Bachelor thesis

Information design

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At war with the peace mission

Interactive data visualisation in a responsive environment

Bachelor Thesis

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Abstract

At war with the peace mission
Interactive data visualisation in a responsive media environment

The purpose of this thesis is documenting the interdisciplinary process of producing a responsive media environment. The concrete task was to produce a responsive media environment with meaningful impact, rather than merely focusing on entertainment or aesthetics. The concrete workpiece produced is an interactive data visualisation addressing responsible exports of defence goods by European Union Member States.

The thesis covers the entire production process in its organisational, content-focused, design-related, and technical dimensions. Hence, it is addressed at creatives, technologists, and anyone interested in promoting dialogue and exchange using innovative media.

While addressing the basics of interaction design for responsive media environments, the work puts significant focus on analysing the subject matter as an essential part of the production process. To that extent, the subject-specific aspects of the responsible arms exports are investigated, and working with data is discussed, both as part of the concept development and design. The thesis also explains planning for the production process at hand, and, finally, outlines software development for the technical implementation of the project.

In conclusion, the thesis continues to highlight the relevance of interdisciplinary collaboration and integrated processes, and demonstrates the transformative role data can have in concept development.

Contents

INTRODUCTION

Foreword

The objective of this project is threefold: creating a responsive (media) environment, exploring data visualisation, and making a statement in and about being political as a designer. The finished product should encompass all three.

The approach follows the usual process of a typical client project in design:

1. choosing a topic from politics, science or society;
2. developing a concept suitable for a responsive (media) environment;
3. planning the implementation process; and
4. implementing the concept.

Design study on responsive environments is not very common. While there is good literature for the separate disciplines that comprise the responsive (media) environments, the field as a whole is documented mostly in case studies, rather than theoretical work encompassing the entire field.

With regard to being political, it has become more common in recent years for designers to take explicit stances on mainstream issues, such as climate change and circular economy. Meanwhile, designers are often amongst the last people that touch digital or physical products and communications before they are distributed. In playing a significant role in influencing perception of a product or communication, they hold great power and responsibility in shaping societies. Political statements are not always explicit, and not always intentional.

A clear non-goal for the project is to create something that is mainly considered art or entertainment. Instead, the finished product should be meaningful, communicate clearly, and foster and encourage dialogue.

Responsive (media) environments

Personally, I would describe responsive (or also immersive) environments by outlining the many possibilities.

Responsive environments can:

- mediate human experience, perception, and interaction;
- engage humans in unexpected ways;
- require instruction or be completely intuitive;
- make use of one, multiple, or all human senses;
- create social experiences;
- excite many different audience types and sizes;
- work with (real-time) data from in- or outside the environment;
- exist within or be part of an existing environment or architecture;
- surprise people in lobbies, showrooms, exhibitions, or public spaces; and
- feature fully custom-built sculptural and kinetic components.

All of the possibilities listed make it an exceptionally exciting field for designers and technologists and offers designers many opportunities for collaboration with other disciplines that is meaningful for all stakeholders. The production process from idea to finished product usually yields exciting and new challenges, thus inviting exploration and discussion, often across disciplines. The process and end-product are characterised by being inherently human-focused, and, refreshingly, steer away from the overused and limiting[1] term "user".

Responsive environments base their principles in modern interaction design. Basic tools used are proactive and satisfying responses from the system, triggers to grab attention and encourage engagement and interaction, a high level of responsiveness. A lot of times, artwork and visuals are produced using generative/parametric design, which means that a system can produce a literally infinite number of unique visuals.

Because responsive environments are typically unexpected, unique, and surprising, it is likely that people engaged share their experiences, thereby allowing a wider reach outside the physical perimeter of the environment.

Flávio Soares Corrêa da Silva and Wamberto Weber Vasconcelos offer a more technical description:

"Responsive environments are physical surroundings whose components change their behaviour to accommodate the presence of people as well as other components. Software agents assigned to components are autonomous and reactive/proactive programs that communicate via message-passing. Arbitrary functionalities can be encoded in such agents, reflecting the capabilities of the components they represent, as well as extending them."[2]

Bruce D. campbell and Francesca Samsel propose[3] a three-dimensional model for categorising art–science collaborations, with the axes being:

- broad to narrow (in scope),
- art to science, and
- physical to virtual.


如东风电场
Rudong
Wind Farm
总装机容量：100兆瓦
Total capacity
100 MW
年发电量：2.2亿千瓦时
Annual electricity output
220 GWh
年二氧化碳减排量：19万吨
Annual CO_2 reduction
190,000 tonnes

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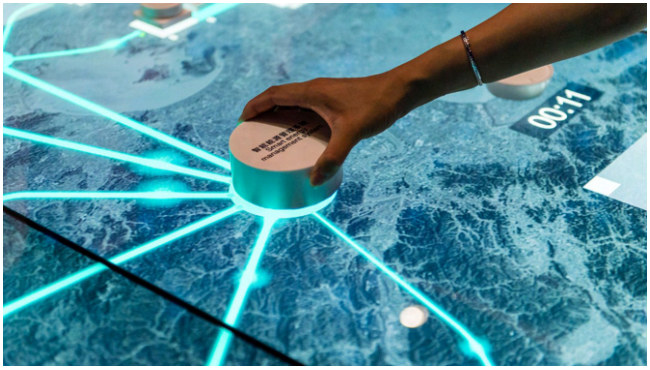


Hanergy Renewable Energy Exhibition Center
TRIAD Berlin & TRIAD China

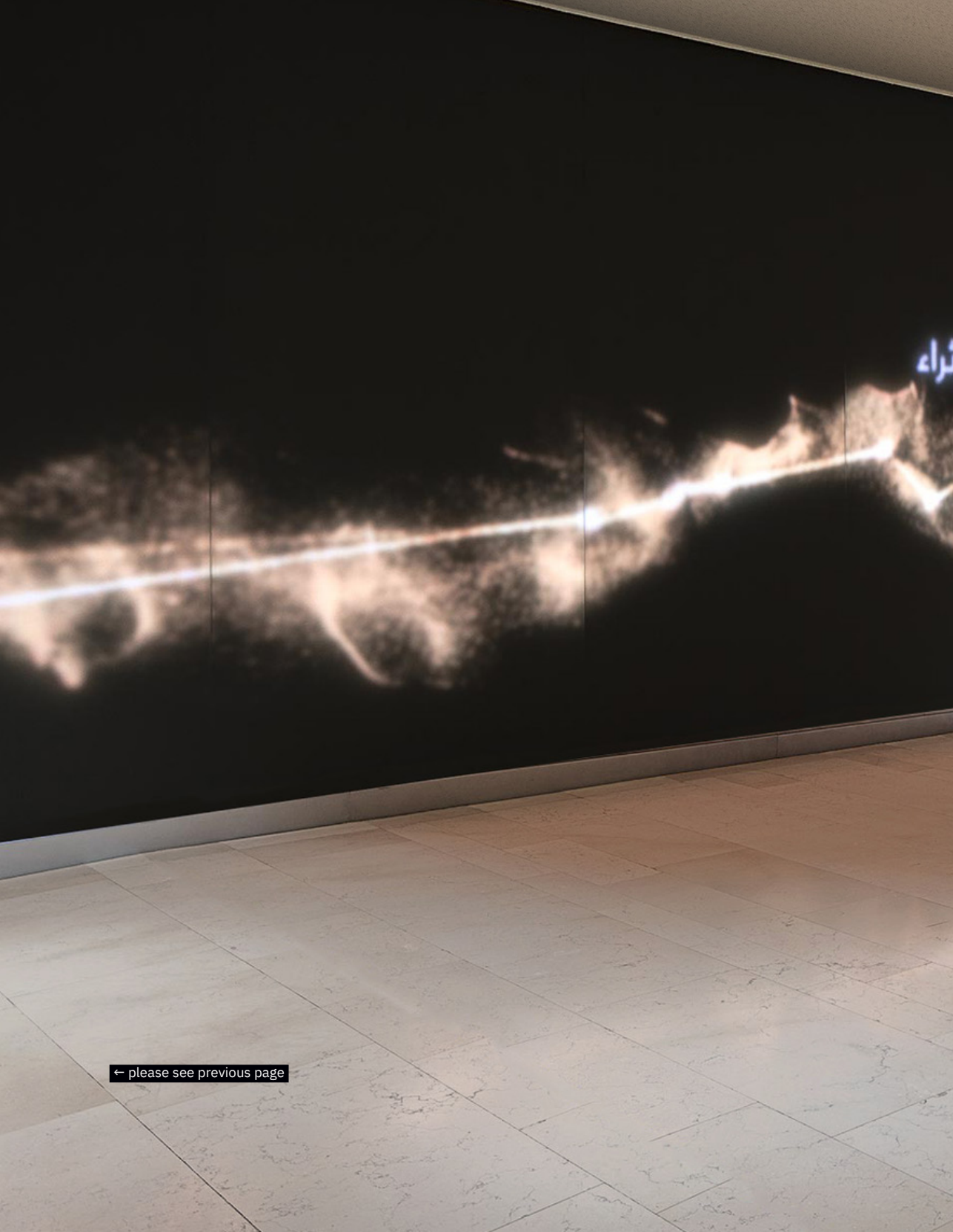
On behalf of one of the world's leading enterprises for the production of solar panels and regenerative energy, TRIAD Berlin and TRIAD China are developing the overall concept for a unique showroom and exhibition sector, which will address both the history and future of energy production.

(image source: https://www.triad.de)

Knowledge Stream
ART+COM Studios

The King Abdulaziz Center for World Culture was inspired by the idea of knowledge as a transformative force that drives creativity and social development. The centre is a place where knowledge can be experienced and cooperatively generated. An interactive, virtual stream of knowledge runs through the culture centre, becoming visible in various places, providing access to information in the form of texts, pictures, and videos.

(image source: https://artcom.de)



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أهلا بكم في إ
Welcome to Ithra

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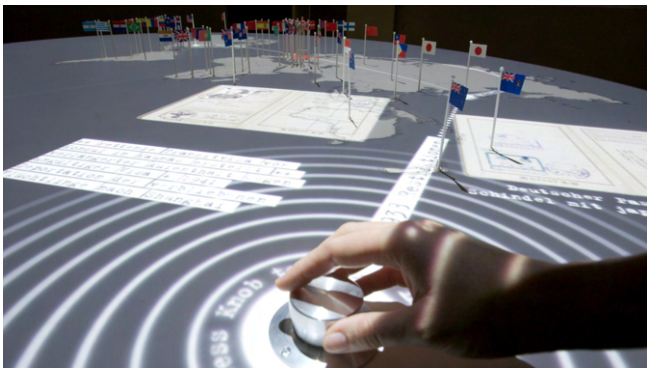
LUMESS LED Panels at Cabrini Hospital
ENESS

LUMES is a light-emitting wall system that blends into surrounding architecture and reveals itself in articulate colour forms. Visitors trigger animations of landscapes and animals to the delight of children.

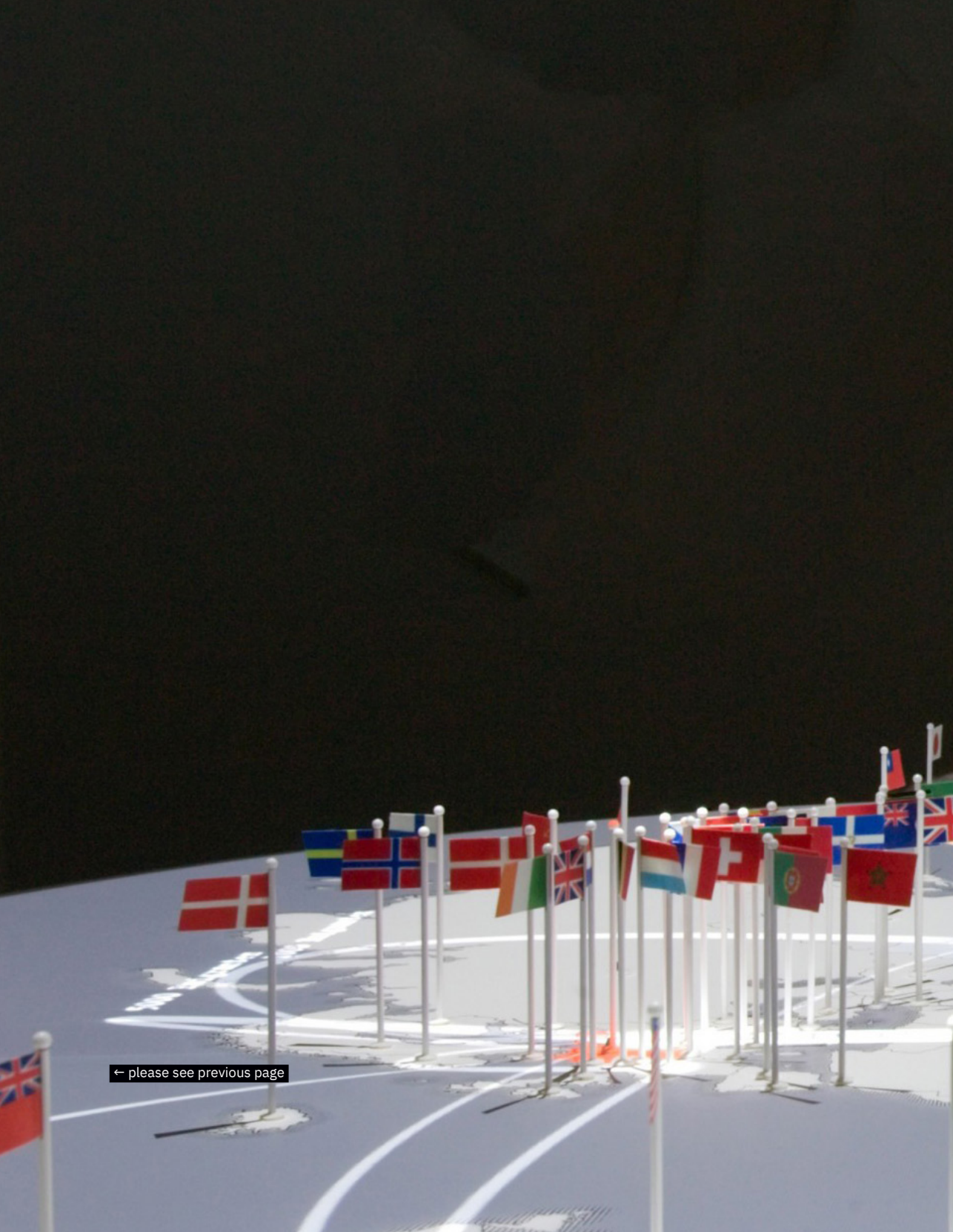
(image source: http://eness.com)



Home and Exile
ART+COM Studios

The exhibition “Home and Exile. Jewish Emigration from Germany since 1933” focused on the forced exodus of German Jews. ART+COM created an interactive installation that told stories about persecution and preparing for flight, about journeys to an uncertain future and, above all, about beginning anew in a foreign world.

(image source: https://artcom.de)



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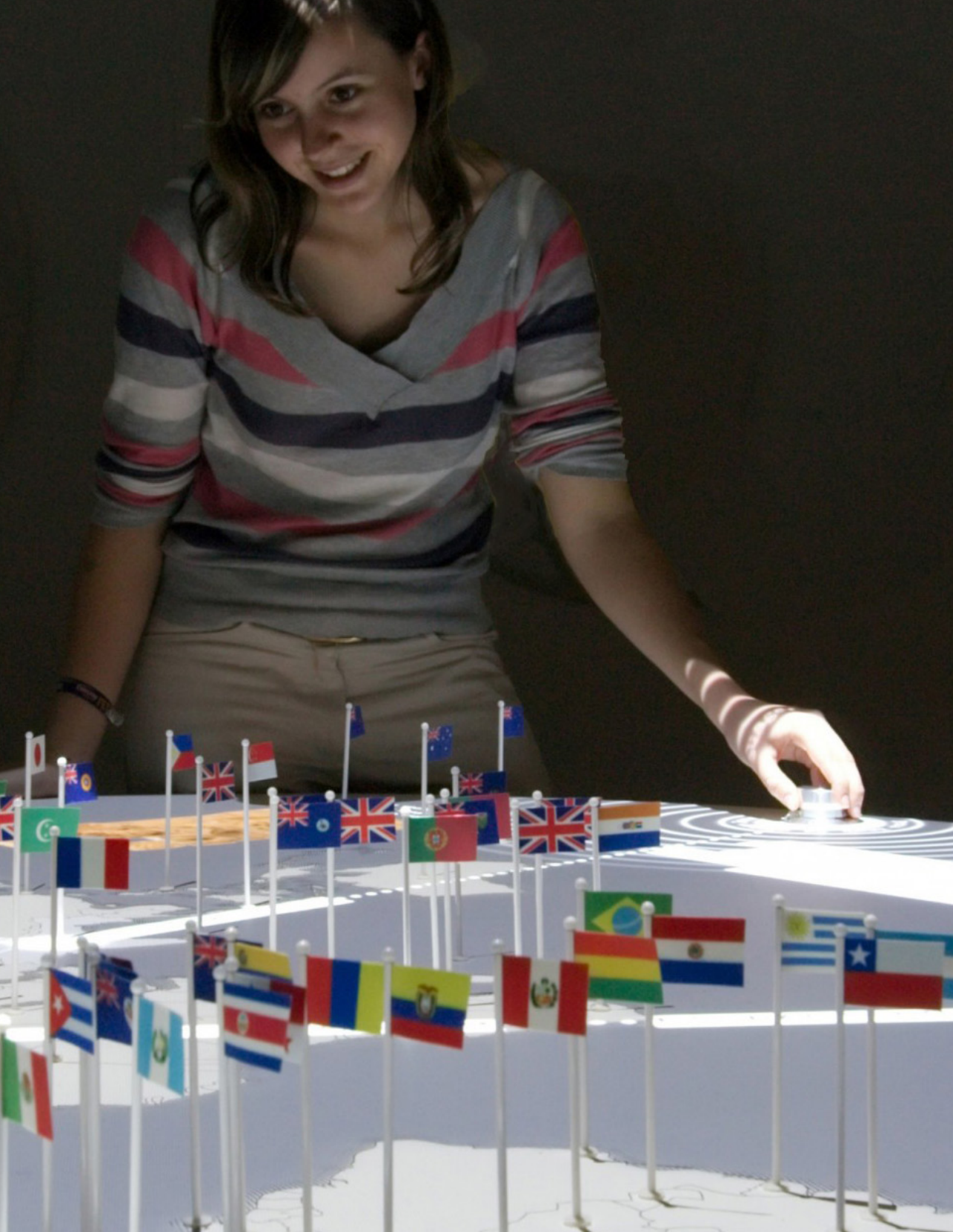

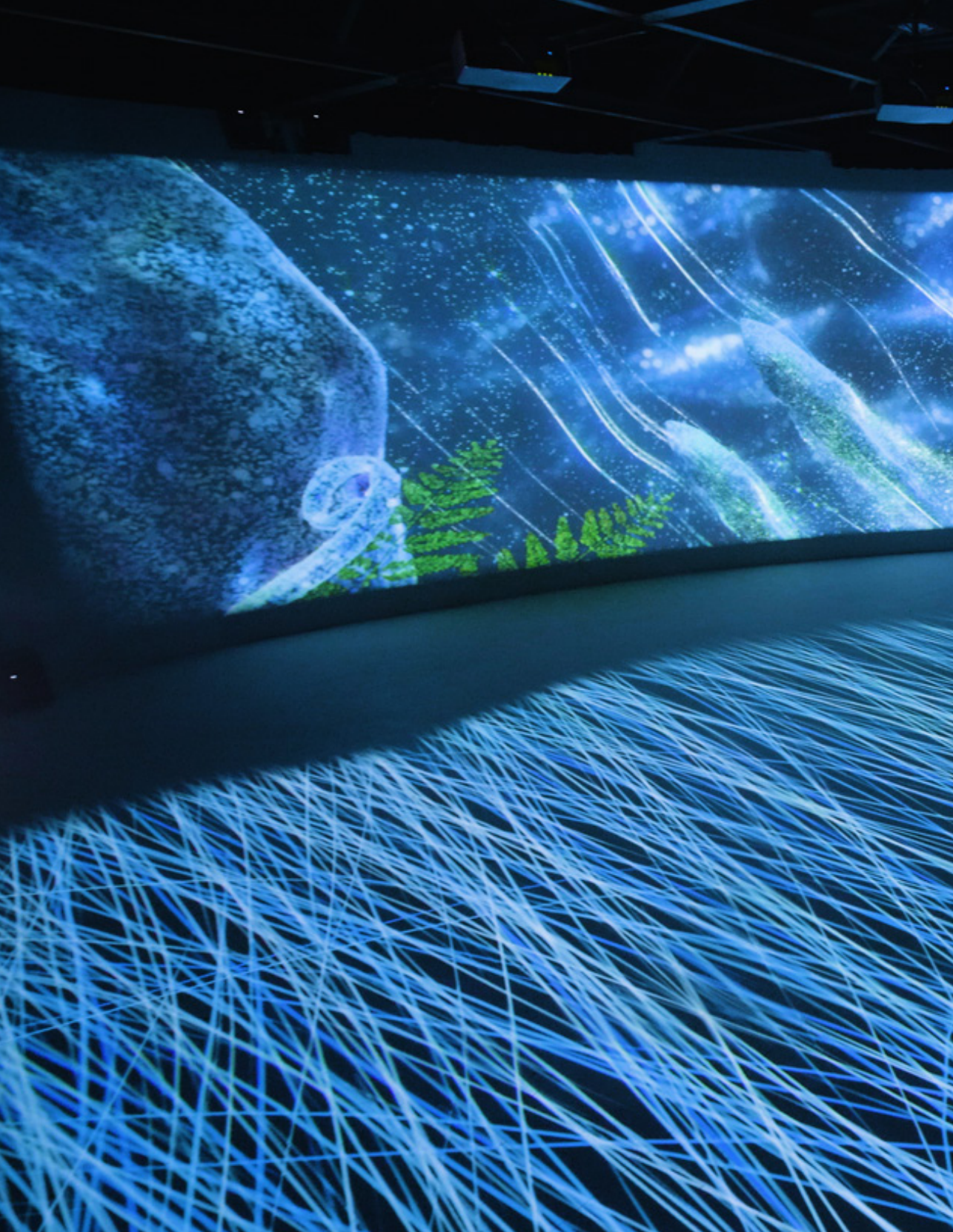

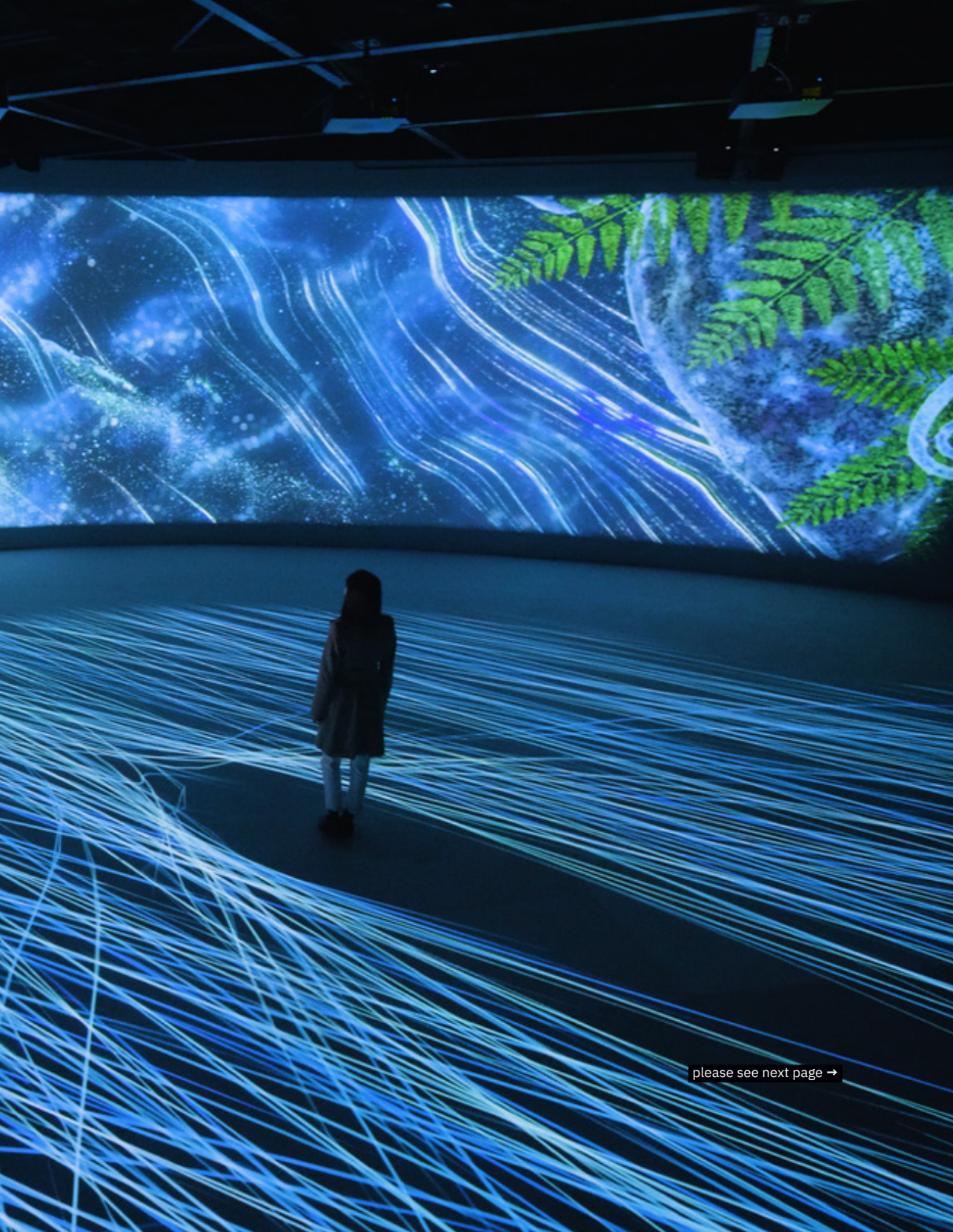

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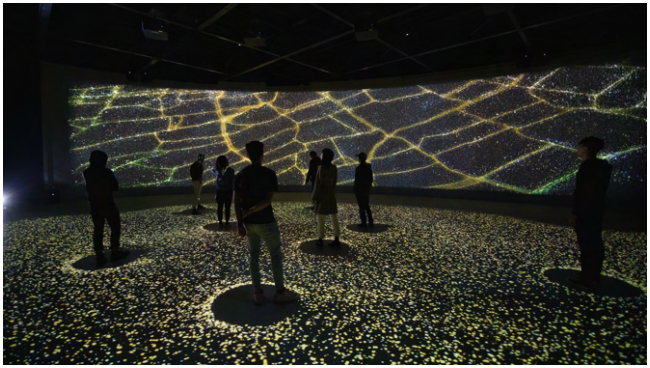

Taichung World Flora Exposition Discovery Pavilion
Ultra Combos

The Discovery Pavilion's design concept is "Seeing Half the Earth in Taichung", which tells about the ecological journey from 0-3886M above sea level along Dajia Creek.

(image source: https://ultracombos.com)

Everything in existence
*fuse**

The works in the exhibition are united by the fact that they are generated by software that is processing data in real time. The data may be derived from interaction with the viewer (“Snowfall”), from social networks (“Amygdala”), from sound (“Clepsydra”) or from the software itself (“Multiverse”). Using this generative technique, fuse* creates “living” art that constantly renews itself and changes before one’s eyes, rewarding prolonged viewing and repeat visits from the spectator.

(image source: https://www.fuseworks.it)

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Data visualisation

Around the 2000s, content producers started gaining access to intuitive and increasingly powerful tools that allowed data visualisation to become more common, complex, and dynamic. Around the same time, dial-up internet started getting replaced by broadband internet, and a decade later people started having smartphones. All the while, access to and generation of data have exploded. Data have become much more complex, more controversial, more economically valuable, and more crucial to the functioning of societies.

With improved hard- and software, the possibilities for communicating visualised data are great. These advancements have given people access to a plethora of visual information, and it has become increasingly difficult to impress with data visualisation. Still, unless data visualisation is purely used for art, narrative objectives should be prioritised over aesthetic choices. For example, force directed graph drawings may be visually more pleasing, but can make things less clear, more confusing, or misleading.

"Seeing data is often an unpleasant experience—reality isn't always easy to stare straight in the face. Human memory and understanding is not always accurate, and most of our memories can be expanded, twisted, and colored in the ways we want to remember. But digital data is, to a certain extent, pure. At a surface level, there is no fantasy or illusion in the data world."

—Sey Min[4]

Synthesising and narrative storytelling with data have become increasingly important topics in many fields far beyond journalism. Miriah Meyer describes design as a method of inquiry and understanding. In her design study[5], she analyses real-world issues and designs visual systems.

“Data isn’t perfect, despite appearances. Numbers, lines, and charts have a way of tricking us into believing they’re fact. The reality is far more messy.”

—Giorgia Lupi[6]

Giorgia Lupi’s *Dear Data* project[7] explores data humanism and shows the use of data to gain new perspectives and comments on its misleading role in discourse.

“Different datasets have different ways to approximate reality. No dataset tells the whole and only truth. [...] People aren’t used to seeing data as something imperfect,”

—Gabrielle Rossi

(Co-founder and Managing Partner at Accurat)

“There’s a crucial distinction to make between inaccuracy and the imperfection that’s bound to show up in any human-gathered dataset. In many cases, accurately depicting a dataset means including its flaws—its biases, its approximations, its uncertainty. For Accurat, those flaws are where the data becomes interesting. It’s an opportunity to make data feel more human, beautiful, and true.”[8]

IDEA

EU Member States and responsible arms exports

The European Union (EU) emerged from the idea of creating and maintaining peace. Even though the EU has undergone significant changes over the past decades, this core idea remains a high priority in the EU's identity and activities.

According to the Treaty on European Union, the EU aims to:

- promote peace, its values and the well-being of its people (Article 3 § 1); and
- preserve peace, prevent conflicts and strengthen international security (Article 21 § 2, (c)).

Despite that, defence is a large and important industrial sector in Europe. Arms exports are important for European companies as national defence budgets in the EU are declining, and the European defence sector needs to stay globally competitive. The defence sector generates economic growth for Member States and helps maintain trade relations with non-EU countries.

Global weapons trade volume is estimated to be over USD 95 billion per year.[9] At the same time, according to studies, corruption in the arms trade contributed roughly 40 %[10] to all corruption in global transactions in 2011.

There are measures in the EU that control arms exports, aiming to ensure responsible exports in regard to peace, security, and human rights. There is also a United Nations (UN) Arms Trade Treaty. Still, there are numerous cases where European defence goods were found to be used to violate human rights in non-EU countries. For example, in 2015, Germany approved exports of patrol boats and battle tanks to the Gulf region, disregarding concerns about conflicts and human rights violations. Other cases include arms sales to dictators in countries such as Bahrain, Egypt, Libya, Syria, and Yemen, when the Arab Spring broke out in 2011.

European companies are enlarging their international client base, and there are ongoing efforts to improve and harmonise the European defence market, also under pressure from international competition. Meanwhile, EU officials have repeatedly expressed the need to strengthen existing export policies that respect European goals regarding peace and human rights. The latter should be done supporting competition on a European level, and without damaging the European defence industry.

A company in the EU can export defence goods after getting an export licence from its national licensing authority. In 2008, the Council of the EU (Council) adopted the Common Position on Arms Exports.[11]

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Eight criteria were developed for the export of conventional arms that EU Member States apply to their licensing decisions:

1. Respect for international obligations of the Member States;

2. Respect for human rights in the country of final destination;

3. The tensions or armed conflicts in the country of final destination;

4. The degree in which the arms delivery would influence peace and security in the region;

5. The national security of the Member States and their allies;

6. The behaviour of the buyer country with regard to the international community, its attitude towards terrorism, the nature of its alliances, and respect for international law;

7. The risk of diversion of the goods from within the country, as well as the risk of re-export under undesirable conditions; and

8. Compatibility of the arms exports with the technical and economic capacity of the recipient country (sustainable development).

Aims and objectives

The primary aim of the project is to produce a responsive media environment that introduces visitors to the topic of responsible exports of defence goods, and, additionally, invite further reflection and exchange on the issue.

The visitor should be as free as possible in making their own judgements. As data are inherently subjective, the presentation cannot reach fully neutral status.

To create a sustainable end product, it should be, technically speaking, scalable, and flexible in deployment. Its data should also be easily updatable.

CONCEPT DEVELOPMENT

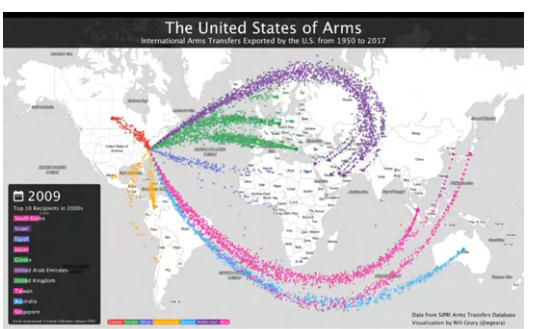
Restrictions

The primary restrictions on responsive media environments mostly come from the target location and budget. Additionally, if the installation needs to be mobile, the resources required have to be available at all target locations.

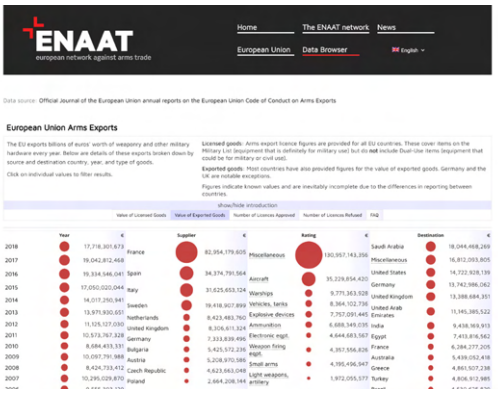
In the case of this project, the budget is virtually non-existent. Required equipment will need to be available from the university. Fortunately, the university owns a wide range of devices and hardware for many purposes. It should also be possible to deploy and test the project without specialised hardware, such as sensors. Therefore, it should be possible to emulate specialised hardware.

Existing work related to the topic

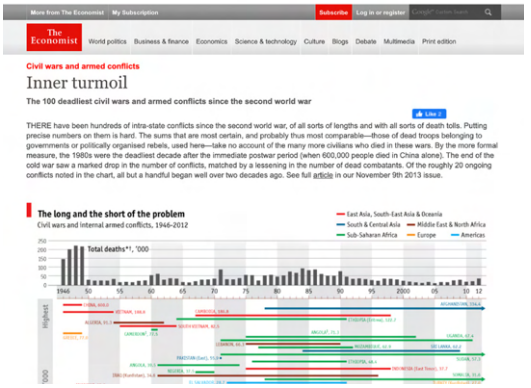
Small Arms Imports & Exports,[12] produced by Google at the Google Ideas INFO Summit, is a website that shows global import and export data from 1992 to 2011 on a 3D globe. Data display can be filtered by year, country, trade direction, military weapons, civilian weapons, and ammunition. The data are sourced from the Peace Research Institute Oslo.



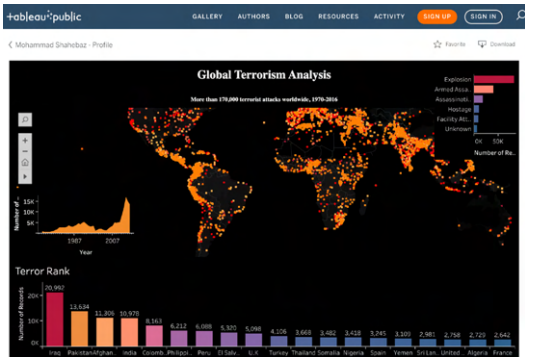
The United States of Arms[13] by Will Geary is a video showing US weapons exports from 1950 to 2017. The visualisation shows trend indicator values from the Stockholm International Peace Research Institute's Arms Transfers Database.



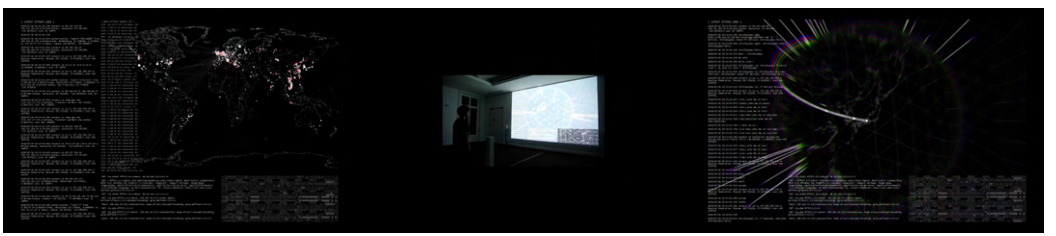
The European Union Arms Exports Data Browser[14] by the European Network Against Arms Trade is a filterable list showing EU Member States' reported exports by year, supplier country, rating according to the Military List of the European Union, and destination country. The filter is limited to the selection of one item. The data can be separately viewed for each of the reporting categories: number of licences approved, value of licensed goods, value of exported goods, and number of licences denied. Each datum is represented by a red circle which is scaled in relation to the other data in the column.



The Economist's *Inner turmoil*[15] chart shows civil wars and armed conflicts on a timeline from 1946 to 2012. The totals of deaths per conflict are displayed as a bar chart on above of the timeline.



Global Terrorism Analysis,[16] by Mohammad Shahebaz, shows over 170,000 terrorist attacks from 1970 to 2016. Individual conflicts can be selected for details, including a short summary.



honey pot,[17] by Masahiko Tsugawa, is an installation that shows real-time attacks on various honeypot servers. The attacks are mapped on a 3D globe, while the display logs attackers' IPs, ports, and locations. The installation also includes a big, red button, which visitors can press to view statistics. The installation uses sound and visual flash effects to intensify the experience.

Political aspects

The various aspects related to the topic are mainly centred around ethics, economic, and defence policy. The latter two are differ significantly at the national and EU levels. All of these aspects are interlinked and form a complex topic.

Key conflicts

Human rights are "inalienable rights of all members of the human family."[18] The Charter of Fundamental Rights of the European Union[19] includes human rights and became legally binding on EU institutions and national governments with the Treaty of Lisbon.

The European defence industry is a major industrial sector, which is highly innovative and centred around high-end engineering and technologies, with a turnover of EUR 97.3 billion in 2014 and investing heavily in innovation. In 2014, the sector employed 400,000 people and generated a further 1.2 million jobs.[20] In 2019, it involved 2,500 small and medium-sized enterprises (SMEs).[21]

The European defence market is largely nationalised and not a genuine internal market. European security depends, more than ever, on European security and defence cooperation, as well as a more collaborative approach towards security and defence R&D and procurement. Member States sometimes tend to put economic interests over other considerations when it comes to arms trade. Sovereignty concerns are still a major obstacle for defence cooperation. Additionally, Member States are, to very different amounts, supporting and subsidising their national defence industries. There are also several major European companies that are partly state-owned: Finmeccanica (Italy), Thales (France), and Airbus Group (France, Germany, Spain; formerly EADS).

Many lobbyists represent the defence industry on the national and EU levels. There are also pan-European lobbying associations where major industry players are represented (e.g., the AeroSpace and Defence Industries Association of Europe). Furthermore, there are networking groups that bring together Member of the European Parliament (MEPs) and industry representatives (most prominently, the Kangaroo Group). Finally, industry representatives make up a majority of the European Commission's advisory and expert groups.

Lobbyists try to achieve increased Member State defence budgets and higher EU research and development funding for defence and dual-use technology.* Lobbyists are also pressing the EU and national governments to apply policies for trade and exports that are favourable to their business (e.g., to allow parts to be transferred to another country, where assembly and export can then take place).

The activities of defence industry lobbyists rarely appear in the media. When they do, however, it is often in connection with cases of bribery, disputable

* Dual-use technology is technology which is normally used for civilian purposes but which may have military applications.

export deals and corrupt government officials. For example, Greek government officials expressed to have felt pressured to spend billions on weapons, while France and Germany denied charges.[22]

Transparency in the defence sector remains difficult on various levels. Member States must publish an annual report on arms exports. It is generally known that sensitivity over security concerns are often used to legitimise non-disclosure of activities in the defence sector, resulting in insufficient transparency in defence budgeting and procurement. Even when defence policy is clear and detailed, it may be the case that budgeting and spending on defence equipment is not related to that policy or its goals.

The misinterpretation of Article 346 § 1, (b) of the Treaty on the Functioning of the European Union (TFEU) is a widely known problem. The article allows the exemption of the production of arms and related projects within the EU to fall under the rules of the single market if it is considered necessary for the protection of the essential interests of the Member State's security. Member States enjoy wide discretion when it comes to national security. The European Court of Justice has largely refrained from scrutinising the article too much. The Commission has generally not paid sufficient attention to various cases. While recommendations for the scrutinisation of the article exist,[23] the European Parliament (EP) has reported that, in practice, the article is applied quasi-automatically to most defence equipment contracts by Member States.

Citizens often have no clear insight into – or do overall not voice opinions and concerns about – military spending, leading to weak civilian and democratic control.

The European Defense Agency (EDA) was created in 2004 as an agency of the Council and is pursuing four goals: developing European capabilities, promoting armaments cooperation amongst Member States, promoting defence research and technology, and developing the necessary tools to increase the competitiveness of the defence industrial base and market in the EU.

The European Council and the Council can take decisions about the CSDP. The High Representative of the Union for Foreign Affairs and Security Policy/ Vice-President of the European Commission (HR/ VP) usually proposes these decisions, which are to be made in unanimity (with some exceptions). The HR/VP is also responsible for coordinating the CSDP.

The EP can adopt decisions regarding the defence industry and has a strong interest in harmonising and strengthening the European defence sector. It may scrutinise the CSDP and address the HR/ VP and the Council in these matters. In December 2015, the EP adopted a resolution[24] calling for a stricter arms export regime.

The Council's Working Party on Conventional Arms (COARM) handles work regarding export control for conventional arms. It also offers a forum and platform to exchange information about export policies for Member States. COARM also deals with outreach activities, dialogue with non-EU countries, and was involved in the process concerning the ATT.

The EU's Member States act in both sovereignty and cooperation under a common strategy and policy in the various contexts of defence-related matters. They must decide and act within multiple processes and frameworks.

Ongoing efforts

The EU's CSDP includes capacities for missions outside the Union for peace-keeping, conflict prevention, and strengthening international security in accordance with the principles of the United Nations Charter.

The European Council, Parliament, and Commission have all expressed their willingness to work on a stronger and more competitive European Defence Technological and Industrial Base (EDTIB), which, in turn, is essential for an effective CSDP. In June 2014, the European Commission presented a roadmap for the implementation of measures aimed at strengthening the single market for defence, promoting a more competitive defence industry and fostering synergies between civil and military research, including details and timelines for the actions.

The EU Transparency Register covered 60–75 %[25] of lobbying organisations active at EU level in 2013. The Commission has implemented a mandatory system for registering lobbying expenses, as promised by Jean-Claude Juncker, former President of the European Commission.

Under the UN Arms Trade Treaty (ATT), countries regulate international trade in conventional weapons (such as small arms, battle tanks, warships and aircraft) and work to prevent the diversion of arms and ammunition. Arms deliveries to non-state actors, however, do not fall under the ATT.

It is notable that the ATT was set up to be a consensus treaty, which, after three countries tried to block it, was eventually moved to a vote by the UN General Assembly, where 23 countries, representing half the world's population (including China, India and Russia), abstained from voting. The treaty was criticised by many for facilitating the arms industry, reinforcing the power of western arms exporters, and legitimising questionable policies.

Shortly after the entry into force of the Lisbon Treaty, the EU introduced the 'defence package' Directives. The Defence and Security Procurement Directive sets out EU procurement rules, adapted to the specificities of the defence and security sectors. The Transfers Directive establishes a new, harmonised licensing system for the transfer of defence-related products within the EU. The aim is also to enhance competitiveness and confidence in the security of supply of products provided by European companies in other Member States.

Public discourse

The topic of arms exports, most of the time, is not discussed by the broader public. On occasions when arms exports are discussed in and around mainstream media, the focus is usually put on major global conflict events or related refugee streams. Knowledge about agreements and processes relating to the export of defence goods on the EU level is uncommon.

In Europe, a politician's or political party's stance on arms exports and related regulations is generally low on voters' priority lists. It is worth mentioning that European citizens are mostly against arms exports. In a 2018 survey,[26] 64 % of Germans voiced their opposition to the export of defence goods, while 80 % were against exports to war and conflict areas. These opinions stood against claims that Sigmar Gabriel, at the time Germany's Minister of Economic Affairs and Energy, made in a letter in response to controversy around German defence goods exported to Saudi Arabia in 2016. In the letter, Gabriel wrote that he had "created the strictest and most restrictive arms export control ever in Germany."[27]

Critique addressing controversial export activities is typically concerned with ethics, refugees, economic considerations. Anger is often expressed by accusing political or economic elites of hypocrisy. Other voices support making political and diplomatic statements by halting exports. A usual counter-argument is that stopping exports would be pointless, as defence goods would be procured from other sources, instead.

Explicit efforts to stop defence goods exports, toughen regulations, or increase transparency are usually made by political parties and peace-oriented NGOs, on both national and EU levels.

Constructive questions

Finally, having explored the topic in its facets, I have come up with some key discussion points. These discussion points are phrased as questions that are constructive in their nature, and also demand knowledge building and reflection.

What should be the next steps towards a European single market for defence?

How can the European defence industry stay (globally) competitive?

How can the EU and its Member States increase transparency and accountability in the defence sector?

Where do export policies and economic interests clash?

How can the EU and its Member States ensure responsible exports of defence equipment?

Target audience

Responsive environments are most often presented as part of an exhibition, or public events spanning one to multiple days. The topic of defence goods exports is, although not the most commonly discussed, relevant to all people. The topic's most discussed aspects are global conflicts and refugees from conflict areas.

Ideally, visitors have interests in political ethics, economic and trade policy, and the European Union. Pre-existing knowledge in either of these areas is not expected at any level; it can be assumed that a visitor has at least a basic grasp of global events pertaining to aspects of the topic.

What to communicate

In deciding what to communicate, I first scoured the internet and looked at all the data I could find, following these principles:

- What relevant data are available?
- What information is the visitor interested in?
- What data are necessary to build essential knowledge?
- What data can be added as secondary information?
- How much bias does respective secondary data add, and should they, therefore, be presented?

I could find useful datasets from independent NGOs, supranational organisations, and universities. I did not look at data generated by private-sector entities, as these datasets are likely insufficient in scope, and also potentially more likely to be biased. Many of the datasets are vast in their extent (up to 200 Megabytes). I also checked the data for completeness and looked at their temporal range, as it is desirable to present recent data to visitors. Unfortunately, some datasets did not qualify, because the record does not go beyond 2010, and omitted information does not contribute towards objectivity. Data were available in CSV and Microsoft Excel format. I used Microsoft Excel and its filter function to initially check data. If a data check showed that the dataset was a good candidate for further use, I transferred it into a MySQL database for further checks on logical integrity in the database, using SQL queries, if necessary.

The primary dataset for this project are exports by EU Member States. The parameters of interest are time, exporter, destination, volume. These data are published in annual reports on arms exports in the Official Journal of the European Union. The annual reports list export data as tables by destination country. Fortunately, the European Network Against Arms Trade has compiled the reports into a machine-readable version of the data with a total of over 211,190 rows.

The data also include rating according to the Military List of the European Union, number of licences approved, value of licensed goods, value of exported goods, and number of licences denied. These parameters are suitable as potential secondary information communicated.

Quite importantly, there are significant differences in value between licenses and exported goods. This is due to different reporting styles of individual Member States. Some Member States did not submit any export data for certain years, leaving gaps in the reporting. This shortcoming can unfortunately not be accommodated with a systematic blanket solution. Meanwhile, the export records may not correspond to actual trade activities, as certain exports were simply not included in the reports for one or the other reason.

Relevant secondary data would mostly be related to the eight criteria laid out in the Council's Common

Position on Arms Exports, as they are used to judge whether an export is responsible, and, consequently, grant or deny a request for export.

Some of the criteria are too specific to individual countries, and in their extent too complex for simple representation through generalised data. These include international obligations of the Member States, national security of the Member States and their allies, and risk of diversion of the goods from within the country, as well as the risk of re-export under undesirable conditions.

Other aspects of criteria are matters of international diplomacy and/or are subject to current debates or predictions for the future. Anyhow, they stand in their own complexity, rather than making sense in a homogenised dataset. The only information recorded as datasets are formal international alliances amongst state entities. This information, however, becomes irrelevant when considering that the receiving end of an export could be both state and non-state entities. While a country's government may receive a good evaluation, a non-state entity in the same country may not.

The second criterion, respect for human rights in the country of final destination, is a metric that is well recorded and measured by various entities. The most elaborate metric is the Latent Human Rights Protection Scores by Christopher Farris. The dataset holds data about extra-judicial killing, political imprisonment, torture, political terror, genocide, massive repressive events, executions, negative sanctions, and mass killings. These parameters are recorded per country and year, and sometimes listed from their separate sources. Unfortunately, the dataset is not consistent in holding data for every country for every year.

There are various records of (armed) conflicts around the world, going into various levels of detail and containing up to tens of thousands of records. One metric I looked out for to be included was the number of persons killed, as killings are the most direct impact of arms, and therefore create a strong association.

How to communicate

A primary question in designing the experience is: How does the interface transport the user and lets them connect to the data on an emotional level?

Other than that, I based my thoughts on the following models from knowledge building or exhibition design:

Information can be categorised in one of five ways:[28] chronologically, alphabetically, geographically, categorically, and hierarchically.

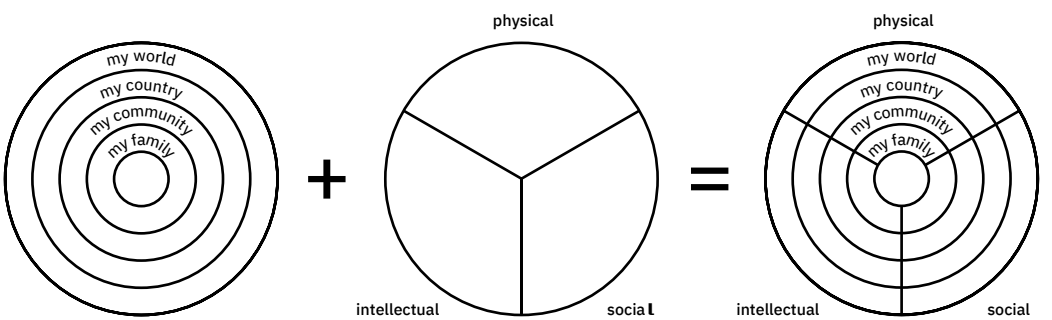
Graziella Tonfoni shared hints for accurate building knowledge in information design:[29]

1. Isolate the most crucial problem;
2. Identify the most accessible level;
3. Create the most consistent metaphor;
4. Foresee and represent all possible evolutions;
5. Anticipate possible endangering factors and resistance; and
6. Plan consistently and dynamically.

Graham Black created a Visitor Bill of Rights for exhibitions:[30]

1. Comfort: “Meet my basic needs.”
2. Orientation: “Make it easy for me to find my way around.”
3. Welcome/belonging: “Make me feel welcome.”
4. Enjoyment: “I want to have fun,”
5. Socialising: “I came to spend time with my family and friends.”
6. Respect: “Accept me for who I am and what I know.”
7. Communication: “Help me understand and let me talk too.”
8. Learning: “I want to learn something new.
9. Choice and control: “Let me choose; give me some control.”
10. Challenge and confidence: “Give me a challenge I know I can handle.”
11. Revitalization: “Help me leave refreshed, restored.”

The world of a child, according to the Massar Children’s Discovery Centre in Damascus, by Damascus Consultants and Cultural Innovations:[31]



Input systems in responsive media environments

Responsive media environments rely on human input of some form. This input is recorded by sensors (motion, sound...), or done via sensitive surfaces, or haptic interfaces and devices that somehow connect to the environment. All these components can be built into the interior of the environment.

Sensors are available for all kinds of uses. Some more advanced sensors are multi-purpose and can handle complex computing tasks, such as the Microsoft Kinect for Xbox One, which provides detailed motion data for up to six people. Sensors are usually not very expensive.

Sensitive surfaces include touchscreens, multi-touch surfaces, or even sensitive floors with built-in screens. This type of hardware is connected with higher costs, and may not be an option to use.

Haptic input devices or objects are available in many forms, or can potentially be built at relatively low cost. Indeed, a custom-built object that is relevant to the subject of the environment adds value to the experience. These objects and input devices can be purely utilitarian, literal, or symbolic.

A great option is allowing visitors to connect to the environment on smartphones via the web browser, custom software that can be downloaded, or in responding to signals emitted from the phone, such as light, Wi-Fi, or Bluetooth. The clear advantage is that most people have smartphones. They can also be used in connection with QR-codes. It is worth noting that smartphones can also be distractions, as most modern smartphones' software has a notification function. This kind of distraction can be considered acceptable, as it is usually unavoidable and, strictly speaking, it is probably not essential for the success of the environment to command a person's full and undivided attention.

Language and tone

Due to the sensible political and controversial nature of the topic, I believe it is responsible to address the language and tone used.

The environment should be:

- serious,
- inviting, or
- humane.

The environment should not be:

- biased,
- judgemental, or
- evasive.

These requirements should be met in the wording and in the experience of the environment.

Inspirations

For scenographic inspiration, I referred to film and TV. I am especially impressed with scenes where characters discuss armed conflict and war situations, often under pressures that contribute to the dramatic flair. Concretely, I picked the White House situation room from House of Cards (TV series, 2013–2018), modelled after the real White House situation room, and the war room from Stanley Kubrick's 1964 film Dr. Strangelove.

One common element of both scenes is that people are sitting down to discuss. From experience, I strongly feel about discussions held sitting down and highly value the distinct atmosphere and tone established by the mere presence of a table and chairs where people sit down to talk.

The second common element is the screens on the wall. While the screens in the White House situation room are turned off or show an inconspicuous logo graphic, the screens in the Dr. Strangelove war room are dramatically over-dimensional and display military strategy on different maps.

A significant difference between both scenes is the size of the room: the White House war room is just big enough to fit the table comfortably, whereas the war room in Dr. Strangelove is a large hall with cement walls, an angled roof, and a circular table seating almost 30 people.

As for light, the White House war room is well lit, although with no windows, and warm artificial light. Dr. Strangelove's war room is lit by the large displays, and by overhead table light, but has an overall rather dark, almost gloomy atmosphere.

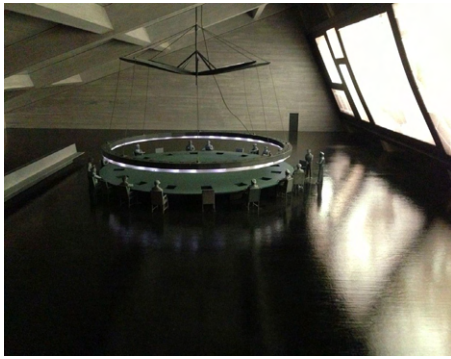


image sources: https://www.netflix.com (1), https://commons.wikimedia.org (2–4)

Concept description

Generally, the environment shows arms exports and relates them to armed conflicts and resulting deaths. Visitors have control over selecting an exporting country and defining a time range for which to display data. Visitors are then invited to draw further conclusions, discuss, or make judgements based on personal knowledge and opinions. The project will display data for all 28 EU Member States, as of 2019. Regarding time, 2000 to present seems like a sensible timeframe, and the export dataset only starts at 1998 with only some countries having reported export activity in the early 2000s.

The scene

The environment establishes a situation room scene. The main projection on the wall shows a world map. Visitors are invited to engage by assuming unnamed roles that can control the environment. A visitor can sit down in front of a touchscreen control element on the table. The control elements can be used to set different parameters on the projection, therefore giving visitors different roles and responsibilities that help establish a dynamic amongst visitors. The intended message is a metaphor about power – people at tables in situation rooms related to military action and defence are usually top-level politicians and military personnel.

The touchscreen controls can be used to select an exporting EU Member State and time range respectively. The input happens sequentially and the touchscreen control will display an idle state when no input is necessary. The decision to select a country first is based on the assumption that people generally have a stronger connection to a country than a timeframe, and also because discourse around arms exports more often focuses on individual countries, rather than timeframes.

Physical setup

The room setup requires a large projection or screen on the wall. The room should be relatively dark. The input controls are set on a table in the middle of the room. The table should be neither too large nor too small,seating at least two people. The table (arrangement) can be rectangular or circular. An odd amount of seats with a chair at the head or centre of the table could add a leader-type role to the dynamic, while an even amount of chairs advocates equality. The exact setup is flexible and can be determined individually.

Knowledge-building

Supporting information and knowledge pertaining to the rules and processes behind arms exports, or data (i.e. on human rights or economic data) can be communicated outside of the situation room, or as part of the situation room across from the projection. The exact shape or form of the information and knowledge communicated can be individually determined and are subject to resources available. I advise sticking to explicit, clear, and structured forms of presentation if an element is considered essential for the kind of dialogue the installation wishes to foster. On the other hand, more abstract forms of presentation will help engage other types of audiences.

Software

The system produced should be able to potentially handle further input controls, data displays, and added or updated datasets. Hence, it will be possible to shift the environment to other narrative concepts.

PLANNING

Project planning

Classically, digital projects follow a mostly sequential process, from concept to design to technical implementation. In this case, integrating processes and disciplines may grant enhanced ownership to respective roles involved, as well as an overall increase in quality.[32] Involving technologists at early stages will help evaluate conceptual options, and upholding active exchanges throughout the production process will give everyone a chance to share discoveries and possibly re-evaluate decisions.

Specifically, when working with large amounts of data, it is hard to seize everything at once and make informed judgements. A collaborative effort in processing through datasets can lead to unexpected discoveries and allow for further conceptual decisions. Concretely, this means that the concept, planning, and implementation overlap to a considerable extent.

The sort of integration described aligns with design thinking methods, as well as agile methodologies in software development. Additionally, sustainable benefits include furthering mutual understanding amongst disciplines. I highly recommend explicitly using an agile method to retain flexibility and support the above-mentioned collaboration.

Skills and roles involved

Realistically, the process from idea to finished project involves several different roles: client, content specialist, production manager, designer, technologist. Individuals or a team may assume these.

The content specialist role is not standard in design projects, as relevant knowledge is usually communicated directly from the client or acquired by the production team. The content specialist is a person with expert knowledge about the core topic and subject of the project. The role's primary responsibility can be described as fostering and upholding subject-related dialogue amongst stakeholders throughout the processes. This role is essential for concept development and in analysing target audiences. Furthermore, a content specialist will also be useful for the purposes of promotion and public communication of the project, to help add depth, authenticity, and sincerity.

The design role focuses on interaction design. Other useful skills include, but are not limited to, motion design, exhibition design, and sound design.

The technologist role's required skills depend on both the production company's resources, and the requirements presented in the concept developed. The role may be filled by designers with technological capabilities, software developers, programmers, and hardware specialists.

The RASCI matrix proposes respective roles' involvement in the processes pertaining to the project. It is tailored to the project at hand and based on usual tasks and roles in design and software development processes.

Group ↓	Process ↓ Role →	client	organiser	content	design	tech
START	briefing/idea	R	A	I	I	×
	exposé	A	C	R	×	×
	project definition, analysis	I	A, R	S	S	S
CONCEPT	research	×	C	A, R	R	×
	detailed concept	I	A	R	R	C
PLANNING	interaction design	I	×	R	A, R	I
	budget	A	R	×	×	×
IMPLEMENTATION	screen, motion design	I	×	C	A, R	I
	software design	×	×	×	C	A, R
	sound design, assets	×	×	C	A, R	I
	development, production	×	×	×	S	A, R
	testing	A	S	R	C	R
LAUNCH	venue, infrastructure	A, R	R	×	I	I
	deployment		A	×	S	R
POST-LAUNCH	maintenance	×	R	×	S	A, R
	evaluation	I	A, R	R	R	R

R: responsible; A: accountable; S: support; C: consulted; I: informed

Hardware requirements

The hardware required for the project is relatively minimal, and not too difficult to procure. The visualisation can be displayed via projection or on a large screen. One or two computers can be used to control the projection and host the server. The computer connected to the projector should be able to handle graphics at 30 fps. The server needs to be able to host a small database. The input controls are touchscreen devices, ideally tablets with a current native internet browser. The tablet and computers should be connected over a network.

Software requirements

Specifying technical requirements towards a system is usually helpful for mutual understanding of both design and technical teams. Ideally, this specification follows the structure of a product requirements document. This kind of document is especially helpful for calling for bids or requesting proposals from third-party software producers. Either way, the structure establishes clarity regarding the technical aspect of the further production process.

Required functionalities

The system must function as described in the concept. Essential components of the system are a database, an animated data visualisation (hereafter called 'view(s)'), and two control elements (hereafter called 'control(s)') connected through a network.

The controls will be used sequentially (first, country; then, time), and the view displays data after it is submitted by a control. A while after the animated data display is finished, the system should resume to input mode. All components must be able to operate throughout the day.

Desired optional functionalities

Ideally, the following software features are also implemented:

- The colours used on the view should be adjustable to accommodate different projectors, screens, and light situations.
- The colours used on the controllers should be easily changeable to accommodate various tablet and touchscreen devices.
- Interaction activity is logged on the database, including inputs, timestamp, and unique identification of the running system.
- The database and view(s) can be run on separate, independent programmes that communicate amongst them.
- The activity loop can be intervened in or reset using an additional control.
- The finished data visualisations are uploaded to the internet and a QR code is displayed. The QR code directs to an online website that shows the data visualisation and some text that includes the data shown in the visualisation. This website should be available for 24 hours.

Modularity

The system must be extendable and alterable without fundamentally changing core components of the software. This flexibility concerns:

- adding and updating datasets in the database,
- adding and modifying controllers, and
- adding and modifying views.
- Systematic needs

Software for the views must be able to run on all common platforms (platform-independent). Software for controls needs to be able to run on two separate screens connected to a computer, or separate tablet devices

The software for the views needs to scale responsively and work on screen sizes from typical tablets to high resolution displays, such as 4K.

Licences

If not provided by the design team, licences for software and assets must allow use for commercial and non-commercial projects. The costs for these licences are included in the total budget.

Security

Outside interference in components in the system must be prevented.

Cooperation

Screen design, interaction design, and sound design are the responsibility of the design team. After initial submission of the concepts, designs, and assets, they are subject to further coordination between the design and technical teams. The timing and manner of these processes will be agreed upon between the design and technical teams.

Documentation

All components need to be documented to an extent that allows intuitive understanding for future modification and adaptation of the system.

Data integrity

The connecting element for all data is the map. Conveniently, there is a mostly open format for mapping purposes: a shapefile is a geospatial vector data format for geographic information system software. Each shape can hold descriptive attributes. This is less complicated than using an SVG file with XML attributes, and probably the more sensible option.

The *Natural Earth* project[33] provides current world maps in different formats and levels of geometric detail, using ISO 3166-1 alpha-2 (ISO A2) codes. I decided to use the 1:50m scaled file that holds 247 administrative countries (version 4.1.0). I transferred the attribute table into a MySQL database, which, in practice, means that foreign keys in other database tables will have to match this table. In addition, I used a dataset of populated places and imported all capitals into the database.

I used the aforementioned exports dataset from the European Network Against Arms Trade and imported the relevant columns into the database. A few export destinations did not have ISO A2 codes matching the country table that relates to the map. This concerns disputed areas (like Northern Cyprus), countries that do not exist anymore (Yugoslavia), or countries that are merged with another entity in the shapefile. The latter include Mayotte (YT), Gibraltar (GI), Bonaire, Sint Eustatius & Saba (BQ). Because modifying the shapefile is quite complicated and export volumes to these countries are minuscule enough, I decided to ignore these three. I updated the other countries with missing ISO A2 codes with their modern geographic equivalent, merely for visualisation purposes. I also invented the country code 'AN' for The Netherlands Antilles – this country code does not exist in the ISO A2 standard.

Some capitals were missing, so I checked which of the export destination countries were missing capitals using an SQL query. I had to manually add the missing capitals' names and coordinates (using the WGS 84 standard). Fortunately, only 27 capitals were missing.

INSERT data for the capitals table:

destination_name	ISO_A2	NAMEASCII	LATITUDE	LONGITUDE
Aruba	AW	Oranjestad	12.53038373	-70.02899195
Bonaire, Sint Eustatius & Saba	BQ	Kralendijk	17.897908	-62.850556
British Virgin Islands	VG	Road Town	12.144444	-68.265556
Cayman Islands	KY	George Town	12.116667	-68.933333
Channel Islands	JE	Saint Peter Port	-51.694444	-57.852778
Curaçao	CW	Willemstad	62.011667	-6.7675
Falklands	FK	Stanley	49.4555	-2.5368
Faroe Islands	FO	Tórshavn	36.133333	-5.35
French Polynesia	PF	Papeete	22.280792	114.165578
French Saint Martin	MF	Philipsburg	49.187	-2107
Gibraltar	GI	Gibraltar	19.3034	-81.3863
Greenland	GL	Nuuk	18.0237	-63.0458
Guernsey	GG	Saint Peter Port	22.166667	113.55
Hong Kong	HK	Tamar	-22.2758	166.458
Jersey	JE	Saint Helier	-0.5477	166.920867
Kosovo	XK	Pristina	-17.535	-149.5696
Macao	MO	Macau	31.783333	35.216667
Mayotte	YT	Mamoudzou	-15.924444	-5.718056
Nauru	NR	Yaren	21.459	-71.139
Netherlands Antilles	AN	Willemstad	18.431389	-64.623056
New Caledonia	NC	Nouméa	-12.7806	45.2278
Palestine	PS	Jerusalem	44.816667	20.466667
Saint Barthélemy	BL	Gustavia	12.116667	-68.933333
Saint Helena, Ascension & Tristan Da Cunha	SH	Jamestown	49.4555	-2.5368
South Sudan	SS	Juba	35.183333	33.366667
Turks & Caicos Islands	TC	Cockburn Town	42.666667	21.166667

Database structure

Aside from the aforementioned corrections, all tables were transferred into the database as-is, except without superfluous columns that were determined to have no useful value for data processing. Further normalisation was not necessary.

The conflicts table had neither ISO A2 codes, nor exactly matching country names. Instead, country names were compared to match `country`, `side_a`, or `side_b` using the `INSTR` function.

Countries

- ISO_A2 *(primary key)*
- name

Capitals

- ISO_A2 *(primary key, foreign key)*
- name
- latitude
- longitude

Exports

- id *(primary key)*
- year
- source_ISO_A2 *(foreign key)*
- source_name
- destination_ISO_A2
- destination_name
- rating, category
- value

Conflicts

- id *(primary key)*
- year
- conflict_name
- country
- side_a
- side_b
- date_start
- date_end
- latitude
- longitude
- deaths_best_estimate

Screen design

I produced low-fidelity prototypes from the screen designs using Adobe XD for presentation purposes. A simple click-through prototype can give a good first impression of the experience.

Colours

The colour scheme for screens is monochromatic with accent colours. It aims at promoting focus and creating tension.

Usage	Name	Colour
Text	Pale grey	#FDFCFA
Background	Outer space	#242424
Countries	Trolley grey	#818181
Trade	White smoke	#F8F7F7
Conflict	Sunset orange	#FA4545
Highlight	Blanched almond	#FFEEC9

Typography

The technical requirements towards the typefaces in this project are availability in at least two weights, ideally three, and each including an italic version. The typeface used for screens should be sans-serif and have good on-screen legibility. While high-resolution displays are widespread, it is not guaranteed and the use of a serif typeface may have negative impacts on accessibility. Quite importantly, the typeface must include lining figures, ideally as a standard, rather than as alternative glyphs. The typeface should be available for free with a licence allowing at least non-commercial use. The typeface should further lean towards a neutral and sincere emotion, and work both on light and dark backgrounds.

My choice of typefaces has fallen on the IBM Plex superfamily. It includes four typefaces in eight weights, and complementing italics. I decided to use IBM Plex Sans in regular, medium, and bold for screens. Additionally, IBM Plex Serif and IBM Plex Mono can be used for print and documentation.

IBM describes the typeface as “distinctly IBM”, which refers to the company’s chosen role in helping humanity and technology move forward together[34] – a mission that aligns quite well with the project’s core topic. The typeface has a balance of humane and technological characteristics.

A great feature of IBM Plex is its internationality, as it works in several non-Latin scripts and in over 100 languages. This may be useful in the future, as the project is relevant in a diverse range of countries.

IBM Plex Sans regular
IBM Plex Sans regular italic

IBM Plex Sans semibold
IBM Plex Sans semibold italic

IBM Plex Sans bold
IBM Plex Sans bold italic

IBM Plex Mono regular
IBM Plex Mono bold

Le groupe Visegrád est une alliance culturelle et politique entre la République tchèque, la Hongrie, la Pologne et la Slovaquie, dans le but de faire progresser la coopération militaire, culturelle, économique et énergétique entre eux, ainsi que de favoriser leur intégration dans l'Union européenne.

BAE Systems	United Kingdom
Airbus Group	*multinational*
Thales	France
Rheinmetall	Germany
Leonardo	Italy
Glock	Austria

SELECT `ISO_A2`
FROM `exports`
WHERE `year` = 2014

Screen inventory

The screen inventory describes designs for individual components at various stages throughout the process:

control: loction	**control: time**	**view: projection**
setup	setup	Setup
input	waiting	Neutral
waiting	input	ExportingMS
idle	idle	MainAnimation
data	data	Data

Projection screen

The projection screen would need to host two elements: a map for projecting data, and an area for some text to accompany the data.

The main component of the projection is a map onto which data are drawn. A flat representation of the world is best suited so that all data can be viewed at once to facilitate establishing patterns and relationships in data. World maps generally come with historic and political connotations,[35] due to the fact that projecting a sphere onto a flat plane will always require distortion in some form. Hence, deciding which map projection style to use is relatively difficult. For example, the well-known Mercator map is accused of being scientifically wrong and colonialist because it places Europe at its centre while making colonised countries look smaller.

While some map projections are more convenient for layout (such as the azimuthal equidistant projection used in the United Nations logo), they might be confusing to viewers, especially when the focus should not be the type of projection. After careful consideration, I decided to use a plate carrée projection, as it is quite commonly used, has no strong political bias, and bears the technical advantage of simple mapping of geographic coordinates to their position on the projection.

Export activity is meant to be represented by a software-generated particle stream type animation. Conflicts are represented by dots on the map. The number of deaths per conflict is indicated by the dot's transparency. Representing this datum with size can be confusing, as it is likely to be confused with geographic scope of the conflict. In this sense, a proportionally sized circular shape is neither accurate, nor is it the exact geo-fence data of the recorded conflict areas available – it would most likely also be catastrophic for render performance.

The top of the screen summarises the data displayed as a sentence. For example: '2013 to 2017 France exported defence goods to 24 countries connected to 113 conflicts and 3,491 humans killed'. The purpose of the sentence is to function as an emotional trigger that encourages the visitor do think about the connections between the data and the impacts of the connections made. I was careful about the phrasing of the sentence, especially trying to avoid making explicit accusations towards any specific country.

2015 to **2018** the **Netherlands** exported defence goods to **15 countries** connected to **67 conflicts** and **3493 humans killed**

Control screens

The control screens allow the visitor to submit data (exporting country and time, respectively) into the system.

The visual design options for the controls are graphic, typographic, or mixed. The control for selecting an exporting country could be a map of Europe. Some countries, however, are quite small and hard to reach on a touchscreen. A more neutral form is to simply list countries alphabetically (as opposed to EU accession date, or export volume, for example). To avoid scrolling, the list is displayed as a grid.

The time control is based on natural language forms, meaning that the form resembles appropriate sentences, rather than the classic label-input field pairs. The time control form is therefore one sentence that reads “Show export activity from ____ to ____”.

please select an exporting country

Austria	Belgium	Bulgaria	Croatia
Cyprus	Czechia	Denmark	Estonia
Finland	France	Italy	Greece
Hungary	Ireland	Italy	Latvia
Lithuania	Luxembourg	Malta	Netherlands
Poland	Portugal	Romania	Slovakia
Slovenia	Spain	Sweden	United Kingdom

please select an exporting country

Austria	Belgium	Bulgaria	Croatia
Cyprus	Czechia	Denmark	**Estonia**
Finland	France	Italy	Greece
Hungary	Ireland	Italy	Latvia
Lithuania	Luxembourg	Malta	Netherlands
Poland	Portugal	Romania	Slovakia
Slovenia	Spain	Sweden	United Kingdom

SUBMIT

Show export activity from ____ to ____

2000 2000
2001 2001
2002 2002
2003 2003
2004 2004

SUBMIT

2001
2002
2003
Show export activity from ____ to **2004**
2000 2005
2001 2006
2002 2007
2003 2008

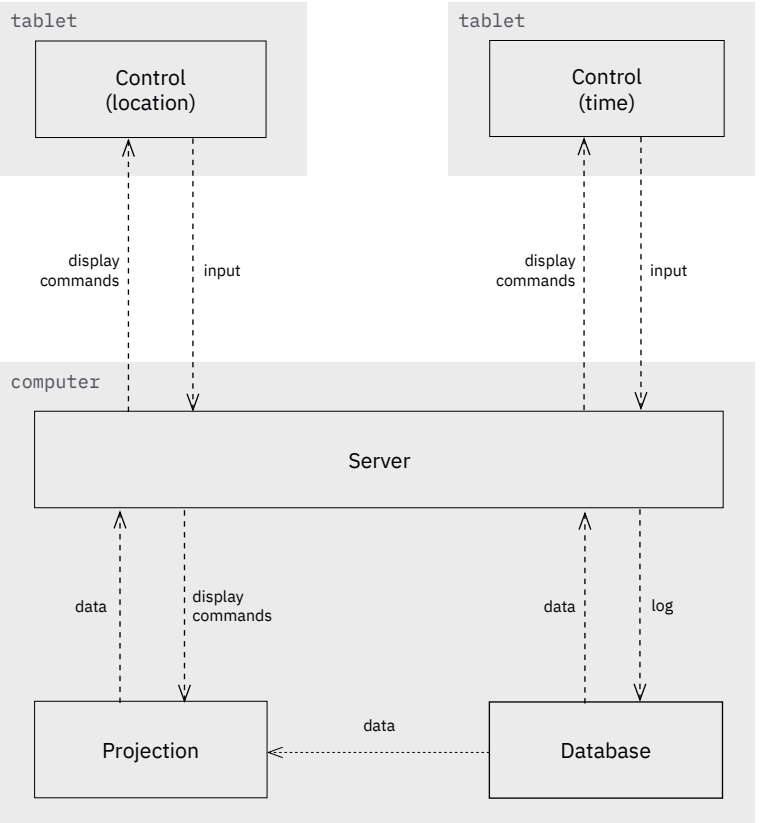
SUBMIT

2005 2008
2006 2009
2007 2010
Show export activity from **2008** to **2011**
2009 2012
2010 2013
2011 2014
2015

IMPLEMENTATION

General plan

The plan is to create individual programmes for all physical components, plus a server programme to handle coordination. The control components will have to be web applications (aka 'web apps'), so that they can be launched on a computer with two touch screens, or two separate tablet devices.



Technologies used

Server and projection

Languages that are both platform-independent and recommended for data handling or visualisation are C#, Java, Python, and Scala. Visual programming languages (usually node-based and popular in the design community) include TouchDesigner, MAX, and vvvv (only available on Microsoft Windows).

To simplify production, I decided that the projection view and server, being the most complex components, would have to be created in the same language. I decided on Java for its flexibility, robustness, object orientation, and ease of use. There is also a wide array of (often free) additional libraries available to fulfil all kinds of purposes. Conveniently, the Processing library, which is popular for graphical programming, is also available as a java library.

Database

For the database, I chose MySQL, which is a classic, widespread, open-source option. It comes with the LAMP/XAMPP/MAMP solution stack that can also be used to host web applications.

Controls

In line with keeping things simple, the controls will be written in PHP, CSS, and JavaScript for interactivity and communication.

Communication

The cleanest option for communication are TCP sockets, which are generally implemented in all common languages.

Tools, IDEs

For Java programming I used the IntelliJ IDEA with an educational licence (completely free alternative IDEs would have been NetBeans or Eclipse). The database and PHP server ran on a MAMP installation. The editor I used for PHP, and JavaScript was Brackets.

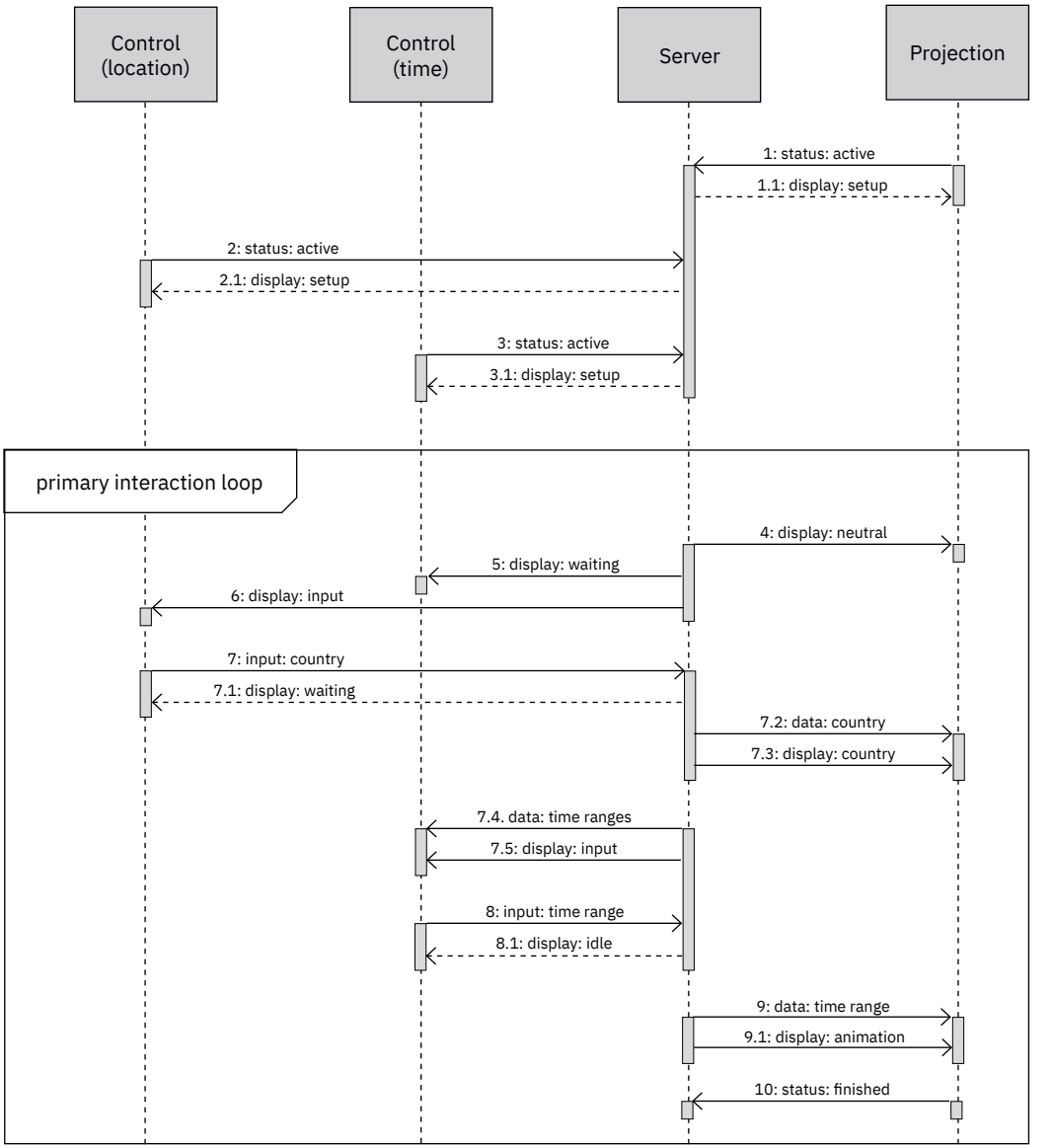
Communication protocol

I found the OOCSI library, which is a simple TCP Socket framework with client libraries for Processing, Java, JavaScript (vanilla and Node.js), and ESP boards. As messages are in JSON format, they can also be received by other client platforms such as C/C++, MAX, OSC, or Pure Data.

The framework allows for the creation of channels and uncomplicated transmission of messages. The solution requires the version of the server that supports WebSocket in order to function with JavaScript.

Other Java-specific solutions can handle more complex tasks, but come with more coding overhead. I also decided to allow the projection programme to read directly from the database, which is easier and overall lighter than Java serialisation. The projection and server will be running in the same network, and there is no good reason to block the database port from access within the network.

The plan is to create a common channel for status-related communication, and individual channels between individual clients (controls, views) and the server. With the server being the coordinating component, it will wait for input from a currently active component and consequently instruct all components in moving forward in the process by defining which screen to display and send additional data if necessary.


Control (location)
Control (time)
Server
Projection
1: status: active
1.1: display: setup
2: status: active
2.1: display: setup
3: status: active
3.1: display: setup
primary interaction loop
4: display: neutral
5: display: waiting
6: display: input
7: input: country
7.1: display: waiting
7.2: data: country
7.3: display: country
7.4. data: time ranges
7.5: display: input
8: input: time range
8.1: display: idle
9: data: time range
9.1: display: animation
10: status: finished

Utilities

To avoid redundant implementation, I created several utility Java classes and Enums to be used by both projection view and server. They may be used by any components in the system and components added in the future.

Entity classes

The Entity classes have no persistence-related functionality, as they are only used to represent database records, but never write to the database. Entity classes exist for exports and conflicts.

Enums

I created two enums to facilitate display instructions from the server to other components. The enums are equipped with fields describing the screen names of components, and have corresponding accessor methods. They define screens for control and view components.

Managing classes

The managing classes, so far all singletons, can be used for shared tasks.

The `ConnectionManager` may be added to any OOCSI `EventHandler` object subscribed to the status channel by a component. The handleMessage method can be used to process a `OOCSIEvent` object. This method will respond to ping messages, or register status updates from other components. The class can also be used to send pings or check if all components are active.

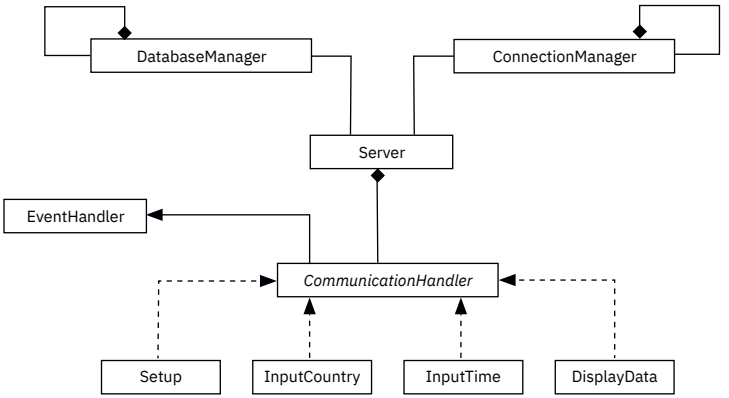
The `DatabaseManager` provides methods to retrieve Collections of Entity classes or other useful related data for further processing from the database.

Config files

Each component is accompanied by a `.config` file, where connection details and other settings can be defined.

Server

The server is a singleton that communicates with the database and the individual components. The different stages of the process are handled by a (finite) state machine with the parent class `CommunicationHandler`. This class extends the OOCSI `EventHandler` and is subscribed to all channels. This means that it can listen to all channels but only process messages that are currently relevant.



Projection

The Projection extends Processing's `PApplet` class. Because of the Processing library treating the server as a singleton, it creates errors. Hence, the instance created needs to be passed through to all drawing methods.

Similar to the server, the projection uses a state machine (with the parent class Visual) to define the behaviour of its different screens.

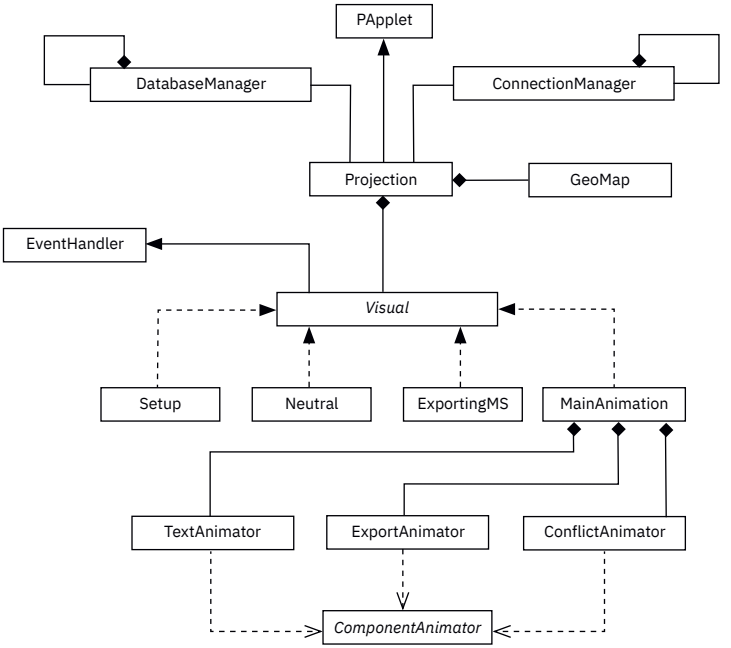
Visuals

The animation of individual components, such as conflicts, is handled by separate classes that extend their corresponding entity classes and implement the `ComponentAnimation` interface, which guarantees graphical representation in active and idle states of the respective individual component. For example, when an export activity is finished animating, it still needs to be visible, but visually more subtle.

The map uses the giCentre's GeoMap library, which is compatible with the Processing library. For performance reasons, the library is used to paint into a `PGraphics` object upon start. The exporting country is painted using GeoMap functions, with the country's ID retrieved from the country table in the database.

In the individual case of France, an additional cropped section from the initial map is drawn over French Guiana, a French overseas *département* and region of France. It has its own ISO code, but is still connected to France in the specific shapefile used.

Generally, the animation shows activities chronologically. When an activity is finished with its animation, it resumes to idle display. Exports are shown as particle animations from exporter to destination capital, and conflicts pop up as red circles. The animation should reach a framerate of at least 25 fps. This can be checked by launching the software in window mode.


PApplet
DatabaseManager
ConnectionManager
Projection
GeoMap
EventHandler
Visual
Setup
Neutral
ExportingMS
MainAnimation
TextAnimator
ExportAnimator
ConflictAnimator
ComponentAnimator

Controllers

The controllers are websites that should be displayed in full screen mode. Different screens are simply various sections that are shown and hidden when a message with an according display key is received in the control's channel.

To create the date input, I recreated the UIPickerView widget from iOS using the jQuery Drum Control library in combination with some carefully written custom logic to avoid false input (such as incompatible from- and to-date). An additional necessary hack was the use of a simulated scroll after changing the time range on an individual widget.

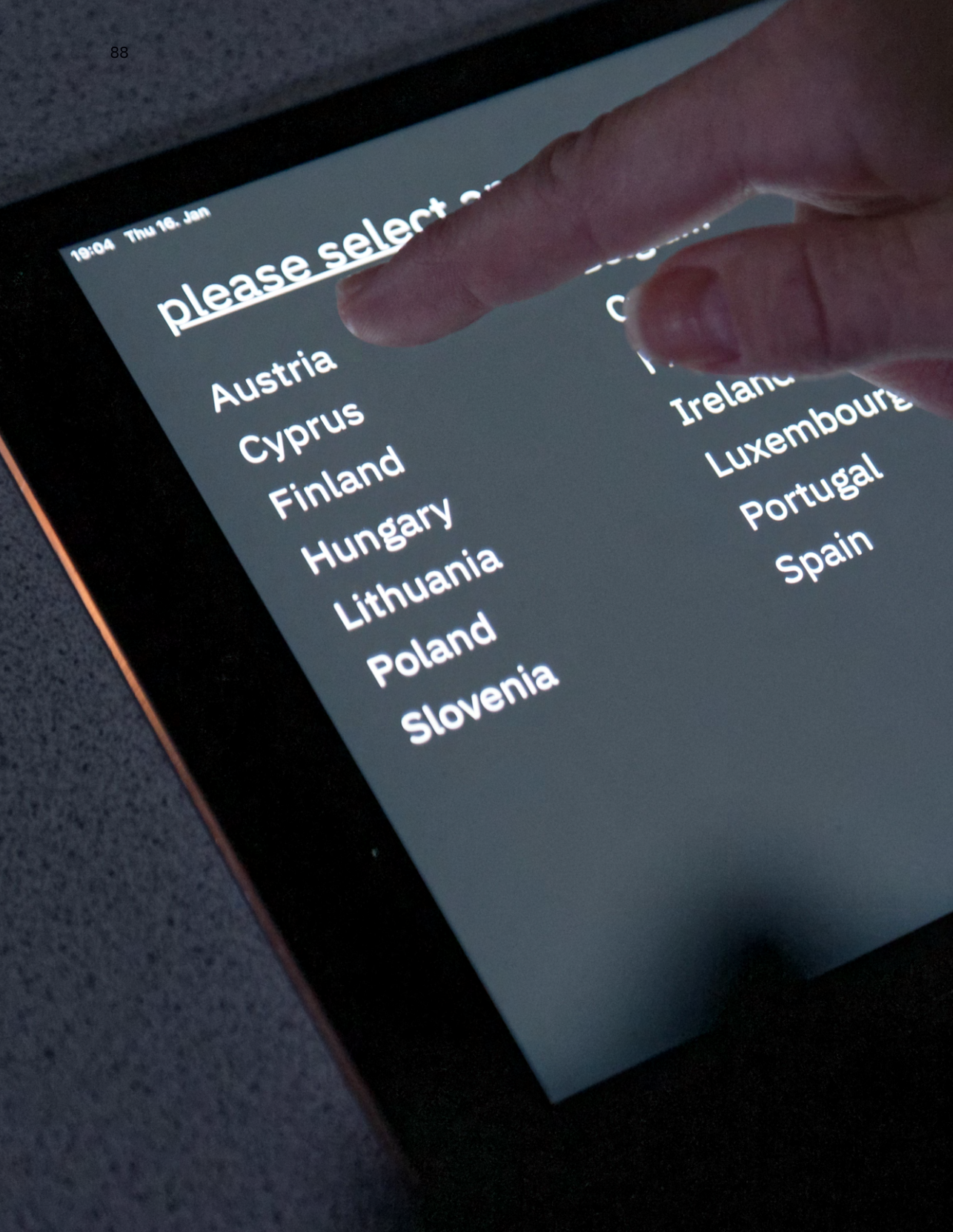
As web browsers tend to idle website activity after some time, or put the entire display to sleep, the nosleep JavaScript library was included.

Problems encountered

Some major problems that cost the most time during implementation included:

- Drawing the map with `geoMap` every frame damaged performance significantly. Drawing the map to a `PGraphics` object fixed the issue.
- Implementing the scrolling input fields for the time controller was a highly frustrating experience. Although laziness makes it hard to believe that a pre-made solution is out there, if the solution cannot be found quickly, it is most likely more time-efficient.
- Issues with messages were mainly caused by the use of the wrong String comparison methods in both Java and JavaScript.
- Web browsers putting the controller website to sleep was fixed by using the nosleep library.
- Reading an SQL query from a file and running Java String replacement does not work well with tabs in a file.
- Processing creates errors when used as a singleton, probably related to Multithreading.
- Java threw a RuntimeException when requests from the database took longer than five seconds. This happened especially when querying from the conflict table.
- The Processing renderer manages to maintain a framerate around 30 fps, unless it has to handle too many calculations or objects per frame, which may easily be the case given the vast datasets. To mitigate this, on-screen buffers were used, or different rendering techniques were used for optimisation. This, consequently, affected the design and animation of the projection.

RESULTS

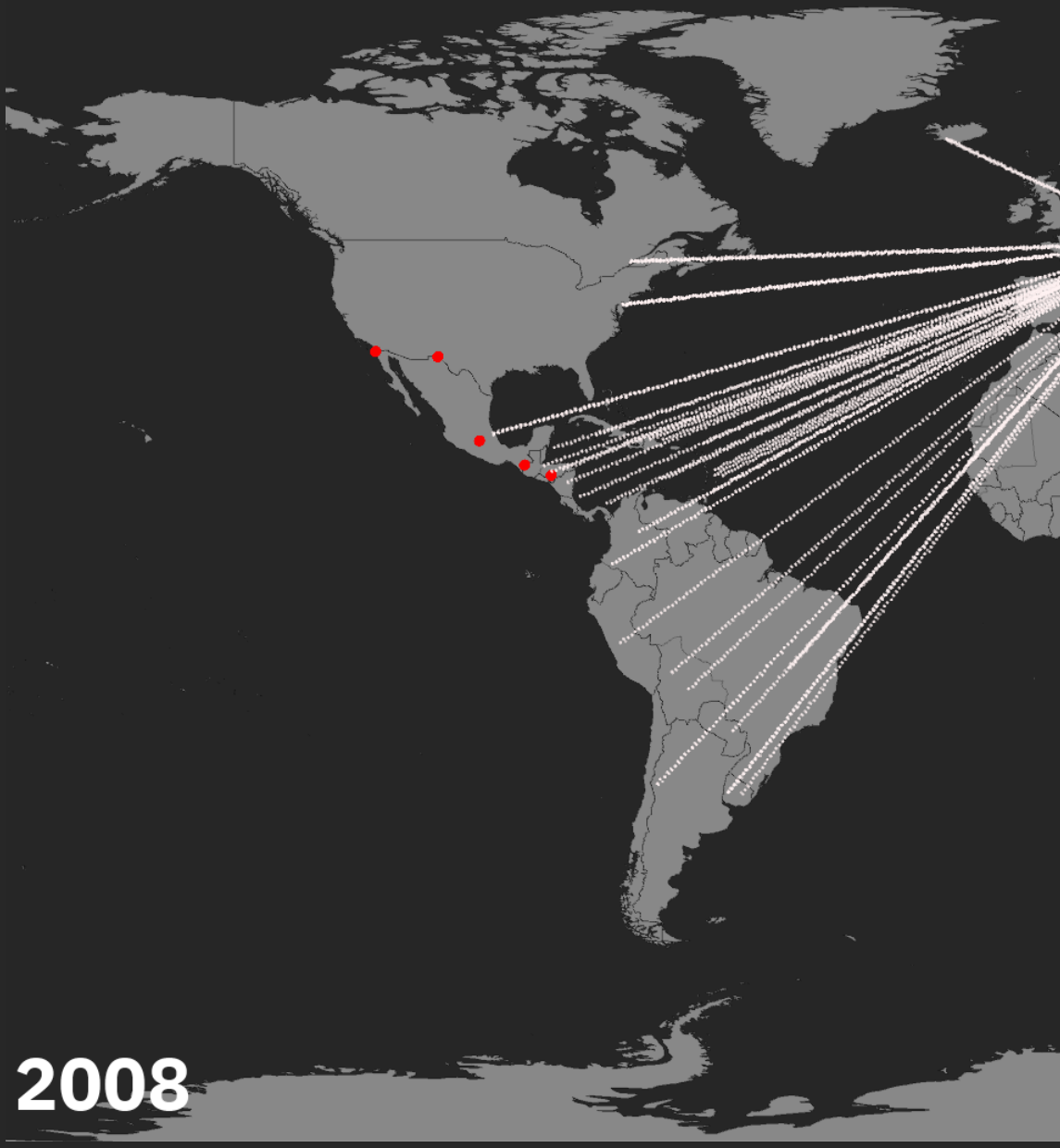

19:04 Thu 16. Jan
please select
Austria
Cyprus
Finland
Hungary
Lithuania
Poland
Slovenia
Ireland
Luxembourg
Portugal
Spain


Sweden


2004 to 2007 Netherlands exported defence goods to 86 co

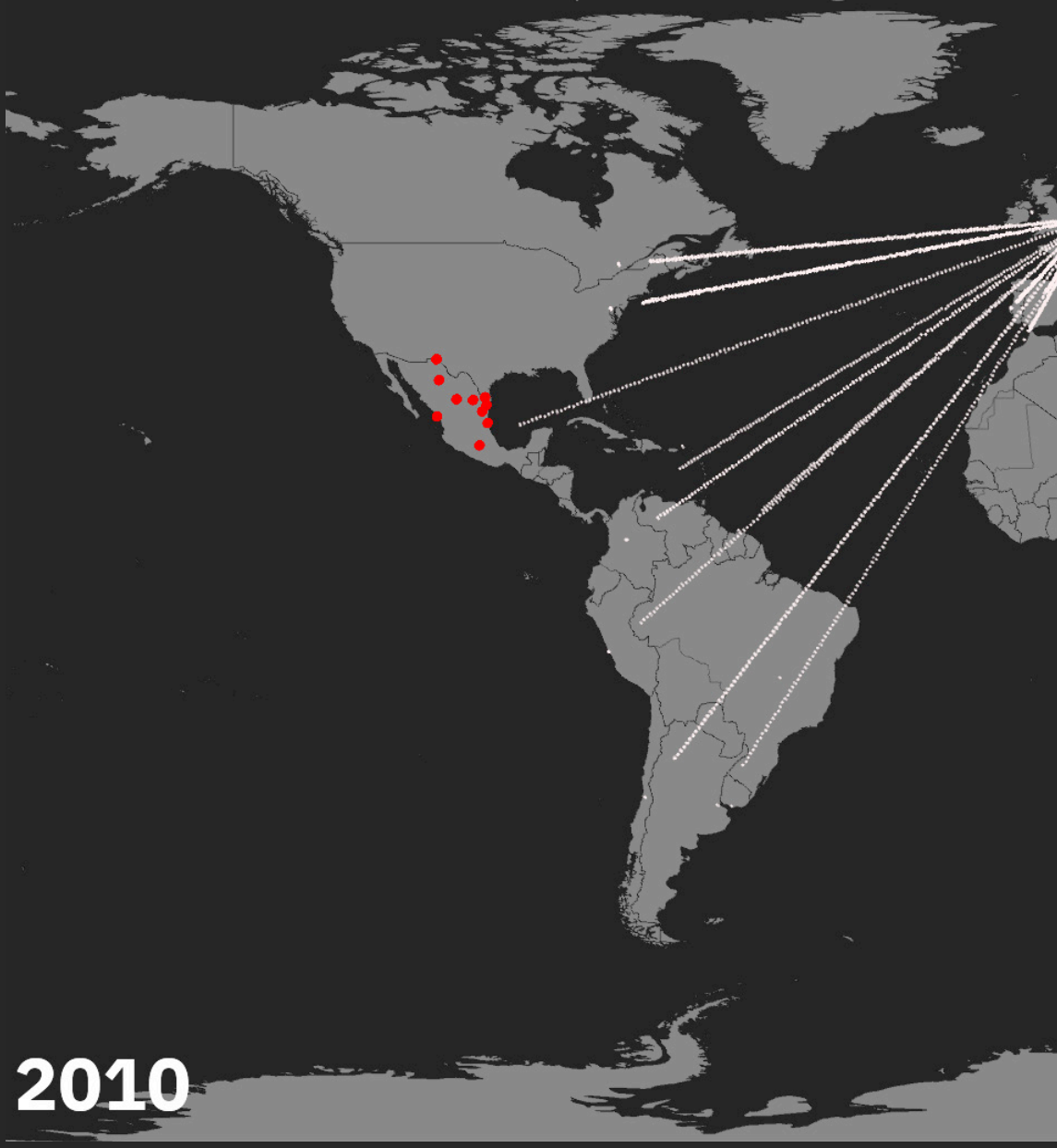

untries connected to 617 conflicts and 30854 humans killed

In **2008 Austria** exported defence goods to **110 countries** conn



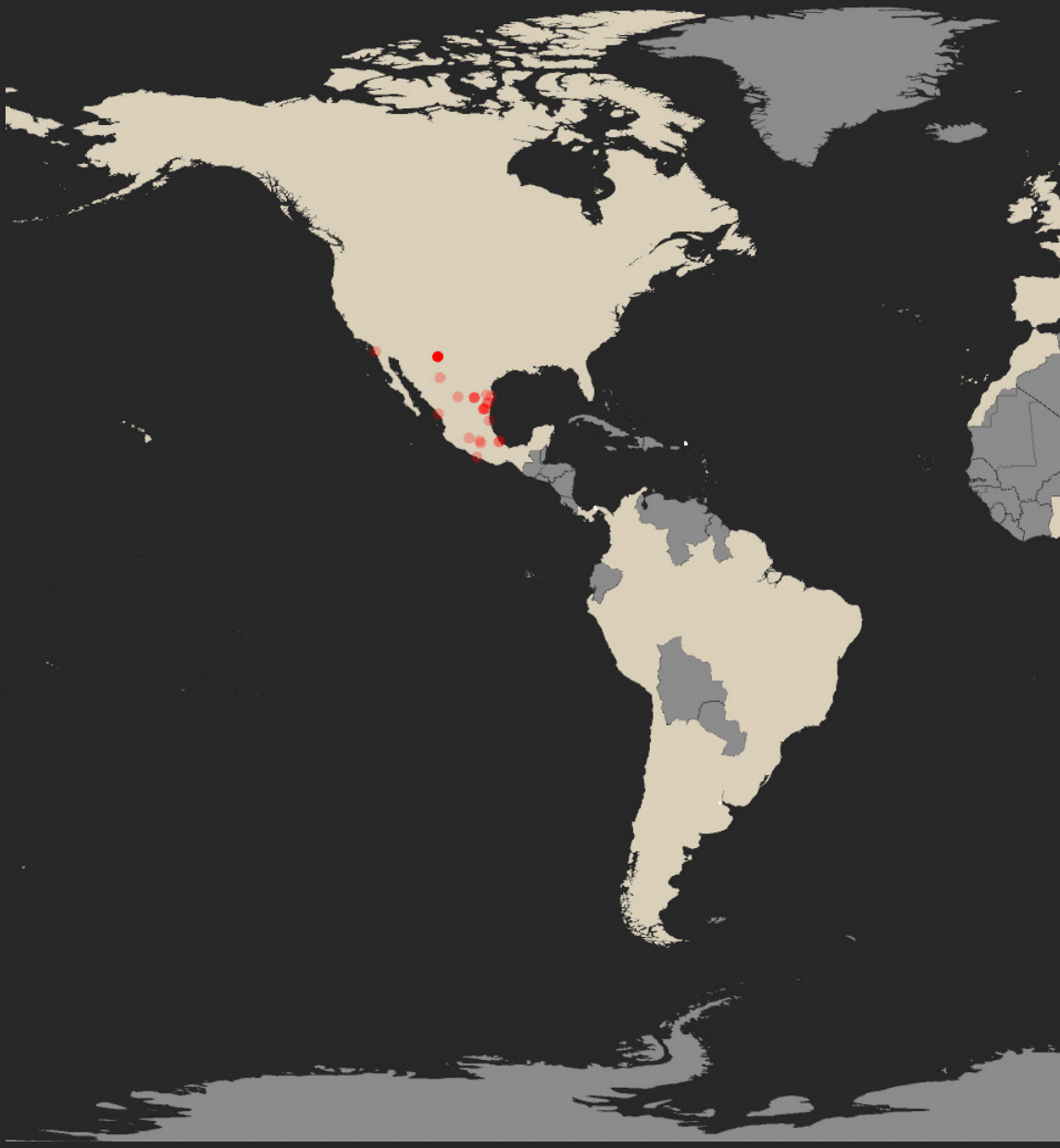
ected to **38 conflicts** and **1619 humans killed**

2008 to **2011** the **Netherlands** exported defence goods to **72 co**

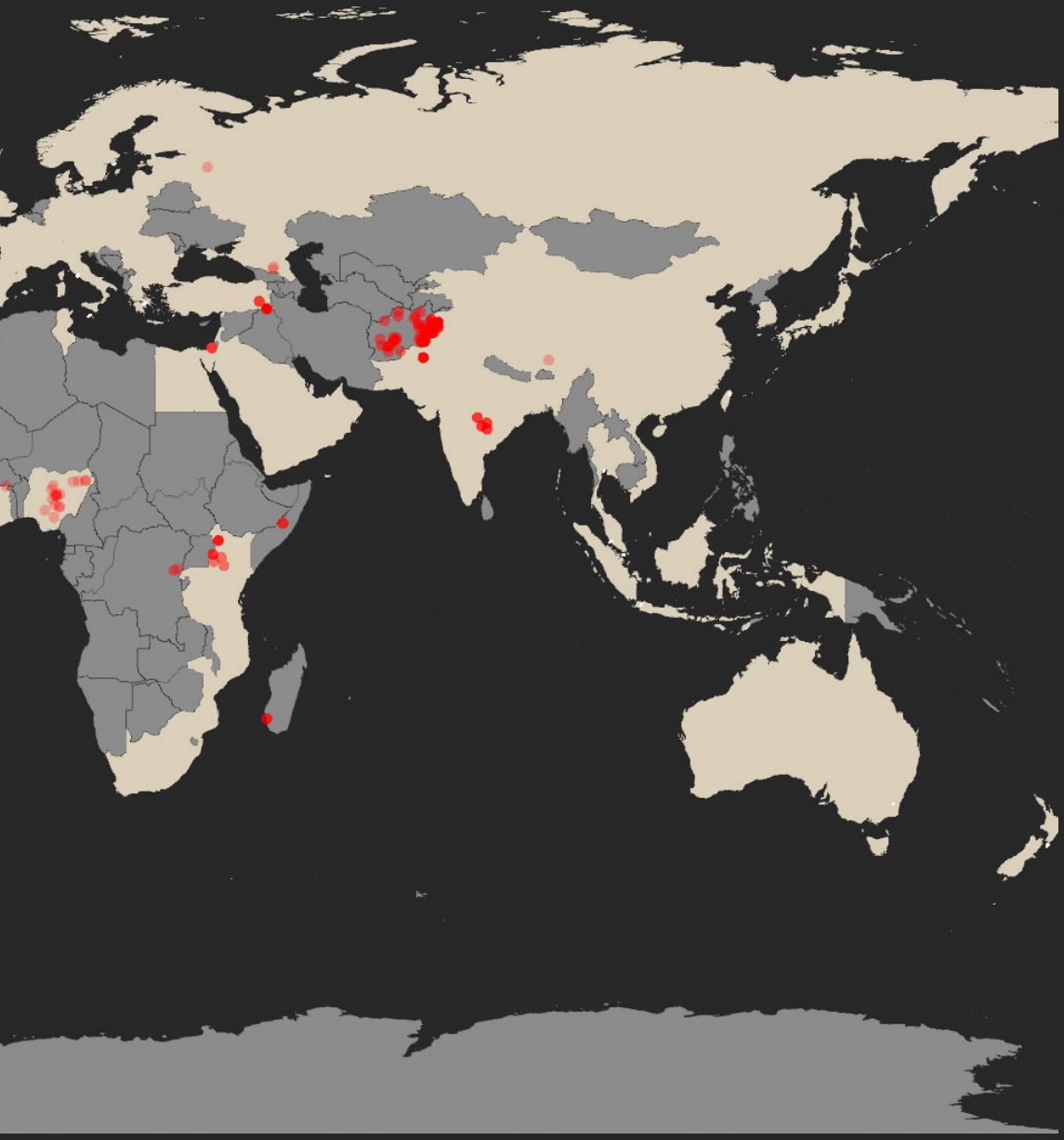


ountries connected to **376 conflicts** and **20346 humans killed**

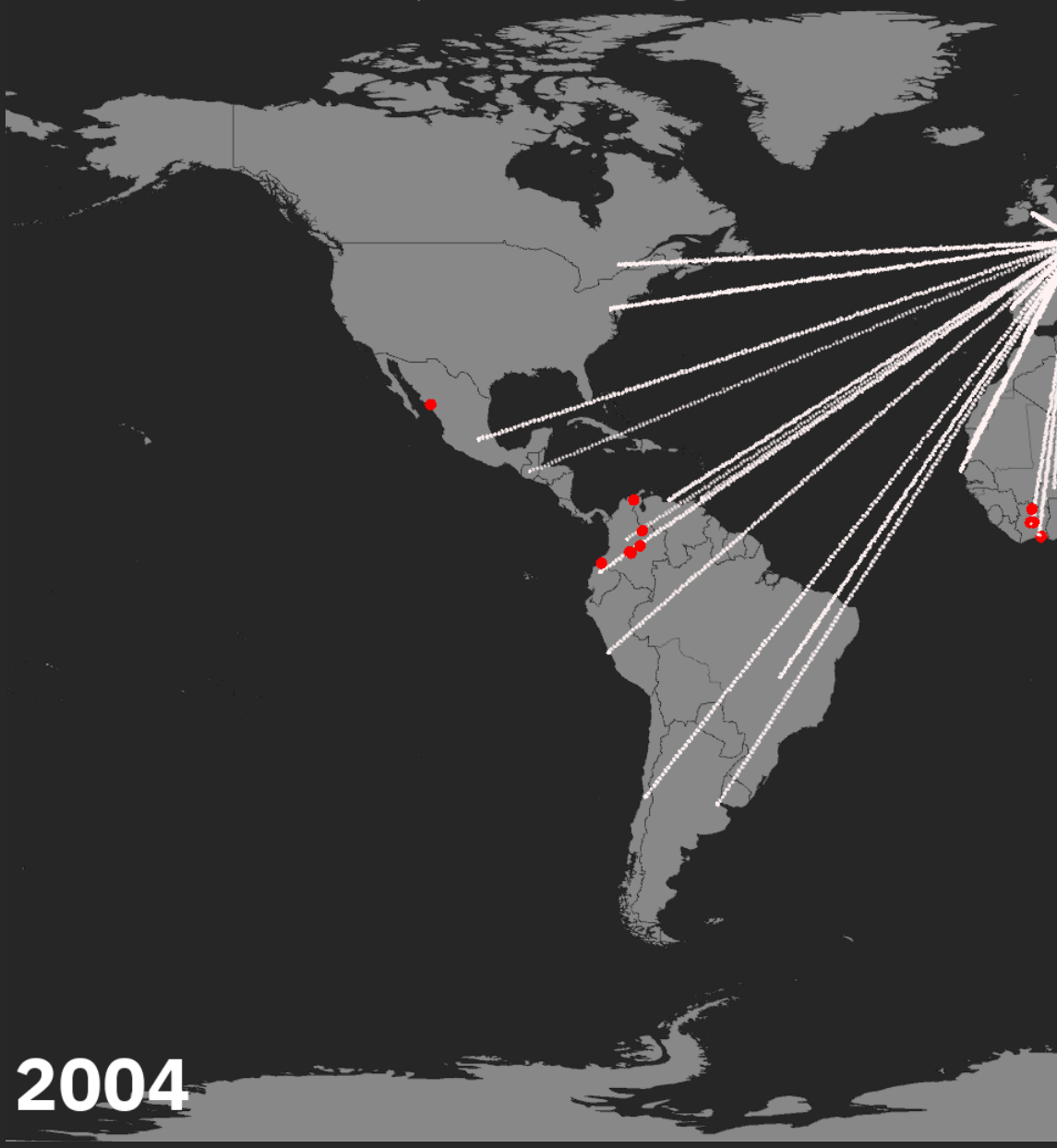
2008 to **2011** the **Netherlands** exported defence goods to **77 co**



ountries connected to **445 conflicts** and **24104 humans killed**



2004 to **2009 France** exported defence goods to **101 countries**



connected to **499 conflicts** and **26923 humans killed**

Conclusions

Overall, besides the many things I explored and learned while working on the project, I left with three conclusions:

Problems that occur during implementation will not only yield learnings but can also (re)open conversation and dialogue with collaborators outside the technical entity (e.g., issues with data integrity). There are great benefits in including opinions from people who are not experts in design or core topic being discussed.

The most interesting stories truly lie where data is odd or missing entirely. Why are there million Euro exports to tiny island states? Why does a Member State leave a complete gap in annual reporting when it made exports of values around € 10 million the year before? Every constructive question asked opens up many other ways of addressing, visualising, and interacting with facts and data.

Having wrapped up implementation, there is a backlog of fresh ideas and topics that may be worth discussing in the future. It was certainly worth it to set up the project in a sustainable and flexible way, so that it can be refined and extended without having to rebuild it from the ground up. There are also many completely different ways that the topic could have been transformed into a responsive environment.

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Abstract (German)

Auf Kriegsfuß mit der Friedensmission
Interaktive Datenvisualisierung in einer reaktiven Medienumgebung

Diese Arbeit dokumentiert den interdisziplinären Prozess der Erstellung einer reaktiven Medienumgebung. Die konkrete Aufgabe bestand darin, ein reaktives Medienumfeld mit bedeutender Wirkung zu schaffen, anstatt sich nur auf Unterhaltung oder Ästhetik zu konzentrieren. Das produzierte Werkstück ist eine interaktive Datenvisualisierung, die sich mit dem verantwortungsvollen Export von Verteidigungsgütern durch die Mitgliedstaaten der Europäischen Union befasst.

Die Arbeit deckt den gesamten Produktionsprozess in organisatorischen, inhaltlichen, gestalterischen und technischen Dimensionen ab. Daher richtet sie sich an Kreative, Technologen und alle, die an der Förderung von Dialog und des Austausch mithilfe innovativer Medien interessiert sind.

Während die Grundlagen des Interaction Design für reaktive Medienumgebungen behandelt werden, liegt der Schwerpunkt der Arbeit auf der Analyse des fachlichen Themas als wesentlicher Bestandteil des Produktionsprozesses. In diesem Rahmen werden die fachspezifischen Aspekte des verantwortungsvollen Waffenexports untersucht, und die Arbeit mit Daten sowohl im Rahmen der Konzeptentwicklung als auch des Designs diskutiert. Die Arbeit erklärt ebenfalls die Planung für den Produktionsprozess und skizziert schließlich die Softwareentwicklung für die technische Umsetzung des Projekts.

Abschließend wird die Relevanz interdisziplinärer Zusammenarbeit und integrierter Prozesse weiter beleuchtet und die transformative Rolle aufgezeigt, die Daten bei der Konzeptentwicklung spielen können.

Statuatory declaration

I declare that I have authored this thesis independently, that I have not submitted it for similar purposes at other places, that I have not used other than the declared sources/resources, and that I have explicitly marked all material which has been quoted either literally or by content from the used sources.

Eidesstattliche Erklärung

Ich erkläre an Eides statt, dass ich die vorliegende Arbeit selbstständig verfasst, bei keiner anderen Stelle für einen ähnlichen Zweck vorgelegt, andere als die angegebenen Quellen/Hilfsmittel nicht benutzt und die den benutzten Quellen wörtlich und inhaltlich entnommenen Stellen als solche kenntlich gemacht habe.