, deciding the “elements of the game”, consider in what “setting” the game will be played, define the audience and number of players, and “how the players will interact with the game”. The second step is by using the design document as a guide consisting of the “in game challenge and content”, “roles of the players”, and “game-mechanical considerations”. The third step of game design is prototyping, Nicholson suggest use of “rapid prototyping” using any tool available that the designer is adept in (such as Word, PowerPoint or simply handwritten notes). The prototyping phase is a iterative process where playtesting and rapid prototyping replace each other until the game is complete. Nicholson gives no recommendations regarding how to know when the game is complete but cautions the designer of two “risks” during this process.
The first risk is adding too much to the game as a way to mend problems discovered during playtesting. "Adding a rules exception or a new mechanism may solve one problem, but many others can be added." The second risk identified by Nicholson is what project management literature often refer as Scope creep, something that may impact the final product so that it does not provide the desired learning outcome. The fourth and last step is to publish the game where he suggests a few different methods ranging from making it freely available online to submitting the game to a game publisher.

Similar to Nicholson, Duke (2014) suggest that one should start with a document. In their three-step design process, the first step is to create a conceptual map (compare to Nicholson’s “design document”). The conceptual map contains the game objective and purpose, what recourses the development project have, and the players will have or need, what the subject of the game will be, who will be the participants and how will they use the game. The last part of the conceptual map is what Duke call the “game message”, they consider games to be a form of communication and the game message is what the game designer wants to communicate. The contextual map can consist of both text and graphics. Once the map is finished it should be validated with the stakeholders of the project and an appropriate level of abstraction should be fund.

After the conceptual map is finished but before the construction of the game is considered, Duke suggests that a concept report is created. Within the report, all parts of the game should be designed and clearly connected to the conceptual map. Failing to do these steps prior to construction may result in a failed to achieve precision of design and could result in a greater overall production cost. If correctly done, the concept report should work as a blueprint for the construction and the elements of the game should only require fine calibration once playtesting is introduced. The third and last step is to publish the game, a consideration Duke highlights maintaining of the game after publication as an important continuous step. Some game will require updates to stay relevant and games focused on professional use will often require educating of game leaders. A method for feedback and ordering of replacement parts should therefore also be considered according do Duke.

The two methods of Nicholson and Duke both share the idea that development benefit form a clearly formulated foundation in the form a document containing goals and boundaries of the game. Where Nicholson advocates for rapid prototyping with regular checks to avoid scope creep, Duke prefer a more rigid blueprint before construction. One might concern these two authors as examples of the different approaches of traditional and rapid prototyping, a discussion of the advantages and disadvantages of the different perspectives can be found in (INCOSE et al., 2015, p. 197)

Lukosch et al (2018) build their design model partly on the work of Duke, an important difference from Dukes method is that the development starts with analysing the system in focus rather then with the development of requirements; it is first after we have a grasp of the “real” system that we may define the aim of the game. The aim of Lukosch et al is to create a concept of game design that allow for scientific enquire, their design starts therefore in a research question rather than the game itself. In contrary to Nicholson and Duke, the requirement of the game is seen as fluid and should be challenged and changed if during the validation and testing of the game. The game turns out to not serve the research question in a suitable and effective manner.

The steps of Lukosch et al’s (2018) model of game design consists of seven steps, (1) Analysing the real system. (2) defining the overall aim of the game. (3) Deciding which elements of reality underpin the real-world problem as well as game. (4) defining how these elements should be represented within the game, (5) and how the player can use and act upon these elements within the game, (6) testing and redefining the game design (7) designing a game session including debriefing and additional research instruments in order to provide rich feedback both to the players as well as the researchers.

When a game is used as a research tool to examine a question stemming from a complex system, validity of any results come from, as with all models, that the game captures the important parts of system of interest (soi) and any relations that effect the soi (Duke, 2014; Lukosch et al., 2018).
Complexity within such games need therefore to be a mirrored image of the complexity of the system or at least the research question. When designing an educational game however, too much complexity can hinder the learning experience (Miller & Cooper, 2021). Validity of the educational game is hinged upon the learning outcome rather than the model validity. It is not only important that the players learn, they have to learn what is intended (Nicholson, 2011). The aim of thesis to explore games both to communicate knowledge about a complex system as well as develop systems thinking and higher Nicholson, Duke or Lukosch models for game design is suitable to use as a strict framework for this aim. The goal is instead reached by compiling the different methods into a framework designed for this specific purpose.

3.1.1 Project design framework

The framework used for the game design and the evaluation of said game is mainly based on the irritative nature and steps described by Lukosch et al, allowing the conceptual map to be a living document throughout the design process. The use of a framework that allow irritative work also permit the use of Nicholsons rapid prototyping method. The final framework described below does not represent a strict sequence of actions, but some steps are made in parallel and/or are redefined at later stages of development.

1. An analysis of the system (Swedish total defense) is made to capture what knowledge is important to the target audience. This analysis covers both the general outline of the system and the relationship the system already has with the players; answering such questions as what are according to the actors within the system important knowledge about the system? Who are the players and what knowledge of they system do they have coming into the game?

2. The second step is to formulate a design document with the learning objectives of the game. An important difference from Nicholson’s framework is that the decision document is to mainly focus on the learning objectives leaving decisions such as number of players to be decided later in the process. During this step the question of what system thinking capabilities is beneficial to the understanding of the system is also considered.

These first two steps have already been done as part of the first two steps of DSRM used in the study.

3. The third step is to again analyse the system but with the design document as a basis of the analysis. Deciding on what parts of the system is suitable to represent in the game in order to achieve the learning objectives. This allows for both seeing different parts of the system and the game as subsystems that can be designed and used to fulfil the different objectives of the game as a whole.

4. Prototyping different subsystems into different game mechanics to find a suitable level of complexity. Rapid prototyping allows trying different game mechanics to find one that reflect the subsystem in a suitable way.

5. Playtesting can either be the whole game or playtest the different mechanics, Each playtest need to be evaluated against the learning objectives as well as playability. Since playability have a relationship with the success factor of the learning objectives, one should aim to find a balance between playability and complexity.

6. Design a game session includes both debriefing and designing of research instruments. These instruments need to both capture the learning outcome as well as any other outcome important to the research question. An important difference between playtesting and the final game session is the aim of the session. During playtesting new mechanics and rules could be introduced to try different approaches. For the results to be as valid as possible, design changes
that could be benefitable should be conducted after the session to make sure that the change itself did not lead to the result. Data could be collected during play testing, but such collection could decrease reliability if changes are not properly recorded; why it might be better to separate the two.

3.1.2 Game validity
The validity of an educational game is connected to the educational outcome. If the educational outcome is the sought after outcome the educational game validity could be considered high (Nicholson, 2011). When designing a game as a communicative tool the game have high validity if it communicates what is intended (Duke, 2014). And simulation games might have higher requirements of how well it depicts the system it is a model of, As this artefact is an educational game the most important aspect of game validity is that it helps the players to gain the sought after knowledge.

3.2 THE TOTAL DEFENCE GAME
This section begins with a description of the game itself and its components. A discussion of some of design decisions can be found in the latter part. This structure is chosen to give the reader a clear understanding of both the game and the reasoning behind the design without going into depth of each and all rapid prototyping iterations.

3.2.1 Game Components
The total defence game (here in after TDG) consists of three boards (Logistics, Map, and Record/Steps), 82 cards, and collections of dies, chips and markers. The Logistics board, consisting of tree flows, A map of the country: Lilla landet lagom (the small state of “just right”). And the record/steps board designed to help the
players keep count of their progress and game state as well as remind the players of play order.

The TDG is a four-player cooperative game in which the players are take the roll of an expert group invited to help the country of Lilla Landet Lagom (LLL). LLL have a similar governmental system as Sweden with municipalities, regions, county councils and Riksdag. There are four regions and eleven municipalities. LLL logistic system are at the beginning of the game heavily influenced by the “Just in time” paradigm of logistic management. There are three different categories of products consumed in LLL: OIL, Food and Pharmaceuticals, LLL produces both food and pharmaceuticals but not enough to fill its own need without import. LLL need to import al of its oil. The players all share the objective of helping LLL build their total defence by introducing new laws and regulations and help the actors of LLL to comply these new laws. The game takes place in a deteriorating security environment and the game ends when an act of war is conducted against LLL.

### 3.2.1.1 Main map

The main map (figure 1) consists of eleven municipalities, four region/county councils and a middle area representing central government and riskdag. The SE region consists of two municipalities while the NE-, NV-, SV-regions consists of three municipalities. Each municipally have one icon showing the size of the main urban area and a number of icons (ranging from zero to four) showing their connections to different logistics flows. The NV-region (figure 2) for example have one rural-region (11), one small town with a medical logistic centre (4) and a large city with a medical logistic centre, a wholesaler and an oil refinery. Each Municipality also have a service level track and the dashed boxes inside the municipalise and region/Countee councils are areas used in later game to store chips in.

### 3.2.1.2 Logistics map

The logistic map consists of three different color-coded logistics flows: Oil (grey), Food (orange) and Pharmaceuticals (purple). The flows start from left and move one step to the right each turn. The incoming products (placed in the far most left column) is stated on the event cards. Food and pharmaceuticals have both domestic and international sources and gather in the second column while oil only have an international source. Each logistic node (e.g., for oil: Raffinaderier, Depå, Bensinstation) in column two, three and four have corresponding icons on the main map. The last column shows the basic need that need to be fulfilled. There is also a counting track (4-1) that is used to show temporary increased or decreased need. To depict the resources in each logistic node on one or two six-sided dice where used.

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Filip Brolin
### 3.2.1.3 Records/steps-board

The two main functions of the record/steps board is to guide the players in what choices they currently have and to keep track of the current status of Försvars vilja, military need, level of preparedness and areas of collaboration. The blue lines and numbers help the players to know what next step they are expected to perform.

The area at the bottom of the board is space for the players to play laws and regulations they wish to create. The green area number one to three helps the players to keep track of what resources military forces require. The blue area keep track of the six areas of collaboration that the players can activate. Each have three levels of cooperation and a specific token to indicate what level they are currently on.

The middle area of the board shows four level of readiness ranging from normal state of operations to highest readiness. Each level has icons that inform the players what may or may not be at the current level. Any icon that has an star in its corner require some law or action card with a corresponding symbol to be in play before it can be conducted. Each player has one action each turn, giving the group a total of 4 available actions each turn.

The uppermost area of the bord shows the current försvars vilja, försvars vilja is used in many of the actions as a modifier to dice throws. A low level of försvars vilja will make actions harder why it is very important that the players don’t allow it to become too low. If försvars vilja reaches the far most left box in the upper scale, the game ends and everybody looses.

![Records/steps-board](image)

Figure 5, Records/steps-board containing information about the game state and helps the players remember the game order.

### 3.2.1.4 Playing cards

There are a total of 82 cards of these; 58 are event cards, 6 areas of collaboration-cards and 18 law/requirements cards. The cards are separated into two piles where areas of collaboration-cards and law/requirements cards go together in one and the event cards in the other pile.

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9 Suggested translation “Will to defend” or “morale” but these fail to capture the concept in a suitable way therefore the concept is not translated into English. See (Wedoerbrand & Jonsson, 2021) for discussion.

10 Samverkansområden
3.2.1.5 Event cards

The event cards are what drives the game, there are a total of 58 cards, but the game will end when any one of five “act of war” cards are drawn making the max game length to be 54 rounds. The cards consist of five components. The header which shows the name of the card. Next to the header there is a small number to help reset the game after playing. The number goes from zero to five indicating the level of aggressiveness from an adversary. The lower number cards are put at the top of the draw pile, cards numbered with a five represent endgame and all are considered as acts of war. The cards have a description of what event that have taken place in LLL or its neighbouring countries. The text within the read box instructs the players what effect the event have on the game. Some have direct effect while others require the players to perform some act (i.e. role a dice to determine the location of the event). The five circles on the left part of the card represent the incoming goods. These are placed at the leftmost column of the logistics board.

3.2.1.6 Law/requirements cards

The available actions that the players might take is limited at the beginning of the game to “draw a card” and “make a law/requirement available for decision”. It is by choosing these new laws and regulations that the players open for more actions. An action/requirements card consists of four components, The header, a description of the law, any extra information and the resulting effect within the game. The effect does not happen automatically, after the law have been created/chosen by the players, the following rounds the players may choose to perform the action In question. The icon at the bottom of the card corresponds with an action on the readiness-scale found on the record/steps board.
3.2.1.7 Areas of collaboration-card

The six areas of collaboration-cards represent the six areas of cooperation defined in förordning (2006:942) om krisberedskap och höjd beredskap. The cards are mixed in with the law/regulations cards and are played as laws; creating them to later use them. Each area of cooperation card is unique in the abilities the card grants. Once the card is played a token corresponding to the symbol in the left corner is placed at its corresponding three step track on the records/steps board. Each card show what actors are part of the cooperation group, the ability of the card and how to upgrade the ability.

3.2.2 Typical gameplay

A player draws an event card and triggers logistics and solves the instructions of the event card. If there is a shortage of two goods, the försvarsvalja decreases, if there is a surplus of two goods and the third is not in short supply, the försvarsvalja increases. After the logistics chains are completed. The player checks if the service level within any municipality is lower than the acceptable (depending on preparedness-level), for any municipality were the level is to low, the player will role a dice deciding if försvarsvalja will be weakened as an effect.

In the second step, each player chooses to complete an action. The actions marked with an asterisk require that a law is played that allows that action before it may be taken.

The last step of each round consists of voting on new laws: If three or more laws have been played, players may vote on which law they want to create. If there are fewer laws then three or the players do not want to vote, one player per turn may role a dice to increase the service level in a municipality.

The game ends when: The event cards are out; The level of service in all municipalities falls below acceptable levels (green if the level of preparedness is normal or danger of war, yellow if the level of preparedness is sharpness preparedness, Red if the level of preparedness is the highest level of preparedness); Or, the försvarsvalja decreases to the lowest level (the far most left position on the scale).
3.2.3 Design choices

The learning objectives and requirements identified in chapter 2 were used as the design document for the game. In total eleven different objectives/requirements were identified and used within game development. A full description of each can be found in appendix A, (Design document).

<table>
<thead>
<tr>
<th>ID</th>
<th>Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>P2</td>
<td>2-hour sessions</td>
</tr>
<tr>
<td>P3</td>
<td>No precursor</td>
</tr>
<tr>
<td>P4</td>
<td>Enjoyable and inspire to discussion</td>
</tr>
<tr>
<td>P5</td>
<td>Game flow</td>
</tr>
<tr>
<td>S1</td>
<td>Be a system</td>
</tr>
<tr>
<td>S2</td>
<td>Entities and flows</td>
</tr>
<tr>
<td>S3</td>
<td>Evolve</td>
</tr>
<tr>
<td>K1</td>
<td>Threats</td>
</tr>
<tr>
<td>K2</td>
<td>Shared conceptual framework/Language/Method</td>
</tr>
<tr>
<td>K3</td>
<td>Law</td>
</tr>
<tr>
<td>K4</td>
<td>Dependencies</td>
</tr>
</tbody>
</table>

The design took place over multiple iterations and different concepts. One of the first suggested concept was a two player game mainly based on cards, a cooperative game where later chosen on the basis that such can lead to more discussions during gameplay (Creighton & Szymkowiak, 2014) and reduce downtime.

P2 Mainly worked as limitative requirements. When designing a game it is often tempting to add new mechanics or rule to solve problems, this is however ill-advised as adding new material often complicates the game and may lead to new problems (Nicholson, 2011). With a set date for playtesting and a limited timeframe design choices often came down to “kill you darlings” and using the other objectives as guidance when choosing what to keep. The following description is used to illustrate how some of these design decisions were made.
The use of logistics flows was early thought as a meaningful way to ensure that the artifact enabled the player to use a systemic perspective and develop systems thinking (S1 & S2). It was also useful as a tool to display dependencies within the system. Early models of flows were however perceived as complicated and hard to understand when play tested. They also proved to be ineffective in moving the game forward as a lot of player-time went into moving resources and understanding what belonged to what flow. The benefit of the early model was that it better depicted dependencies (K4) and feedback lops. The design decision to simplify the model was primarily based on a game flow (P5) argument. Focus on dependencies were instead included as part of the action cards. To answer the problem with playability the model was simplified in to three linear flows. Each flow did however keep three input and output boxes which allowed the flows both to be connected to the map and for delays be visual to the players.

Figure 9 Early logistics flow example

The Incoming goods of the logistics flow was first a function of dice throws, this too turned out to be quite time consuming why they instead were put as a part of the action cards, this decision made a better game flow (P5), during playtest the decision to remove the dice throws appear to contribute to higher face value.

To balance the game a rule of shortage/abundance were created. The rule state that the basic need within each category of produce needed to be supplied at the end of each logistic flow or else försvarsvilja will weekend (or if there is an abundance, strengthen). The rule was designed to a $p=0.38$ that försvarsvilja is strengthen and a $p=0.2$ that it is weakened. If the game would turn out to present the players with to low of a challenge, the basic need could simply be heightened.

During the design of the logistics map an important design challenge was discovered, when trying to create an learning environment for objective S2 and especially the “non-obvious relationships” no suitable way without the use of a computer model or game leader was found. The main problem is that all movement within the game, if they are to be performed by the players, need to be
understood by the players. Meaning that all relationships need to be described within the rules of the
game. Within this project this problem never was solved, why S2 could not be fulfilled completely.

Cards are an important part of the game and most of the learning objectives are incorporated
in the cards. The threat cards (figure 5) are mainly use both to introduce threats (K1) and highlight
dependencies (K4). One design goal of the cards is that most cards have a source and/or reference as
to invite the players to search for more information on their own.

The use of the fictive state of LLL was decided as a suitable tool to balance reality and learning
objectives. The use of a fictive state allows players to focus on the game itself instead of continuously
comparing their perspective of the system with the perspective within the game. Similarly, the decision
to create a cooperative game was made on the basis that such would limit downtime and enhance the
discussions as the players would have to strategize together.

4. Game session
As discussed in chapter 3.1, the game session aims to capture and measure both the learning outcome
as well as any other outcome important to the research question. In the creation of this artefact the
objectives of solution are both of knowledge creation within the players as well as playability and sys-
tems thinking. Each of these, hard to capture, and complex in nature. Often multiple methods that may
overlap and cover each other’s weaknesses is suggested when studying complex subjects such as
learning and knowledge accusation (Seda & Pearson, 1991). The study might have benefited from the
use of such a multiple research instrument to capture the different aspects of the research question
and learning outcome. Due to the limitations of the project regarding time and resources the use of
semi-structured interviews was deemed to be the most effective, and good enough method to capture
the wide aspect of the research question.

A total of eight players were recruited to the game session. Four of the players were chosen
to be interviewed, Due to time restrictions one of the interviews was conducted the day after the game
session over zoom while the other three were conducted directly after the game. The four respondents
was chosen on the basis of their lack of experience on the topic of Swedish total defence, and their
educational background. The aim was to choose the players that best represented a newly hired opera-
tions analyst. All the respondents were in the age of 25-30, had finished university studies at a master’s
level or higher, but assessed themselves to have low knowledge of the Swedish defence system. Two
of the respondents had degrees within engineering, one within biology and one within medicine, one
respondent worked within a governmental agency but not with total defence questions.

Due to the request of one or more of the respondents the answers have been anonymised in the study.

The players were first introduced to the game with a brief description of the rules, the mechanics, and
the objective of the game. The players were introduced to a short backstory of the game portraying
them as a group of experts hired to help LLL to create and build their total defence. This introduction
can be found in the rules (appendix B). Before the game, each player got to evaluate their own
knowledge of the Swedish total defence and Swedish governmental structure. The players were di-
vided into two groups by a draw. the time for when each group started was noted and the groups were
then given one and a half hours of playing time. The groups were placed in different rooms, after the
first group was started and any initial questions about game mechanics were resolved. After 45 minutes
the second group was permitted to start their game.

4.1 Development of research instrument
One of the great values of semi structured interviews is its accommodation for a wide range of research
questions (Galletta & Cross, 2016). In the construction of this studies artefact the objectives of solution
span multiple subject each in its own hard to capture. The use of semi structured interviews was chosen on the basics that the study aims to capture both learning experience and knowledge of a more conceptual form. When assessing the game, player experience such as enjoyment and playability was also important to the evaluation. Semi structured interviews allow the interviewer to explore the logic behind answers, as to not only judge the correctness of the answer but also how that answer was reached (Seda & Pearson, 1991), such exploration is important to understand how different aspects of the artefact may or may not have led the players to a specific learning outcome.

The structure of the interviews follow the suggestions of (Galletta & Cross, 2016) with three segments. When preforming an interview, the interviewee will always to some extent be affected by the conscious or subconscious reactions of the interviewer (Esaiasson, 2017, p. 243), in a semi structured interview this effect can be expected to be greater as giving responses is an important part of the method. (Welzel & Roth, 1998) suggests that the interview should be seen as an opportunity to help the student to scaffold and help the interviewees cognitive process, the interview in this perspective become a research instrument that is useful to find the highest level of complexity within a given subject the interviewee may reach. Using this interviewer effect as a tool is an interesting thought but possess the challenge of determine what was learned during the interview and what was the contribution of the artefact.

4.1.1 First segments of questions.
Since the interview effect can’t be ignored, Galletta and Cross suggests that the first segment of the interview should focus on elicit the central story that may give the interview direction and depth. The first section need require questions that allow the interviewee to be in control of the direction and complexity used to describe the answers. The questioning needs also assist the interviewee to stay within the subject of the study and ensure that not too much time are left on information that will not assist in answering the research question. As the interviewee story unfolds flow up questions should at this stage focus on clarifications needed to better understand the story, questions regarding different junctions or subject withs the interviewee don’t develop to significant depth should be left to later stages of the interview (Galletta & Cross, 2016, pp. 47–49). When developing the questions for this first section care was taken to avoid the interviewer effect by keeping the questions general (Galletta & Cross, 2016), avoiding language that suggest a specific answer (Southerland et al., 2005), avoiding questions that might need clarifications (Southerland et al., 2005) and using questions that are at low level of complexity (Welzel & Roth, 1998). The full interview protocol can be found in appendix C.

What are your general thoughts of the game?
How would you describe the game to some one else?

Early questions are aimed to capture the experience of playing the game, these questions are coated to requirement P3, P4, P5, S2, S3. The responses to these questions varied and while some interviewees gave long elaborate answers while others needed encouragements by asking them to define or elaborate their answer. One example is a respondent that described the game as complex. This could have been accounted to a failure of P5 and that the game was overwhelming, on the other hand it could also be connected to systems thinking part of the game. By asking the respondent to elaborate what they meant by complex a better understanding of the respondents perspective was achieved. The answers to these first questions also helped in developing different lines of questioning for later segments of the interview.

Once the respondent appeared as comfortable giving more exhaustive answers, the questioning continued with more specific questions trying to encapsule the central story that is the game and learning. The questions remain general but start to focus on the game session that the player just took part of.
Can you describe how the game developed?
What were the challenges of the game? – How did you solve them?
Was anything surprising during the game?
Did you learn something?

These questions allowed the respondents to reflect on the game session, their part in the game and their learning. The aim of these questions was to see what parts of the game that left remaining impressions. They had however to some extent already been answered earlier. Once the game had been described by the respondent using their own words, the interview continued in to the second segment of Galletta and Cross’s (2016) structure.

4.1.2 Second segments of questions
The middle segment of questioning involves consideration of questions that will ensure that the research topic is adequately explored. To ensure that all aspects of the artifact is covered questions directly connected to the different artefact objective where devised. The language of the questions where tried to match the language the respondent used in the first segment to avoid scaffolding but inviting the respondent to answer each question in depth. The order of the questions was not planed but instead was dependent on the respondent, If they recently had talked about a subject that was close to a line of questions these were preferred.

P3: How would you describe your knowledge of the total defence system before playing the game, did the game encapsuled your perspective? Did someone else in your group possess any other knowledge and how did that effect the game?

P4: How was it to play as a group?

P5: How would you describe the difficulty of the game? Tried to follow up and distinguish between difficulty to understand and difficult play

S1: In the game, what effects did your strategy have, where there any parts of the game important?

S2: How would you describe the different parts/entities/actors/flows of the game? (This question focused on the description of the game that the respondent gave in the previous segment of the interview.)

S3: What was your approach to the events in the game? Did it change? (This question focused on the challenges described by the respondent in the previous segment of the interview.)

K 1-4 What did you learn from the game?

K1: What are your initial thoughts about the event cards, were they probable? How where they simplified/different from reality?

K2/K3: Can you describe the Swedish total defence?

K4: How well did the game represent the real world?

4.1.3 Concluding Segment
The concluding segment of the interview offers opportunity for more theory driven questions. It is important that the questionings in this part support the respondent to generate meaningful responses and allow both the interviewer and respondent to explore any subject and give clarifications (Galletta & Cross, 2016, pp. 51–52). Supporting the respondent and asking more theory driven questions increase the risks associated with the interviewer effect (controlling the answer, scaffolding), which must
therefore be considered when analysing the data from this segment. The concluding segment is also meant to acknowledge that the interview is coming to an end.

The questions of the concluding segment are similar to the questions of the middle segment, and questions for a selection of the artefact objectives was asked. If a subject had been covered extensively in earlier segments, these questions were skipped to benefit other subjects. The segment began with informing the respondent that the interview was coming to an end and that these were the final questions.

(P4) Did your group have any discussions? About what and how did you solve them?
(S1, S2) Was there any relationships within the game that you found interesting?
(S3) Did you or your group device a specific strategy to beat the game? Did it or the game change?
(K1) can you give some suggestions of different threats within the grey zone? What effect had these in the game and what effect would that transfer to in reality?
(K3) What laws are there connected to total defence, are there different types of laws?
(K4) What actors can you name that have responsibility within total defence? How to they relate to each other? What are some dependencies within the Swedish society and how to they relate to the total defence actors?

Finally in accordance with the suggestions of game development experts at FOI, Erik Nordstrand and Johan Elg, three game development related questions were added:

Was there anything in the game that you could not do that you wanted to?
If you could change one thing about the game, what would that be?
Were the rules easy to understand?

4.2 Results

The following three sections of this chapter capture the results of the interviews by presenting excerpts from the interviews. Each citation has been anonymized at the request of study participants. The results from the interviews, the development process and limitations of the study will be discussed in the following chapter.

The use of interview to determine if the players achieved any improvement in systems thinking turned problematic. When discussing the total defence as a system it is hard to distinguish between what meaning that the interviewer attributes to the answers and what system understanding the players themselves achieved. All four respondents responded that they had learned new thing about the total defence, it was however hard to explain what that “thing” actually consisted of, one of the player remarked the following when asked to develop their answer:

“Well, now that I have played the game, nothing really surprised me. I did not know that there were so many laws that was applicable only during war.”

“you kind of expect someone to have responsibility within government for stuff like food and such, I have always expected MSB to be in charge of such”

One player remarked that he/she had not thought about some of the threats as being part of perpetration for war before, when talking about grey zone conflicts:
"I have never really reflected on the concept that a demonstration or similar would be supported by another state with a purpose, you hear about religious leaders who provoke conflicts or demonstrations, but I guess I have thought of it in any larger context."

When the interview came in to the second stage the respondents appeared to have a clearer picture of what they had learn.

"I did not really know anything about the total defence, defence is like something the military do, like NATO. Have never really thought of it as something that everyone else is a part of, I guess I kind of expects everything to work and that war, war don’t happen in Sweden so why would I think about it, it feels a bit remote."

Another player had a similar thought but with a starting point in his/her own assignment.

"I have imagined how life would be if society falls, like in the zombie movies. You wake up one day and everyone else is gone. That’s kind of how you imagin catastrophises, of curse it is different in real life but the idea of that one should continue to go to work in such a world is strange."

Regarding the different actors of total defence, none of the respondents started to name actors, instead they kept the discussion at a general level. One of the respondents noted that he/she did not understand the difference between region and Countee councils, when asked to evolve this she/he stated that this was true before the game and that the game had not clarified the difference.

Once asked to name actors and responsibilities all four can name municipalities and that they continue to be responsible of their normal work during crisis. They can also correctly name that governmental agencies have responsibility to prepare for total defence but can only name a few regarding what that actually means. Each of the players show knowledge about the areas of collaboration but only one can name more than one.

One of the players mentioned that they had no knowledge of total defence before playing the game and had a hard time understanding what parts of the game was related to in the real world.

"I can’t really tell you anything about the total defence, I don’t know, I guess everyone that are working with crisis preparedness are part of the total defence, I, the game obviously contained like municipalities and such. But really the game contains the like the state. Is like everyone part of the total defence? Every one, from sixteen to sixty is part of the total defence according to the game, but I cant really tell what that means."

The knowledge about threats appeared to be more easily accessible to the players then knowledge about actors. All respondents managed to describe different threats that was encapsulated in the game. The second group of players had even started to anticipate what next threat could be.

At first, we did not really understand the event cards, nothing really appeared to be happening. but after a few rounds we began to see a pattern where events became harder to deal with, the problem was that we then didn’t have time to solve the problems as they were drawn. We looked at the discard pile and built a timeline trying to imagine what event it was building up to. Maybe that was cheating.

The other player same group of players:

"We did not have a strategy at first, didn’t really understand the different laws and what was good to have. Once we understood the game we started to try to stay ahead of the game by building resources (he/she was talking about emergency stockpiles), At some point however we thought that the cards was in a specific order and that they would hint on coming cards."
The team that had anticipated treats and event cards appeared to have reached a deeper ide of different types of threats. One of the players of this game for example mentioned terrorist attacks against a municipally and how that would remove the municipality’s ability to service completely and that the players would have to balance this with the surrounding municipalities.

The two other respondents mainly talked about different cards in the game,

In the game it appears as almost anything can be a threat to society, I guess that the main difference between threats and other things are the actor behind it. But it is like hard to know when there is an actor behind it, Take the demonstrations for example, was that a treat or something else? 

At the end of the interviews and the question of “What laws are there connected to total defence, are there different types of laws?” it turned out that all the players could describe multiple laws. They could however not name them correctly. One of the respondents did question the usefulness of the laws due the players in the first team waiting a long time until they voted to raise the preparedness level

\[ The \text{laws that were the most useful, we didn’t really get to use them because it seemed hard to raise the preparedness level, we didn’t really agree on it until very late in the game because it didn’t seem that the events were not big or well defined enough (talking about the rule card that states how to raise the preparedness level). It wasn’t until there was an oil embargo (one of the card at level 4 is about oil embargo against LLL) that we agreed on raising the level, and then the game was almost already over.} \]

I think that the different kids of laws are ether the ones that are always applicable and the ones that required us to raise the preparedness level,

Well there was like the laws, and then there were the sammarbetsområden, I don’t know if there were any other kinds of laws, (Interviewer asked if the there were any special laws or were they al equal), Well there were some laws that required us to raise the (preparedness) level, 

All the players described the game as fun, but sometimes hard to understand. One respondent mentions that it was hard to understand what choices they had and what effect it would have later in the game.

To be honest, the first half of the game I don’t think any of us knew what we were doing, we just tried to play out laws and samordnings cards. Like, we understood what we needed to do to make the game move forward, we simply didn’t understand why we were doing it.

Another respondent mentioned that the logistics tracks were a source of discussion.

The tracks and knowing that there won’t be enough resources in two turns was a nice addition, We had quite a few discussions about if we should focus on the event, the shortage or upcoming shortage. . . . . . . The nods in the tracks was a bit hard to understand, like we didn’t realise that they were connected to the map at first, it made a lot more since after you pointed it out (when the group draw a card telling them that the effect would happen in a municipally they required assistance to understand what it meant.)

One respondent when trying to describe the game

The game is sort of a time stories meets risk game, It has a celar story line, but you still need to strategize to succeed in the game, . . . . . . The four player thing, I mean it was fund to discuss what to do but I would have like it if there were some competitive element. A lot of the time we just agreed with each other. But I think it would be fun to play it again now that I have a better since of how to play.
The Complexity of the game was received differently by different players.

I’m going to be onset with you, when you first showed the game, I thought it would be way too complex to understand anything. It was not until we started to play that I started to understand the different parts of the game.

No I did not find it too hard, it did become harder later in the game, not to understand the game itself but there was simply to many things happening at the same time, … rule wise, no it was quite easy, I hate games with large rulebooks so I liked that we could start playing without a long reding or video, there were some cards in the game that was a bit hard to understand. And the cards that don’t have an effect on the game, you should write that they don’t have an effect because that was quite hard to understand. Like now that I have played, I understand it, but when we first draw it, we tried to figure out what we were supposed to do.

When asked what they would change three players had suggestions

It was a bit annoying that it ended when it did, we did not raise the preparedness level and it would be nice to see how a war would have progressed in the total defence we built. I think that the game could be quicker in the beginning and then allowed us to play a bit longer, it would also be nice if the military was a bigger part of it, like now it didn’t really have the feel of defence in a way if you know what I mean.

I don’t know, well it would be nice if you made a clearer connection between the two boards, like use the colour of the oil on all the thing on the map connected to oil.

I would have liked to have more different things to do before raising the preparedness level, I don’t know how it is in the total defence, but we were really restricted by it.

When asked to describe the game (first stage of interview) multiple of the players used words as that could be interpreted as describing systems relationships and dependencies.

“at the start of the game, it revolves around the just in time concept and how vulnerable it is, however as the game progress we started facing other challenges as well.”

When asked about it later the respondent evolved his/her answer and identified multiple flows and relationships built in the game.

“There is of course the flows of the, products in the game (speaking of the logistics board)… …but there is also like a bigger relationship between the Försvarsvidja, the products, and like the service levels… …the whole game is connected by like different flows”

5. Discussion

The focus of this chapter is the results from the interview and if the learning goals of the game was achieved. The chapter is divided into four sections, the first three follows the structure of the learning objectives, and a discussion of the limitations and lessons learned during development can be found in the latter part of the chapter.
5.1 Learning objectives and requirements

5.1.1 Knowledge goals connected to the system in focus (Swedish total defence)

\((K1)\) The players should be able to give some suggestions of different threats that could occur during grey zone conflict and discuss what effect these threats may have on different levels of society.

The interviews showed that the threats described in the game was revived by the players, all of the respondents could name multiple threats and discuss how they would affect Swedish society if they appeared in real life. One respondent questioned how to distinguish a threat from an actor and an event without intentions. The threats discussed were of a wide variety. By discussing and trying to anticipate threats and their effect on the game the players of said group showed that they could go beyond the game in aspect of identifying threats. When asked all respondents could in some aspects discuss what effects a threats might have if it was realised.

\((K2)\) The players should after the game have some basic knowledge of the conceptual framework of the total defence after playing the game.

The reasoning behind this objective was not to do any harm and contribute to conceptual confusion. From the interviews no one appeared to be using any concept in a manner that was incoherent with the understanding of the designer. Instead the respondents show that they have some understanding of the conceptual framework.

\((K3)\) The players should have basic knowledge about some of the laws regarding total defence and preparedness after playing the game. The players should also have knowledge and be able to describe some of the special laws that came into effect once decided by the government. (Fullmaktslagarna)

The laws that were given most attention from the respondents during the interview was the fullmaktslagarna and the law of totalförsvarsplikt, Fullmaktslagarna were described by the respondents as special laws and was perceived as effective against the events in the game. The players showed that they had some knowledge of the other laws, The card naming totalförsvarsplikt appears to have had quite the impact and multiple players asked for more information about this law. It is quite possible due to it being the law that have the most direct effect on the players themselves outside of the game session.

\((K4)\) The players should after the game have some ability to reason about dependencies in society and between actors.

The players where able to discuss and image different threat scenarios and how what effect they would have on Swedish society, the players could also go beyond the game and reason about effects that the system of the game did not encapsulate. The actors that the players mostly discussed where their own role and what effect their response might have within the system.

5.1.2 Systems thinking requirement

\((S1)\) The game must in itself be (or contain); a system of different parts (1.2) that are distinguishable by someone untrained in systems thinking but works together as a whole.
The respondents did difference between the various parts of the game (and system). There where however some problem to understand the system as a whole.

(S2) The different parts need in turn represent different types of entities and flows (2.3) that have both outspoken and non-obvious relationships (3.1).

There were four different stocks put into the game, Time (the players had a limited set of moves), Försvarsvilja, Service levels and resources. All respondents, when asked, identified resources as the stocks and flows of the game. One respondent also identified relationships between service levels and försvarsvilja. This players answer also might indicate that he/she did view the game as system or as a “whole”. None of the players identified their own relationship with the game or the limitations of turns (times) as a resource/stock.

(S3) The system needs to evolve and change over time in a manner that challenges the user to adapt their understanding and develop new strategies to evaluate the system (4.3).

This might be the hardest learning objective to validate, the respondents talked about strategy but had a hard time describing what they did or if they ever caged it. One respondent reasoned about the game changing form a game focused on just in time related vulnerabilities to something more.

5.1.3 Project requirement:

(P1) The game needs to be ready to play by 22 April of 2022. (P2) A single game session (introduction, play and evaluation) should be no more then two hours.

A successful playtest was conducted by required date. During the playtest the game was well received but as shown in the interviews there are still room for improvement within the game. The successful game session shows that the game can be introduced and played within the given timeframe.

(P3) The game should be playable and educational for multiple users of different backgrounds. Any one new to the Swedish total defence (regardless of higher education) should be able in some extent to acquire sufficient knowledge to fulfil the learning objectives.

The game was tested with different players that none had experience of the toal defence. Each player assessed that they had learned important aspects of the Swedish total defence system even if the research instrument failed to capture what they had learned.

(P4) The game should be enjoyable and inspire to discussion among players.

The game was well received by the players, the main subject of discussion turned out to be threats and the players own place within the total defence system. Multiple players have after the game session reach out to the researcher with different questions regarding the total defence and how to where to find more information, showing that at very least led the game to an interest in better understanding the total defence.

(P5) The flow of the game should not be overwhelming to the player but invite them to continue playing.

None of the players reported feeling overwhelmed by the game (apart from some initial concerns about the complexity of the game). According to the players the game session flowed on well and without any major difficulties.
5.2 Development and research instrument

The design research science methodology used in this thesis is based on an iterative process that ends with a decision of “whether to iterate back to activity 3, to try to improve the effectiveness of the artifact or to continue on to communication and leave further improvements to subsequent projects.” (Peffers et al., 2007). During the design, the goals formulated in the objectives of solution have been used as game design document steering design decisions. The final part has been an evaluation of the game against these objectives of solution by interviews.

To identify the objectives of solution both stakeholder discussions and literature reviews where conducted. The result was eleven educational and design goals stemming from research on game based learning, systems thinking, and the Swedish total defence. The use of these eleven goals as the fundament of the design document (and by extension the game) proved to be effective to drive the design process forward. They have however proved difficult to transform into measurable objects of effectiveness. E.g... “The players should be able to give some suggestions of different threats that could occur during grey zone conflict and discuss what effect these threats may have on different levels of society”. Generates the question of how many suggestions is enough to fulfil the goal. The use of interviews to examine the respondents learning allowed an insight into how the players was reasoning about different threats but not the quantity of such threats. A mixed study approach using other forms of testing knowledge might have enlighten more about the number of threats and type of threats the players created knowledge about. One of the benefits of computer games is the ability to log more data, maybe similar logs could be employed by recording the game session with video and/or audio. Such logs might give insights into discussions and if there is any strategy change during the game session.

The design stage of the development was conducted thru a modified version of of Lukosch et al’s (2018) seven steps for game design. With the addition form Nicholson (2011) with rapid prototyping multiple different game mechanics and level of complexity could be tested and evaluated on the basis of playability. A challenge with the method of rapid prototyping was that the outcome regarding learning objectives required more rigours testing and therefore was not conducted until the final game session. The tabletop format proved to have inherent restrictions that was (within the given time and knowledge of the project) challenging and ended up not solved. The requirement (S2) The different parts need in turn represent different types of entities and flows that both have outspoken and non-obvious relationships. This proved during the development hard to fulfil as the rules of the game needed to give the players enough instructions so that they performed what outputs any relationships would have. Studying the games designed in Luis Garcia-Barrios et al (2016) and Rossa et al (2014) neither of these had have similar problems and requirements. It appears as the one possible method would be to employ some other form of controller to the game if one wants to include “non-outspoken relationships”, i.e. with the help of a gamemaster / workshop leader (Nordstrand et al., 2011, p. 14) or by creating an app driven game (Kosa & Spronck, 2018).

The design decision to make the game cooperative instead of a competitive aper to have given the sought-after effect of creating discussions. That all respondents could identify several laws during the interview and is probably connected to the mechanics for law making, which was created with an aim to create discussion. The group who had discussions about different coming treats appears to have gain more knowledge about threats then the other group, such relationships would, however, need to explore with a method adapted to for that purpose, which the method in this study does not allow in a satisfactory way. It is however coherent with previous research that discussion lead to stronger knowledge creation (Pollock et al., 2011).

Using interviews as the main data collection method proved to be a greater limitation then expected, with restricted the results and the generalisability of any results. A multi method approach with interviews and other test as applied by (Luis Garcia-Barrios et al., 2016; Luis García-Barrios et al., 2014).
2017) may have better showed more of what the players actually learned. Since no data collection before the game session, the study relies entirely on the respondent’s self-estimation regarding their knowledge production which could come into considered regarding the validity of the result. There was of course no clear incitement for the respondents to lie and regardless method, when dealing with humans there is always a risk that individuals will employ different methods to appear in a “better” light (Randalla & Phoenix, 2009).

The limitation due to the choice of evaluation method and the abstract learning objectives does not however mean that there is no important results to learn form. The most important might of course be the one described above, that the study would benefit from another form of evaluation method (or development of research instrument) and when designing a game document, one might want to consider adding measurements of effectiveness early in the process. The method for game design developed through the project did nevertheless prove to some extent successful and could potentially be useful in future similar projects.

6. CONCLUSIONS AND RECOMMENDATIONS

This study describes the development of the board game “Totalförsvarsspelet”, a game based on the Swedish governmental structure and total defence system with the objective of facilitating learning, communication and understanding of the Swedish total defence system, and the threats to said system. The development of a board game was used as an example of how a novel educational tool can potentially make individuals without a formal system thinking training aware of complex systems such as society, threats, and civil defence. In the specific case of the total defence game, play sessions are aimed to help operations analysts and other individuals to gain knowledge both about the actors within the total defence; some of the different types of rules and regulations that dictates the structure and the actors’ options for action; the different threats, both antagonistic and non-antagonistic, against Swedish society; and be able to discuss and reason about different dependencies and relationships within the total defence.

Like the few scientific boardgames dealing with complexity and systems (Luís García-Barrios et al., 2017; Rossa et al., 2014), Totalförsvarsspelet was designed and adjusted to the need of transferring the required knowledge but remaining playable and enjoyable. Major design concerns where therefore to this challenge of creating a balance between keeping rules and mechanics as simple as possible but yet complex enough to challenge the player and depict the system in a fair way, and simultaneous enjoyable, to create engagement and entertainment. The results of the interviews show that the players considered the game to be meets those goals. The game will however in the future still have room for continues improvements both as an educational tool and as enjoyment.

The project has had three distinct stages, each stage interconnected with each other but with different focus. The first stage was the development of the goals of the artefact, this was done true stakeholder engagement (by interviews and discussions), and literature studies. The second stage was the game development, building on a modified version of of Lukosch et al’s seven steps for game design. The final and concluding part was a play session with eight players form whom four players were chosen for interviews to examine if they succeeded in learning about the total defence.

The result of the evaluation strengthens the idea that tabletop games may be used as a tool within education, during the interviews the players both reported and showed that they had fulfilled some of the established learning criteria. The latter part of the objective “outspoken and non-obvious relationships” emerged as very difficult to solve as relationships need to be expressed in order for the players to know how to change the gameboard within each turn. The use of semi structured interviews
proved to be an efficient research instrument with regards to the limitations of the study, the validity of the results would however greatly have benefited from the use of multiple methods of measurement. The abstract nature of the learning objectives proved efficient as game design goals but proved hard to measure and evaluate.

The design process showed that different requirements and learning goals pose different challenges to game design, and that there might be limitations inherent in the board game format that excludes or makes it difficult to include hidden, or less obvious, relationships. The use of augmented tabletop games or app driven games (see Kosa & Spronck, 2018) might be a possible continuation to the game based learning that could potentially solve such issues connected these types of relationships.
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Mynigheten för samhällsskydd och beredskap (MSB).


http://www.nids.go.jp/english/event/forum/


Läroplan, program och ämnen i gymnasieskolan - Skolverket. (n.d.).


Appendix A: Game design Document

Game literature and other project requirements:

(P1) The game needs to be ready to play by 22 April of 2022.

(P2) A single game session (introduction, play and evaluation) should be no more then two hours.

(P3) The game should be playable and educational for multiple users of different backgrounds. Any one new to the Swedish total defence (regardless of higher education) should be able in some extent to acquire sufficient knowledge to fulfil the learning objectives.

(P4) The game should be enjoyable and inspire to discussion among players.

(P5) The flow of the game should not be overwhelming to the player but invite them to continue playing.

Systems thinking requirements:

(S1) The game must in itself be (or contain); a system of different parts (1.2) that are distinguishable by someone untrained in systems thinking but works together as a whole.

(S2) The different parts need in turn represent different types of entities and flows (2.3) that have both outspoken and non-obvious relationships (3.1).

(S3) The system needs to evolve and change over time in a manner that challenges the user to adapt their understanding and develop new strategies to evaluate the system (4.3).

Knowledge goals connected to the system in focus (Swedish total defence):

(K1) The players should be able to give some suggestions off different threats that could occur during grey zone conflict and discuss what effect these threats may have on different levels of society.

(K2) The players should after the game have some basic knowledge of the conceptual framework of the total defence after playing the game.

(K3) The players should have basic knowledge abulte some of the laws regarding total defence and preparedness after playing the game. The players should also have knowledge and be able to describe some of the special laws that come into effect once decided by the government. (Fullmaktslagarna)

(K4) The players should after the game have some ability to reason about dependencies in society and between actors.

(K5) The players should be able to name important actors of the total defence and their main responsibilities.

Audience

The targeted players of the total defence game is firstly and foremost people with little or no prior knowledge of the total defence system. Some knowledge of the Swedish governmental system is expected as the targeted audience at the very least is expected to have completed a Swedish high
school education. The educational goal of the game is therefore formulated at a level that requires little or no prior knowledge about the Swedish defence system or system thinking methodology.

Social sciences 1 and History 1 is part of the education that are compulsory in all Swedish high school programs (Läroplan, Program Och Ämnen i Gymnasieskolan - Skolverket, n.d.) These subjects should give the audience basic knowledge about the Swedish model of governance and administration.
Appendix B

**Appendix B Rules, Totalförsvarsspelet**

Detta spel är utvecklat med målet att introducera Operationsanalytiker och andra som arbetar inom totalförsvaret men inte besitter tidigare kunskap om det svenska totalförsvaret och dess uppbyggnad.

**Spelkomponenter**

58 Händelse kort  
6 Samverkans kort  
18 Lag kort  
Spelplan  
Logistikkedja  
Tärningar  
Kuber  
Brickor

**Bakgrund**

Lilla landet lagom (LLL) har observerat ett försämrat omvärldsläge och därför bestämt sig för att utveckla ett totalförsvar. I dags läget så har LLL en förvaltningsstruktur som bygger på den svenska men man har inga lagar eller uppgifter kopplade till totalförsvar eftersom LLL länge varit omgivet av fred. Ni som experter på Totalförsvar har blivit ombmedda att hjälpa aktörerna i LLL att bygga upp regelverk för totalförsvar och bidra till att olika myndigheter och samhällets motståndskraft.

**Förbereda spelet**

Böja med att lägga ut spelplan och Logistikkedjor så att alla spelare enkelt kan överskåda båda. Blanda lagar och samverkansområden i en hög och placera denna ned texten nedåt där alla spelare kan nå och lägg dessa i en gemensam.

Sortera händelsekorten i sex högar beroende på den lilla siffran uppe till vänster (0-5) på kortet. Blanda sedan varje hög för sig. Välj tre högar och dra det översta kortet. Placera logistik enligt korten och blandar sedan in dessa i deras respektive högar. Placera sedan högen i vilken korten med nr 5 ligger med ansiktet nedåt i närheten av planen. Ovan på denna hög läggs sedan korten med nr 4 med ansiktet nedåt, och så vidare tills alla de sec högarna bildar en hög.

Sortera ut brickorna och placera i lättåtkomliga högar, placera tärningararna så att de är lättåtkomliga,
Placera en markör på:

- Mitten av Försvarsvilja
- Normalbild
- Längst upp på servicenivåskalan av varje kommun

Alla spelare drar två kort från högen med lagar och samverkanskort. Dessa får ej diskuteras med de andra spelarna utom när kortet är utspelat.

**Spelordning**


Efter första omgången fortsätter spelet enligt nedan:

2. Spelarna väljer att genomföra en handling var. Handlingarna markerade med en stjärna kräver att det finns en lag utspelat som tillåter den handlingen (en lag med samma symbol på)
3. Om tre eller fler lagar har spelats ut för votering så kan spelarna rösta om vilken lag de vill skapa. Om färre lagar finns eller spelarna inte vill rösta så får en spelare slå för att höja servicenivån i valfri kommun.
4. Återgå till steg 1 och spela ytterligare en omgång

**Spelet tar slut när**

- Händelsekorten är slut
- Servicenivån i alla kommuner nå under (grön om beredskapsnivån är normalbild eller krigsfara, gul om beredskapsnivån är skärptberedskap, Röd om beredskapsnivån är högsta beredskap)
- Försvarsviljan sjunker till en yttersta vänstra positionen på skalan.
1. Logistikkedjor

Logistikkedjorna respekterar några utvalda samhällsviktiga produkter. Varje bubbla representeras av olika symboler på kartan (se sista sidan).

I början av varje omgång så dras ett händelsekort. På vänster sida av kortet finns det siffror som avgör hur mycket produktion som sker, Denna kan antingen komma från internationell marknad eller inhemska.

I exemplet till höger så tillkommer 4 olja, 3 livsmedel från internationell marknad, 2 läkemedel från internationell marknad, 1 Livsmedel från bondgårdar 0 Läkemedel från inhemska produktion.


Samhällets behov består av två delar. Det grundläggande behovet som representeras av en siffra (3 olja, 5 livsmedel, 2 Läkemedel. Till dessa kan det läggas till extra behov i upp till fyra omgångar. När sådant sker så representeras det av en täning som läggs på behovs delen och flyttas ner längs stegen för att påminna om hur många runder som det extra behovet kommer kvarstå.

Försvarsvalja

Försvarsvalja representeras i spelet av fem steg. Beroende på försvarsvalja så ska spelarna ibland slå tärning medan runda från -2 till +2 på slaget. Försvarsvaljan styrs huvudsakligen av att det finns tillräckligt med varor i LLL. Om det råder brist av två eller fler typer av varor så sjunker försvarsvaljan ett steg. Om det finns överflöd av två eller fler varor och det inte råder brist av någon vara så ökar försvarsvaljan. Försvarsvaljan kan även öka eller sjunka beroende av servicenivå hos kommuner, händelser, och beredskapshöjning.

Filip Brolin
**Kommunalservicenivå**

Varje kommun har mycket att göra och i början av spelat så klarar de kommunanställda sina uppgifter bra. Men om många lagar snabbt genomförs så kan servicenivån sjunka.

Om service nivån sjunker under vad medborgarna tycker är acceptabelt så kommer försvarsviljan sjunka. Vid normalberedskap och krigsfara så förväntar sig medborgarna att servicenivån skall vara på den gröna nivån. Vid skärpberedskap så accepterar man en servicenivå som är gul. Vid Högsta beredskap så accepterar man att den är på den röda nivån.

För varje kommun där servicenivån är under den accepterade så slås tärning för försvarsvilja. Om resultatet blir 1-3 med modifiering på slaget av rådande försvarsvilja så sjunker försvarsviljan ett steg. Slår man 4-5 så förändras inte försvarsviljan. Slår man 6 eller mer så stärks försvarsviljan ett steg. Exempel


För kommun 11 slås ingen tärning eftersom servicenivån är över den förväntade.

OBS: Om flera kommuner har för låg servicenivå så slås dem i nummerordning och försvarsviljan modifieras efter varje slag.
Appendix B

2.


Observera att nya lagar inte kan dras från högen vid höjd beredskap och nya lagar inte kan stiftas vid högsta beredskap.

Höja beredskap

Om spelarna önskar att höja beredskap så måste alla vara överens och bestämma det mellan steg tre och ett. Vid höjdbredskap sjunker servicenivån i samtliga kommuner ett steg. En av spelarna får sedan slå en tärning mot försvarsstämpling. Om resultatet är 1-3 och försvarsviljan är på minus eller startpunkten så sjunker försvarsviljan med två steg. Om resultatet är 4-6 och försvarsviljan är på pluss eller i startpunkten så höjs försvarsviljan med två steg.

När beredskapen höjs så dras en extra händelse och denna utförs direkt innan spelet går vidare som vanligt.
3.
Om tre eller fler lagar har blivit utplacerade för votering så får spelarna välja en lag att skapa. Den lagen som välja kan följa omgångar användas. Observera att lagen/samverkansområdet börjar gälla direkt men kan inte aktiveras eller användas förens tidigas nästa omgång.

Om spelarna väljer att inte rösta om en ny lag så får de öka servicenivån i en valfri kommun.

**Övriga regler**

**Försvarsmaktens behov:**

Försvarsmaktens behov i LLL är i början av spelet inräknat i det grundläggande behovet. Genom olika händelser och lagar kan detta behov öka. Om det gör det så placeras en ikon för behovet i den gröna rutan. Ökar behovet av läkemedel med 1 så läggs en läkemedels markör i 1an i den gröna ytan. Ökar behovet ytterligare med 1 så flyttas markören ett steg åt höger. Detta behov måste tillfredsställas vid varje logistik runda, annars sjunker försvarsviljan med -1 för varje ouppfyllt försvarsmaktens behov.

**Samverkansområden:**

Den blåa ytan representerar de sex olika samverkansområden som spelarna kan välja att skapa. Dessa kan sedan om spelarna önskar vidareutvecklas i tre steg för att förbättra samverkan mellan olika myndigheter. Varje samverkansområdes kort beskriver hur dessa vidareutvecklas och vilken effekt dessa har.

**Tveksamheter och otydligheter:**

Den första spelaren som utropar "Hej se på mig, jag kan alla regler" får veto rätt gällande regler. Detta innebär att om några tveksamheter uppstår så kan hen bestämma hur dessa skall lösas.
Appendix C

Appendix C: Interview guide
Tack för att du vill vara med och delat I detta speltillfälle, Spelet vi provar idag är kopplat till totalförsvar och kunskap om det svenska totalförsvaret. Informationen som samlas in kommer hanteras på ett säkert sätt och endast hanteras i sin helhet av intervjuaren (Filip Brolin). Intervjun beräknas ta ca 30 minuter och du ombeds att ej diskutera intervjun eller spelet (efter avslutat spel) med dina medspelare förens du medalatas att detta är okej. Frågorna kommer ställas på engelska men du är fri att svara på svenska eller engelska och bjuds in att fråga om du har svårt att förstå språket i någon fråga.

Den första sidan ska du självständigt fylla i innan vi börjar spela

Namn: ____________________________ Ålder: ______ Kön: ______

På en skala 1 (ingen) till 5 (mycket god) skulle jag säga att jag har kunskap om;

- Totalförsvaret: 1 2 3 4 5
- System: 1 2 3 4 5
- Svensk förvaltningsstruktur: 1 2 3 4 5

Jag godkänner att delar eller hela intervjun kan komma att publiceras (efter anonymisering) i samband med mastersarbetet som ligger till grund för totalförsvars spelet i vilket jag idag deltar. Jag godkänner också att intervjun spelas in för att senare transkriberas. Jag är väl införstådd i att jag när som helst kan välja att avsluta mitt deltagande och återkalla detta godkännande,

Underskrift ____________________________ Namnförttydligande ____________________________

Filip Brolin
First section: Approx. 15 min
Aim: Low complexity, allow the respondent time to formulate answers, Keep notes of subject that might be suitable to return to

INSPELNING!

What are your general thoughts of the game?

How would you describe the game to someone else?

Can you describe your session and group?
Appendix C

Can you describe how the game developed?

What were the challenges of the game? – How did you solve them?

Was anything surprising during the game?

Did you learn something?

Notes and other questions
Appendix C

Second section: Approx. 10 min

The middle segment of questioning involves consideration of questions that will ensure that the research topic is adequately explored.

Reminders:

The game should be enjoyable and inspire to discussion among players.

The flow of the game should not be overwhelming to the player but invite them to continue playing.

A system of different parts that are distinguishable by someone untrained in systems thinking but works together as a whole.

Represent different types of entities and flows relationships

Adapt their understanding and develop new strategies to evaluate the system
different threats effect these threats may have on different levels of society.

conceptual framework of the total defence

laws regarding total defence and preparedness (Fullmaktslagarna)

dependencies in society and between actors.

name important actors of the total defence and their main responsibilities.

P3: How would you describe your knowledge of the total defence system before playing the game, did the game encapsuled your perspective? Did someone else in your group possess any other knowledge and how did that effect the game?

P4: How was it to play as a group?
Appendix C

P5: How would you describe the difficulty of the game? Tried to follow up and distinguish between difficulty to understand and difficult play

S1: In the game, what effects did your strategy have, where there any parts of the game important?

S2: How would you describe the different parts/entities/actors/flows of the game? (This question focused on the description of the game that the respondent gave in the previous segment of the interview.)

S3: What was your approach to the events in the game? Did it change? (This question focused on the challenges described by the respondent in the previous segment of the interview.)
K 1-4 What did you learn from the game?

K1: What are your initial thoughts about the event cards, were they probable? How where they simplified/different from reality?

K2/K3: Can you describe the Swedish total defence?
Appendix C

K4: How well did the game represent the real world?
The concluding segment of the interview offers opportunity for more theory driven questions. It is important that the questionings in this part support the respondent to generate meaningful responses and allow both the interviewer and respondent to explore any subject and give clarifications.

**INTERVIEW ENDING SOON!** final questions

(P4) Did your group have any discussions? About what and how did you solve them?

(S1,S2) Was there any relationships within the game that you found interesting?

(S3) Did you or your group device a specific strategy to beat the game? Did it or the game change?
Appendix C

(K1) can you give some suggestions of different threats within the Gray zone? What effect had these in the game and what effect would that transfer to in reality?

(K3) What laws are there connected to total defence, are there different types of laws?

(K4) What actors can you name that have responsibility within total defence? How to they relate to each other? What are some dependencies within the Swedish society and how to they relate to the total defence actors?
Appendix C

Was there anything in the game that you could not do that you wanted to?

Were the rules easy to understand?

If you could change one thing about the game, what would that be?

NOTE: häfta ihop papper, avbryt inspelning, tacka för medverkan.