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DATABASE FOR THE CONSERVATION OF KINETIC ART AND HISTORICAL MECHANISMS

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WPI

Developing a Relational Database of Approaches to Conservation of Functional Artifacts

An Interactive Qualifying Project
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Abstract

Despite globalization, independent conservators in Switzerland have problems finding and sharing approaches to the conservation of culturally-relevant mechanical artifacts. Our sponsors, Swiss Federal Laboratories for Material Science and Technology (Empa) and Haute École Arc Conservation-Restoration (HE-Arc CR), research and test materials for scientific and everyday use, and in addition, develop and teach conservation methods to prospective conservators, respectively. We interviewed Swiss museums and private professionals to develop a database system to summarize the approaches to conservation of historical artifacts.

Executive Summary

Introduction

Mechanical objects of cultural heritage are an important part of a nation's history, especially if said objects are functional and can be used for their intended purpose by the general population. There are several reasons why mechanical objects are in a unique position and should be conserved for future generations. Firstly, there is an educational need. Genuine historical mechanisms have been found to produce unique feelings and responses in people (Pye, 2016). Secondly, there is a scientific need for the conservation of these objects. Since many mechanical artifacts are complex in nature, they inspire science in new fields by virtue of their ingenuity. In addition, these complex mechanisms require very specific and technical conservation procedures to continue functioning. This has made the field of conservation extremely important in the 21st century.

Conservation is a broad and technical field that contains three subgroups: monitoring or diagnostic methods (observing the artifact for abnormalities), preventive conservation (controlling the environment to prevent degradation), and intervention (actively restoring the artifact to make it function). While every museum and private conservator may employ their own technical strategies for these three categories, they nevertheless remain fairly constant between museums. Our sponsor HE-Arc CR is a university and research institution that teaches and develops new conservation methods for museums in Switzerland and Central Europe.

Monitoring methods, however, are unique in that most tend to be non-invasive, but aim to collect large amounts of information about the mechanism to determine its state of disrepair or degradation. Since mechanical objects create noise, it has been found that sonic measurements, in particular, can easily and quickly be used in museums to find if the sound profile of a given object is abnormal. Our sponsor Empa is material testing and development institution that uses sonic measurements frequently for laboratory tests. Empa has found, however, that this technology could be desirable in other fields, such as conservation.

Project description and methodology

We contacted twenty-five museums and private conservators and interviewed nine of them. The interview questions were developed by us and reviewed with the help of our sponsors. Each interview lasted about one hour and was conducted either in person or online through Zoom. Questions were split among members of the team, while one person took notes. The interview notes were then cleaned and the information was split among the following categories:

- Museum name, private conservators were left anonymous
- Interview date
- Museum/conservator location: Where the interviewee is based
- Interview highlights: Main takeaways identified by the team
- General museum information: Interesting facts about the museum
- Preventive conservation strategies: Common ways to prevent damage to artifacts
- Acquisition of artifacts: How artifacts are analyzed upon entry to collection
- Conservation state: The usual state of conservation of their artifacts
- Materials of the artifacts: What materials do they work with most commonly
- Conservation methods: Methods for the conservation of their artifacts
- Conservation decision making: Who decides and approves the conservation to be done on the artifacts or what affects what methods are chosen
- Artifact's parts replacement policy: How are parts replaced, including possible stamping, and selection of materials
- Long-term storage and documentation: How do they keep track of the artifact's conservation and restoration

- Knowledge sharing of conservation methods: How do they learn or teach new specialists about conservation methods

The data was added to a SQLite database, a format suggested by the US Library of Congress for the sustainability of digital datasets, accessible through a web user interface designed using Bootstrap Studio (Figure 1). While developing the user interface, we kept in mind the accessibility of the platform by using color safe palettes and accessible elements such as buttons and text boxes. The web platform allows to easily filter the interviews by organization type, artifact type, and text search.

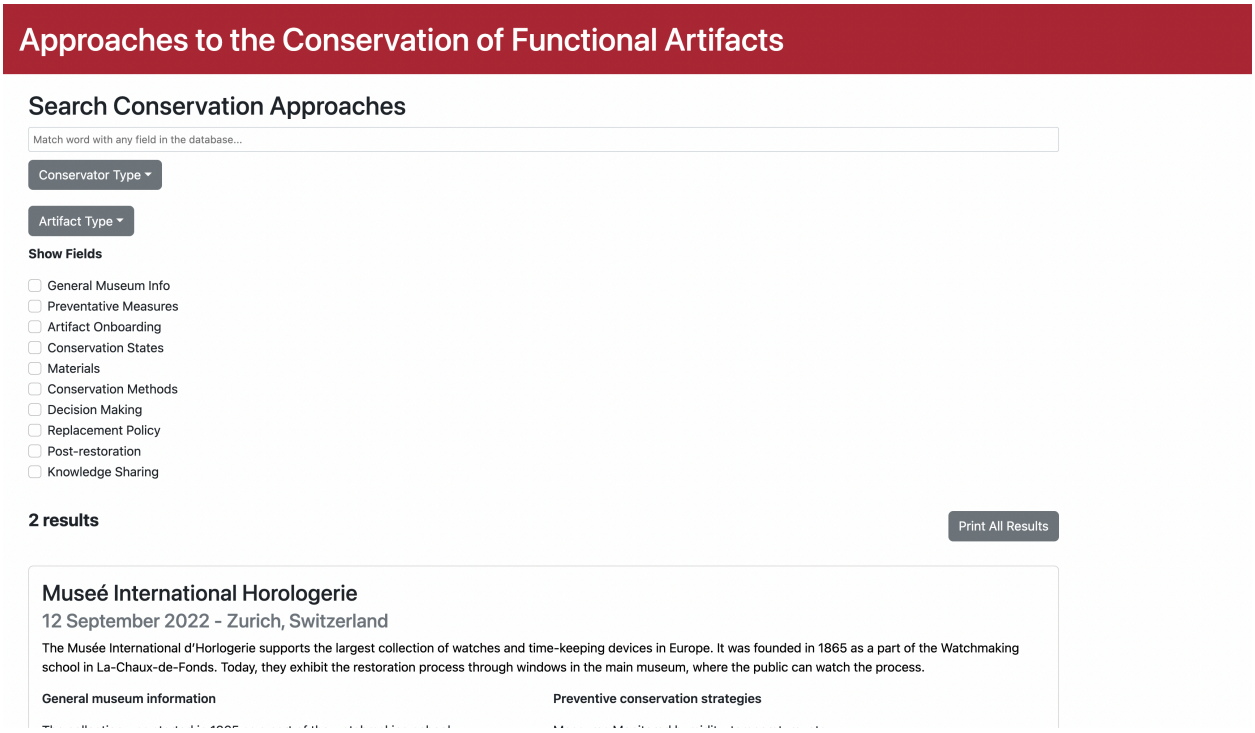

Figure 1: Screenshot of the web platform home page on a desktop

While investigating the conservation and restoration methods used by conservators, we were given the opportunity to perform diagnostic sonic measurements of three Tinguely kinetic art pieces. Using an acoustic camera, a tool with an array of precise microphones and a camera, it was possible to record videos of individual mechanisms, with sound heat-maps overlayed, and sonograms of the mechanism's sound 2.

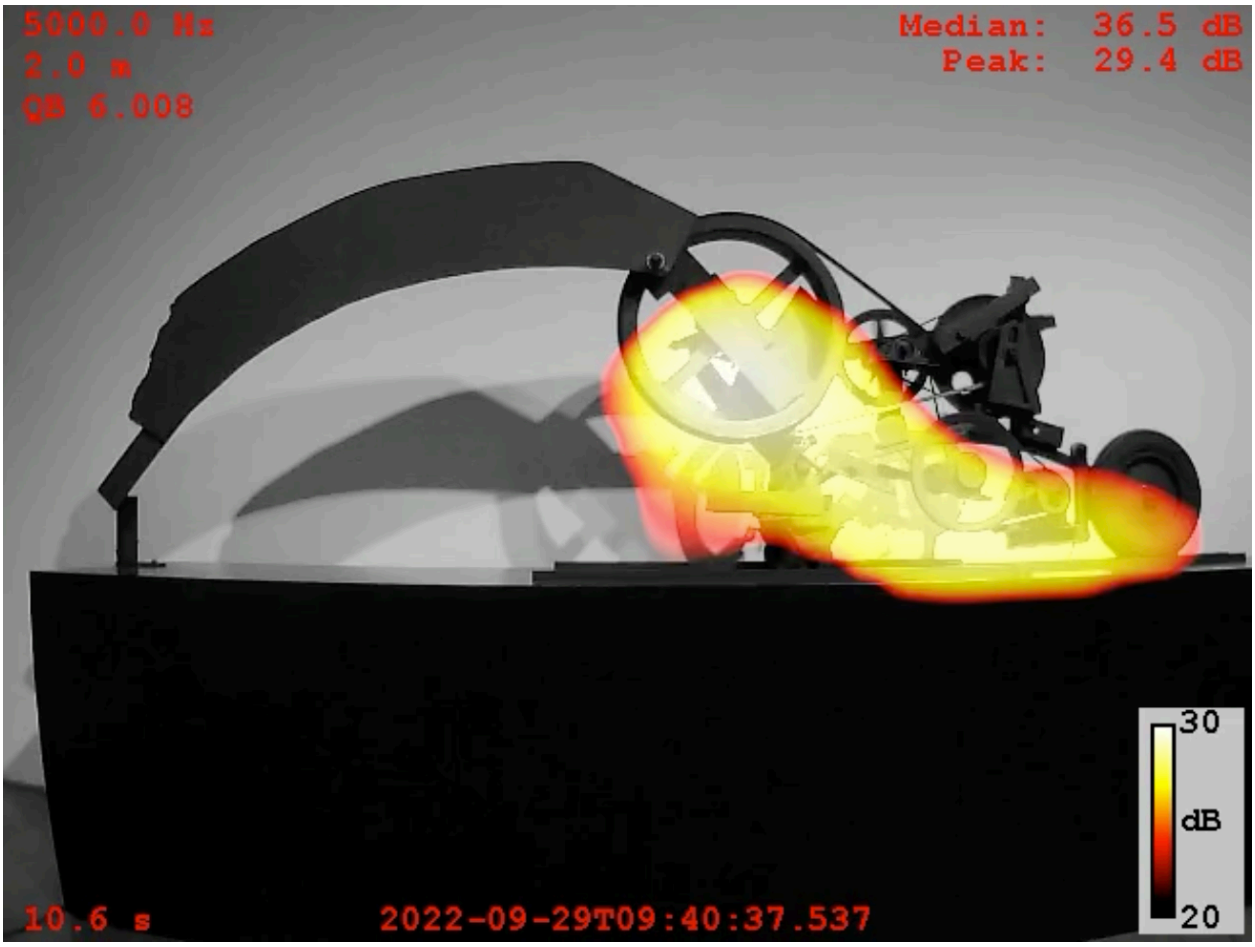

Figure 2: Screenshot of the web platform home page on a desktop

Results and recommendations

While adapting to the various cultural differences between the US and Switzerland, including language barriers and formality standards, we conducted nine interviews. Some of the museums specialized in kinetic art pieces that move and make noises, as intended. And the others specialized in watches, clocks, typewriters, and, even tram cars.

Each museum seemed to have unique conservation methods that they have researched themselves. While their conservation methods shared common themes, many museums had methods that were specific to their artwork that the conservators built themselves in the years they worked with those pieces. For example, the museum conservators that worked with Jean Tinguely's kinetic art pieces were so familiar with his work that when one of his pieces began to

make a slightly different noise than normal, they would immediately notice the difference and know that one component of the piece was going to need to be replaced or repaired.

As well as having unique approaches to conservation methods, they also have specific issues that hinder the conservators in repairing certain art pieces. Many museums had simple issues such as a lack of human resources, while others had issues with communication and networking between different specialists. One museum had a problem with its mechanisms being activated too often, causing stress on the components.

One of our sponsors had access to a type of sonic camera that takes both visual and audio components of a video and uses that data to create a heat map of where the sound is occurring in the visual part of the video. This seemed useful to us as it could help museums recognize a different noise of one of the kinetic art pieces. We used this tool to measure sonic data with four separate pieces. We were also able to compare the videos with a video taken of the same mechanisms back in 2017. Comparing the two videos, there is a distinct difference between the two sounds and heat maps. With this data, the museum's conservators can not only tell that that mechanism is in need of repairs but also where exactly the components need them due to the heat map.

Acknowledgements

We would like to thank our sponsor Swiss Federal Laboratories for Material Science and Technology (Empa) alongside Dr. Rowena Crockett, for helping us search for museums and private conservators, providing an opportunity to present at ETH, and guiding us through a hands-on experience with sonic analysis. We equally thank our sponsor Haute École Arc Conservation-Restoration (HE-Arc CR) alongside Dr. Laura Brambilla, for guiding us through this project, giving insight into conservation, and helping us identify and contact professionals.

We would also like to thank our project advisors, Professors Brigitte and Herman Servatius, for providing communication and organizational feedback, information and multimedia content on mechanical objects in Switzerland and Central Europe, and teaching us travel safety.

We would also like to thank Elodie Granget for helping us refine our interview questions and providing contacts in the field of conservation. In addition, we would like to thank Professor Nancy Burnham for finding and organizing globally-relevant projects in Switzerland. Moreover, we would like to thank the WPI Global Experience Office for providing us with an opportunity to go abroad and complete a project in Switzerland. We would also like to thank Dr. Carol Stimmel for helping us develop this project and guiding us in drafting the project proposal.

Finally, we would like to thank all the museums and conservators who provided invaluable information for our project. This project could not have been completed without this data.

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1 Introduction

Today's globalized world is causing important changes to the conservation of cultural heritage (Winter, 2014). Around the world, artifacts representing humanity's technological past are degrading. Museums and other organizations can preserve these objects of cultural heritage, but no conservation approach is perfect. While these objects can still be protected, there is a need to interact with them for the sake of preserving our cultures. Objects of cultural heritage can take many forms, including paintings, sculptures, kinetic art pieces, household items, and also military and scientific apparatus. The most interactive objects tend to be mechanical ones, because people can either use them themselves, or watch them be used for their original purpose. Physical interactions with a historical mechanism can spark unique emotional responses in people, although that is not the only advantage to their preservation (Pye, 2016). Economically, a nation housing an array of interactive historical artifacts is generally expected to make more money through tourism (McDonald et al., 2019). Nations such as Switzerland, which are home to many types of manufacturing, both historically and today, house a multitude of mechanical artifacts, many of which are in disrepair or are simply stationary (Hofer, 2014).

To prevent artifacts from deteriorating, many museums hold their artifacts stationary. However, this isolates the item and prevents people from seeing the mechanisms in action. Many museums want to display their collection in an interactive way, but doing so leaves the artifact vulnerable to damage (Whittle, 2012). Choosing the right approach for artifact conservation is dependent on said artifact's characteristics, such as the material, use, and overall design. Also, many objects cannot handle undergoing some destructive testing techniques, especially if the artifacts have age-related damage. This is especially the case with mechanical artifacts or kinetic art, where the moving pieces contribute to entirely different wear patterns and conservation hurdles than traditional static artifacts (Whittle, 2012). As a result, it is crucial that museums have insights into conservation approaches, their use, and their likelihood of success.

Some museums and private conservators may want specific information that is exclusively available in scientific journals that are too expensive to access. There exists an opportunity to

work with museums and conservators, as well as the sponsors HE-Arc CR and Empa, to develop and initiate a database system that can be used as a way for private conservators and students to learn how museums around Switzerland logistically approach the conservation of their artifacts.

1.1 The importance of the conservation of historical artifacts

Artifacts of cultural heritage come in a variety of forms and are all manufactured in different time periods. These artifacts can be paintings, sculptures, static objects of everyday life, or mechanisms. Mechanisms are particularly important due to their ability to be interactive. This interactivity has been demonstrated to be an effective tool of cultural and historical education because it allows people to connect with their heritage in tangible ways that other museum exhibits cannot (Pye, 2016).

Mechanical objects can come from all aspects of a nation's culture and history, such as military, manufacturing, and household use. These objects, such as cars, clocks, and sewing machines provide people with an ability to reconnect with aspects of their culture which have since been lost (Moropoulou et al., 2005; Whittle, 2012). Since these objects degrade over time but provide demonstrable benefits, it is in the conservators' best interest to restore and conserve them. Interactive mechanisms that move are perceived by people as being "real" (Pye, 2016). The sounds, smells, and feelings of a working historical mechanism are a total immersion in the past; something that re-creations cannot capture in the same way (Pye, 2016).

Cultural heritage objects also serve a historical purpose to the nation in which they were conceived and later used. Mechanisms and other such objects of cultural heritage make up a nation's cultural identity and increase the value of conservation. In addition, cultural heritage objects aid in a society's development of science, history, and culture, as they not only showcase the scientific achievements of the past, but also help scientists and researchers in new areas by virtue of their complexity and ingenuity.

An example of such an object can be found on the border between Austria and Slovenia. On the Cloud, created by Renate Kordon, is a work of wind-powered kinetic art that was built to

showcase the unrestricted movement of wind, light, and sound, as opposed to movement by people between Austria and then-existent Yugoslavia. The art piece was solar-powered when it was built, but after 20 years, required extensive renovation with the help of the artist. In the process, the piece was updated to be wind-powered. Even today, the art piece is fully operational. The change to wind power has made further restoration procedures easier, as the piece became fully mechanical (Mracek, 2008).

1.2 An overview of the field of conservation

1.2.1 Conservation subgroups

The conservation of artifacts is a complex process. Conservation itself includes three main operational groups. First, monitoring methods, which include ways to observe artifacts and determine if or when they will need intervention. Second, preventive conservation, which often involves controlling the environment where the object is kept to prevent physical decay. Third, intervention on the artifact, such as restoring or repairing it. Every museum and conservation specialist uses different approaches and sometimes develops unique strategies.

1.2.2 Kinetic art and problems in restoration

Kinetic art is a mechanical form of art that either moves on its own or is made to be an interactive installation for museum-goers. Artists like Jean Tinguely make Dadaist kinetic works that primarily involve the use of discarded items to create moving sculptures (“Jean Tinguely”, n.d.). Although historical mechanisms and kinetic art pieces are fundamentally different in use, they often face the same problems when it comes to restoration (Roda-Buch et al., 2021).

Museums and private collections have two options when housing mechanical artifacts. In general, the artifacts can be restored for their original use, or alternatively shut down and put on display where no museum-goer can physically touch them. The first option is preferred since interactions are emotional experiences (Read, 2020), but the artifact must be actively conserved to

account for age and use (Roda-Buch et al., 2021).

1.2.3 Effects of environmental damage on artifacts

An artifact's surrounding environment plays a large role in the conservation of that artifact and its restoration. A mechanical artifact with moving parts is likely to experience complications and damage, especially with corrosion. Whenever metal is in use, corrosion will remain a permanent threat as it is a chemical reaction between the air and the metal itself (Read, 2020). Sometimes cleaning or even routine maintenance can cause increasing damage. The complexity of artifact conservation leads many conservators to reach out to peer researchers for insight and experience before embarking on a new project, see interview notes Appendix F.

1.2.4 Non-destructive diagnostic methods

Non-destructive testing can be done to identify potential damage or stress to an artifact. For example, infrared thermography images can be used to see the thermal environmental effects to which the artifact has been subjected (van Grieken et al., 2014). Another non-destructive testing technique involves acoustic sampling to diagnose changes in the operation of kinetic artifacts. Both sponsors for this project, HE-Arc CR and Empa, are involved in researching and developing acoustic sampling techniques. Sonic measurements can be used as a diagnostic method to identify faulty components of a mechanism. The measurements can be performed using sensitive microphone arrays such as an acoustic camera (ACAM) (Figure 3). The recording is then compared to a reference recording of the mechanism in good working conditions in order to identify differences in the sonograms, which could be signs of faulty or wearing parts (Brambilla et al., 2021). See Subsection 2.3 for our use of this technology.

1.2.5 Swiss research in restoration and conservation

The conservation-restoration field is ever-changing, with new methods frequently being developed. In Switzerland, HE-Arc CR and Empa are highly focused on both pioneering new

Figure 3: Recording a Tinguely artwork through an ACAM (Tinguely Museum, Basel)

conservation methods and diagnostic strategies, sharing their findings with other organizations around the world.

HE-Arc CR is a university based in Neuchâtel that trains students and does research into the principles of conservation and restoration work in a variety of focus areas. In the interviews, the conservators mentioned working with or wanting to work with HE-Arc CR to learn about new methods in the field.

Empa is a Swiss laboratory consortium that is interested in surface treatments and non-destructive analyses of the materials in historical mechanisms. In the past, they have worked with one of the interviewed museums to produce sound maps of objects' motion, in order to more accurately predict when intervention is necessary. The museum asked if they could use the sound/video maps in their exhibitions as a way to show the public both how conservators work,

and why the sound that an artifact makes is important not only to its value as art, but also as diagnostic information.

1.3 Our space for contribution

A way to help private conservators in Switzerland is to develop a database system with the help of Swiss Federal Laboratories for Material Science and Technology (Empa) and the Haute École Arc Conservation-Restoration (HE-Arc CR). This provides open access to the many approaches used in the conservation of functional artifacts. To accomplish this, we conducted interviews to investigate different conservation approaches used by museums and private conservators. The interview information included insights into the acquisition, diagnostics, restoration, documentation, and ethics of kinetic art. We then categorized the interviews by type of object and conservator affiliation (private professional or museum). We summarized our findings within a searchable online database, accessible by conservators and researchers. Lastly, we performed sonic analysis on Tinguely kinetic art pieces to identify evidence of decay.

1.4 Improving accessibility of restoration approaches with a shared database

1.4.1 Overview of relational databases

A relational database is a digital collection of shareable and structured information ("What is a database?", n.d.). Databases are an important aspect of any solution for organizing conservation and restoration approaches collected at various museums and institutions. This has already been demonstrated, with the creation of a database of 3-dimensional and structured data to catalog restoration techniques done for the Sacri Monti UNESCO World Heritage site (Achille et al., 2019).

A database allows storing, organizing, updating, and retrieving data safely and efficiently. Many types of relational databases have a straightforward setup process and can be accessed and

modified remotely in real-time by multiple people. Depending on several factors such as the software, the number of users, the amount of data, and more, the pricing of a database can vary significantly. However, very capable open-source database software is available and used in a broad range of mission-critical applications ("What is a database?", n.d.).

1.4.2 History of data usage in Switzerland

With recent internet security breaches, European countries have been concerned with the collection of their citizens' data. In 2016, the EU passed a law known as the General Data Protection Regulation (GDPR). Under GDPR, there are regulations set for those that use or collect data from EU citizens. Broadly, in order to lawfully collect or process personally identifiable information (PII), one must justify why they need the data or under what permission they have to use the data ("What is GDPR, the EU's new data protection law?", 2018). Switzerland, although not in the EU, has similar regulations in place. Generally, the law in Switzerland varies by canton, but pushes toward transparency in how the data is being used ((FDPIC), 2018). Data collected about artifacts and conservation procedures is not subject to these laws. However, in the case of museum or conservator email addresses, or other PII, there would be a need for a privacy policy and additional data handling procedures.

1.4.3 Information that relational databases can store

Relational databases can contain various types of data, including text, numbers, and files. For example, SQLite, a lightweight and popular open-source relational database, supports various storage classes such as null, integers, real numbers, text, or non-text data such as images, but it can also store boolean values, dates and timestamps ("Datatypes in SQLite", n.d.). In the special case of restoration-specific databases, these often included fields such as the materials involved, the museums and organizations responsible for an artifact's restoration, geographical origin, and construction epoch. Moreover, some metadata can be restoration specific, such as the urgency of restoration, deterioration state, and history of accidents. In addition, restoration methods were

often categorized based on necessary tools, budget, destructiveness of the technique, and more. Table 1 includes some fields used for a historical roof restoration database (Achille et al., 2019).

Table 1: Sample of some fields used for a historical roof restoration dataset table developed by the authors of Achille et al., 2019

Date of survey	Recent interventions	Material
Survey operator	Description	State of health
Urgency	Historic data	Author
Date	Attribution	Urgency of intervention

1.4.4 Interacting with databases

Private conservators and researchers could interact with the database using a Relational Database Management System (RDBMS) and queries. An RDBMS is software that provides a user-friendly interface for a user to interact with a database. Most importantly, an RDBMS allows performing efficient queries on the stored data. Most databases allow writing queries using the Structured Query Language (SQL). SQL was first developed in the 1970s by IBM and Oracle, and later made into an American National Standards Institute (ANSI) standard. Practically, users can input commands such as

```
SELECT * FROM CONSERVATION_METHODS WHERE urgency=high
```

to research useful methods for their restoration needs. These filters can be combined to find case studies or general methods that they can apply to their artifact conservation challenges (“SQL language expressions”, n.d.). Queries can also be used to update or create new entries in a database. For example, museum curators can contribute, adding what new information they have found with regard to their own artifacts and restoration processes.

1.4.5 SQLite database technology

There are many relational database technologies available that were assessed for their capabilities, cost, and ease of use. One of them, SQLite, has an emphasis on “economy,

efficiency, reliability, independence, and simplicity" ("Appropriate uses for SQLite", n.d.). SQLite works well when no administration is needed. The database could run without the support of an expert. Limitations of SQLite include managing large amounts of data, high concurrency, or thousands of operations per day which are unlikely to inhibit its use for this project. ("Appropriate uses for SQLite", n.d.). Additionally, the code base for SQLite is public, giving customers full control of their data ("About SQLite", n.d.). Lastly, the US Library of Congress recommends SQLite as one of a few "Recommended Storage Formats" for the sustainability of digital datasets, confirming the quality of this product ("Sustainability of digital formats: Planning for Library of Congress collections", 2017).

2 Methodology

2.1 Interviews with museums and private conservators

To develop a database of restoration and maintenance approaches, interviews were carried out asking local museums and private conservators in Switzerland about the types of approaches they employ regarding their mechanical artifacts.

2.1.1 Identifying museums

We researched specific museums and collections in Switzerland, specifically collections that stored mechanical artifacts; non-electrified mechanisms used for household and commercial applications. We contacted the staff and curators of museums via email, explaining the purpose and timeline of the project (see Appendix D). In addition, a sample list of questions, included in Appendix A, was attached to each email to prepare the museums or conservators in question for the interview.

2.1.2 Conducting interviews

The interviewees decided on their own location for an interview. Due to the linguistic and geographic features of Switzerland, many chose interview locations such as museums, often located in German-speaking areas. Figure 4 shows a map of Switzerland and the surrounding areas, including dots that represent the locations of museums as well as the primary language spoken in those areas.

Interviews with curators were semi-structured and were designed to expose methods a particular conservator used, as well as why a particular approach was selected. The information gathered was qualitative in its potential to draw open-ended answers and specific facts about the mechanisms in question. To store data such as interview responses, notes, audio recordings, and transcripts from interviews were collected. Please see Appendix A for the focus areas and sample probes and Appendix C for the informed consent form. The questions are also available in french

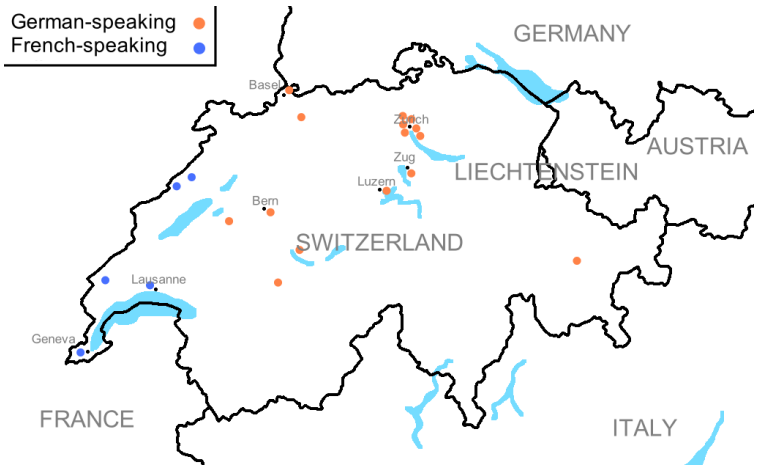

Figure 4: A map of the locations and languages of the museums contacted

in Appendix B.

As the interviews were conducted, it was found that the responses to our questions did not focus on restoration methods as much as they did on ethical concerns and artistic viewpoints in the field of conservation. These responses led us to change our database originally focusing on specific restoration procedures and case studies to higher-level approaches taken by professionals in mechanical conservation.

2.1.3 Interview data analysis

As the data was analyzed and organized, the database structure was updated accordingly. Categorization was mostly by the content of the answer. For example, an answer relating to the people involved in making conservation decisions would be in the conservation decision making category. The final list of categories can be seen in 3.3. Database entries were different in terms of approaches, as type of object (watch, tram, etc.), type of material, and type of degradation all play a role in how a conservator makes decisions about how to restore and conserve it.

2.1.4 Limitations in the interview process

The biggest limitation in interviewing Swiss conservators was finding their email address, as it is often not listed on their museum websites. When contact was made with a conservator,

selecting times for an interview posed more problems as they were busy with their daily work. TO mitigate this problem, the interviews ended with a snowball recruitment tactic; asking the conservator if they know anyone else in the field. This networking strategy put us in contact with many private conservators who we would not have discovered otherwise. Following up with all of the conservators ensured contact accuracy and prompt scheduling.

2.2 Creation of a relational database

After collecting information about existing approaches of functional artifact conservation among Swiss conservators, it was stored in a useful way.

2.3 Collecting acoustic data

The research performed in the course of the project revealed the importance of diagnostic methods to conservators. Through Empa, we were given the opportunity to collect acoustic data on four different Tinguely sculptures at the Tinguely museum in Basel, using BeamformX6008 software and an ACAM 120 sensor device. The data produced was then compared to data taken in the past to monitor changes in the sounds produced by the mechanisms (see Results Subsection 3.5).

3 Discussion and Results

3.1 Cultural differences between Switzerland and the USA

Although we found that Swiss and American culture are similar in everyday life, project-related work such as interviews were different compared to what we were used to in the United States.

Firstly, we discovered that Swiss museums and private conservators strongly preferred to conduct interviews early in the day, usually around 9:00, whereas interviews in the United States could happen at any time of day. In addition, language barriers posed problems for us in Switzerland due to the several official languages spoken in the country. This became apparent in the Typewriter Museum, where the conservator only spoke French, and the sample questions had to be translated in order to conduct the interview. A similar situation arose in the Urania Observatory, where the staff only spoke German and no interview could be conducted. In the United States, a language barrier has never posed a problem for us in a professional setting.

The communication methods vary between Switzerland and the United States as well. On multiple occasions, we were encouraged by our sponsors to call museums and conservators in order to schedule interviews. In the United States, email is the most professional form of communication, and is always used in favor of phone calls in case an in-person interview is not possible. Moreover, response times vary strongly between the two countries because of cultural reasons and a difference in the work-life balance. Swiss professionals do not answer their emails on weekends, vacations, or in the evenings. It was not uncommon for us to wait over two weeks for a museum's response to our interview request. However, professionals in the United States try to be available during most hours of the day, and answer their emails within a few days. This was evident when we emailed the conservator of the Diana and Stag automaton in the Boston MFA.

It was also found that contacting specific people was easier in the United States than it was in Switzerland. Organizations such as universities and museums, may list the contact information of professionals on their websites. In Switzerland, contacting a museum as a whole was often the

first step to finding the conservators working there.

Lastly, emails were more informal, and project objectives were more flexible than expected. This is a contrast to what is usually done in the United States; strict objectives are set at the start, and it is usually expected that they are met.

Figure 5: The team conducting an interview at the MIH in La Chaux-de-Fonds

3.2 Conducted interviews

Out of the twenty-five museums contacted, see Appendix E, we conducted interviews with the following eight museums and one private conservator:

- Diana and Stag automaton at the Boston Museum of Fine Arts
- Espace Jean Tinguely - Niki de Saint Phalle, Fribourg
- Heureka Sculpture, Zurich

- Musée Atelier Audemars Piguet, Le Chenit
- Musée de la Machine à Ecrire de Lausanne (MMàE), Lausanne
- Musée International d'Horologerie (MIH), La Chaux-de-Fonds
- Museum Tinguely, Basel
- Tram Museum, Zurich
- Private Conservator #1 (anonymized)

Throughout the interviews, we learned various approaches that museums and professionals take towards the conservation of kinetic art pieces and historical mechanisms. The information collected was split among the following fourteen categories. The following sections contain unique takeaways from each interview, also included in the database as interview highlights. The full notes from the interviews can be found in Appendix F.

3.2.1 Diana and Stag automaton at the Boston Museum of Fine Arts

- Instead of restoring the mechanism, a new one was constructed based on analyses of the old mechanism.
- High-tech analysis methods (radiographing, XRF) are considered 'standard practice' analysis methods, while other musems have touble accessing them.
- A major struggle to further restoration are Human resource limitations.

3.2.2 Espace Jean Tinguely - Niki de Saint Phalle, Fribourg

- Highly rely on the sound of the mechanism to identify problems with mechanisms.
- Due to the use of very different materials and artifacts, they often create custom restoration methods.
- Maintenance used to be done by friends and students of Tinguely.

3.2.3 Heureka Sculpture, Zurich

- Until 2019, a team from Zurich's Waste Management and Recycling (ERZ) carried out regular inspections and maintenance.
- After 2019, maintenance was handed over to an external company, which took over the employees and thus the knowledge of how to take care of Heureka.
- During the operating time from April 1st to October 15th, the object is checked monthly with a visual inspection and service work is carried out. Lubrication of the mechanisms occurs annually in October, and general fixes are performed before the start of the season.
- The coloring was adjusted because sources could prove that it was Jean Tinguely's intention to present the work of art painted black.
- The restoration of the Heureka was carried out by the Museum Tinguely in Basel, also interviewed as part of this project.

3.2.4 Musée Atelier Audemars Piguet, Le Chenit

- Performs all of its restorations using traditional techniques, minimizing the use of technology. They strongly rely on visual inspection with non-digital microscopes.
- As a watchmaking company, they emphasized distinction between reparation and restoration. Reparation is carried out by a different team.
- Specialists place small markings on large replaced pieces.

3.2.5 Musée de la Machine à Ecrire de Lausanne (MMàE), Lausanne

- Responses received in French and included in F.9
- Due to the timing of these responses, they are not translated and are instead listed in red in their original French

3.2.6 Musée International d'Horologerie (MIH), La Chaux-de-Fonds

- Advanced restoration techniques using instruments such as X-Ray Fluorescence (XRF) guns.
- They rely on internal and external specialists and collaborate closely with academic institutions such as HE-Arc CR.

- Museum Plus is the industry-standard database used by museums such as MIH for tracking artifacts, restorations, and any custom information that should be stored, including 3D models.

3.2.7 Museum Tinguely, Basel

- To avoid excessive stress on the mechanisms, foot-operated pedals allow to activate the mechanisms once every ten minutes. The pedals also track statistics on the total running time of the artifact.
- Tinguely's views are considered throughout every restoration. Restorations are carried out minimizing the changes and keeping even the new replacement parts as authentic as possible.

3.2.8 Tram Museum, Zurich

- There is a large physical archive of schematics of the trams. Any change is tracked and the original drawings are updated.
- The reactivation of a tram and its mechanisms is constrained by the Swiss legislation. Even old trams must meet modern safety and operational requirements which is sometimes impossible.

3.2.9 Private Conservator #1

- There is a lack of accessibility of private conservators to analysis methods. Most methods are too expensive or take too long to be conducted
- The client/ owner has final say on all methods, restoration steps, and reactivation frequency
- The view is that the artist no longer has control over their art once sold- it then belongs to the client
- There are difficulties in working with a large team- scheduling, conservation opinions, and debate over the best method to apply

3.3 Categories of interview data

- Museum name, private conservators were left anonymous
- Interview date

- Museum/conservator location: Where the interviewee is based
- Interview highlights: Main takeaways identified by the team
- General museum information: Interesting facts about the museum
- Preventive conservation strategies: Common ways to prevent damage to artifacts
- Acquisition of artifacts: How artifacts are analyzed upon entry to collection
- Conservation state: The usual state of conservation of their artifacts
- Materials of the artifacts: What materials do they work with most commonly
- Conservation methods: Methods for the conservation of their artifacts
- Conservation decision making: Who decides and approves the conservation to be done on the artifacts or what affects what methods are chosen
- Artifact's parts replacement policy: How are parts replaced, including possible stamping, and selection of materials
- Long-term storage and documentation: How do they keep track of the artifact's conservation and restoration
- Knowledge sharing of conservation methods: How do they learn or teach new specialists about conservation methods

3.4 Live database release

This project resulted in the creation of a SQLite database with a web user interface, containing organized information from the interviews conducted during the project. The database is stored as a single .sqlite file in the GitHub repository at https://github.com/fedeit/mechanisms-conservation. Storing the database on GitHub allows to

store it for free on the web and make it easily downloadable by anyone with an internet connection. Additionally, the GitHub repository also shows the revision history of the SQLite file, making it easy to see who made changes and when. The GitHub repository, however, was not setup to allow unauthorized people to modify the database directly.

The SQLite database is accessible through any RDBMS but also through the web platform at https://fedeit.github.io/mechanisms-conservation/. This platform allows to search in the database using specific keywords for each field, and then visualize the results in a list. Each results includes information and restoration approaches of a specific museum. The page can be easily printed using the ”Print” button, but it is also possible to print all the results that match the search query using the ”Print All” button. Figure 6 shows a screenshot of the user interface as seen on a computer.

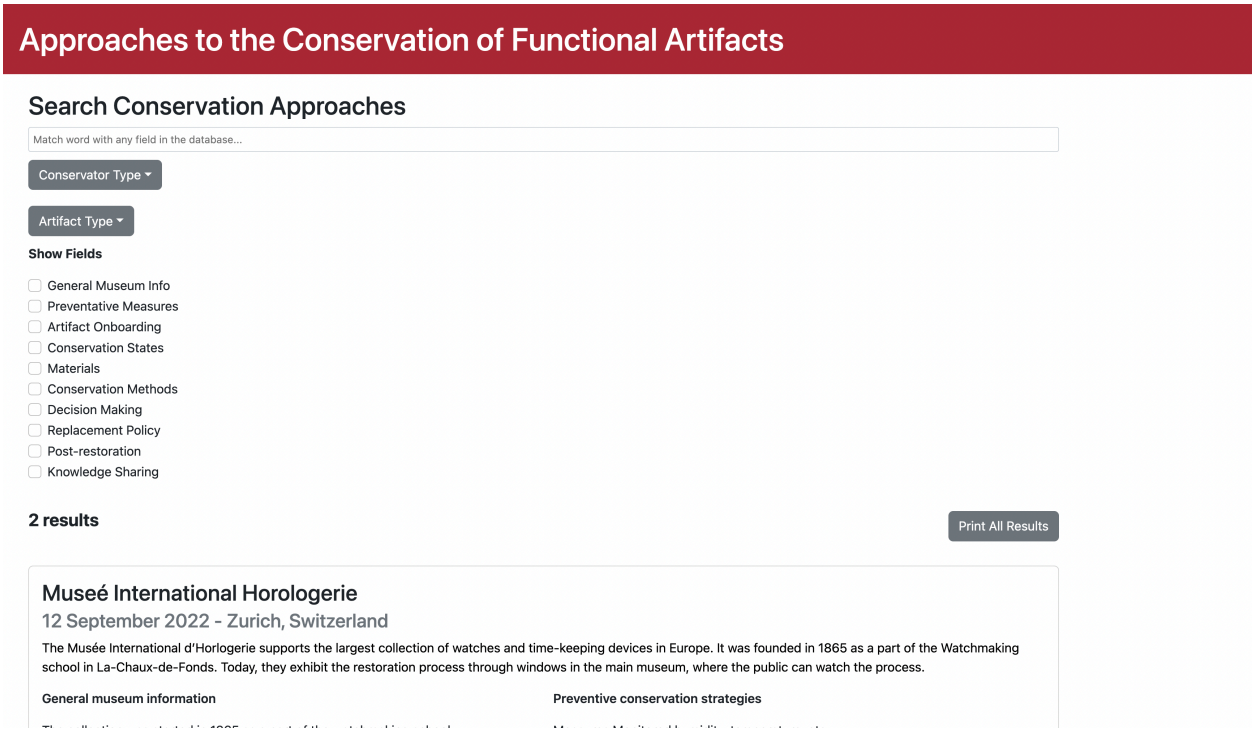

Figure 6: Screenshot of the web platform home page on a desktop

We tested the platform for mobile friendliness to allow researchers working in a lab or mobile setting to browse the database with a phone or tablet instead of a computer. Figure 7 shows a screenshot of the user interface as seen from a mobile phone. Moreover, the design was

generated using color safe palettes and accessible elements to make the web page clear to people with various types of impairments. The accessibility was evaluated using the Lighthouse test and received the maximum score.

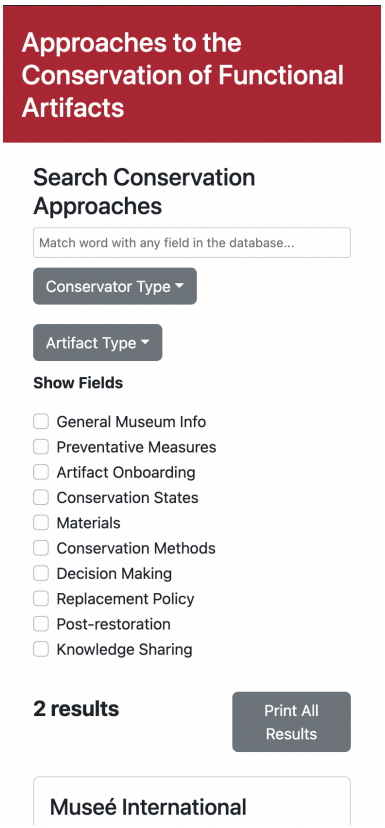

Figure 7: Screenshot of the web platform home page in mobile mode

3.5 Sonic measurements

Sonic measurement data was taken of four different sculptures at the Tinguely Museum in Basel, using an ACAM 120 sensor device and BeamformX6008 software. These tools take videos of the object in question and overlay a heat map, as seen in Figure 8, that displays the location and intensity of a particular frequency at each moment in time. Additionally, the software generates a sonogram that includes all of the acoustic information collected in a multi-dimensional plot.

In comparing the past recordings to the new ones taken this year, there were noticeable differences in both the video heat maps and the sonograms, seen in Figure 9, which is an indication of a change in the movement of the sculpture that could be a sign of deterioration.

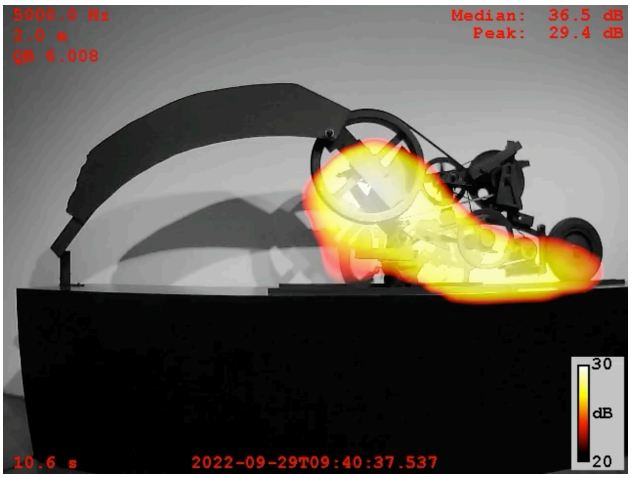

Figure 8: Sample frame of Tinguely's Char M.K. captured from the acoustic camera with an overlayed heatmap of the mechanism's sound intensity at a particular frequency

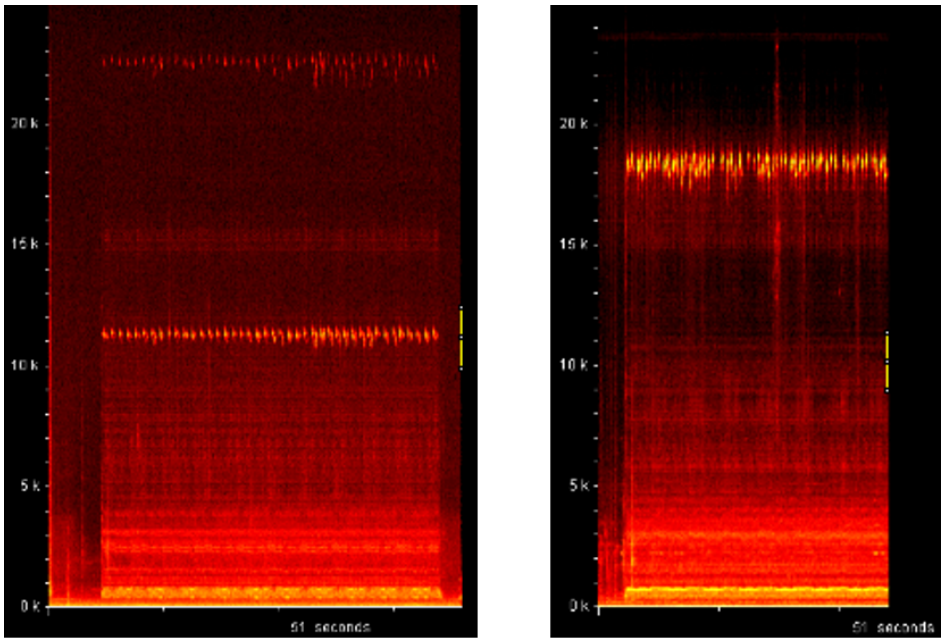

Figure 9: Sample sonograms collected in 2017 and 2022 of the Tinguely sculpture Meta Kandinsky that show a striking change in frequencies

4 Recommendations

The database is expected to be more useful in the future as it is expanded to include data from additional museums and private conservators. We think a main way to use the database is to help private conservators, students, and researchers compare differences in the approaches of museums on various types of mechanical objects. Additional information from such professionals would improve the usability of the database for others in the conservation field. There could also be more interviews conducted with the contacted professionals to collect additional data on specific issues facing them. Many museums have issues in their conservation processes, such as lack of knowledge on widely-used approaches (see Appendix F.2), not having contact with educational conservation institutions (see Appendix F.4), or experiencing restoration problems posed by easily-degrading materials such as polymers (see Appendix F.5).

To further assist museums in their conservation challenges, Haute École Arc Conservation-Restoration could serve as a resource on innovative conservation methods and conservator contacts. Having such a resource could prove to be very valuable to the museum community in Switzerland. It would benefit the conservation community if HE-Arc CR released and share an advertisement for the purpose of demonstrating what conservation methods are currently being developed, and how museums and private conservators could enlist their help.

Through the conducted interviews (see interview notes Appendix F), it was found that many museums have issues with widely-used materials such as metals and polymers. As a result, there should be more research into material-science aspects within the fields of conservation and restoration. Specifically, museums and private conservators mentioned a lack of conservation and restoration material analyses that are cost-effective, space-efficient, and widely-accessible.

5 Future work in conservation

In a time when the world is moving away from devices that are purely mechanical, interactions with these objects are important for teaching history and reminding us of our cultural heritage (Hofer, 2014). New forms of light and kinetic art are appearing in museums worldwide, such as the Pixel Forest by Pipilotti Rist, Figure 10. These electricity-based artworks, like the mechanical works of the past, will eventually need restoration, and bringing awareness to the field of conservation is necessary.

Figure 10: Pixel Forest, a light artwork in the Kunsthaus Zurich art museum

6 References

About SQLite [SQLite]. (n.d.). Retrieved April 13, 2022, from https://www.sqlite.org/about.html. (Cit. on p. 9)

This website is the official documentation page for SQLite, which is the database that we are using for the project.

Achille, C., Tommasi, C., Rechichi, F., Fassi, F., & De Filippis, E. (2019). Towards an advanced conservation strategy: A structured database for sharing 3d documentation between expert users [Place: [S.l.] : Lemmer, Netherlands : Publisher: Organising Committee of the International Congress for Photogrammetry and Remote Sensing]. *The international archives of photogrammetry, remote sensing and spatial information sciences.*, *42*(2), 9–16. https://doi.org/https://doi.org/10.5194/isprs-archives-XLII-2-W15-9-2019 (cit. on pp. 6, 8)

Appropriate uses for SQLite [SQLite]. (n.d.). Retrieved April 13, 2022, from https://www.sqlite.org/whentouse.html. (Cit. on p. 9)

Published by the creators of the SQLite database framework, this website explores the suggested uses of the structure and how they can be expanded.

Brambilla, L., Chalançon, B., Buch, A., Cornet, E., Rapp, G., & Mischler, S. (2021). Acoustic emission techniques for the detection of simulated failures in historical vehicles engines. *The European Physical Journal Plus*, *136*. https://doi.org/10.1140/epjp/s13360-021-01611-9 (cit. on p. 4)

Datatypes in SQLite [SQLite]. (n.d.). Retrieved April 13, 2022, from https://www.sqlite.org/datatype3.html. (Cit. on p. 7)

Published by the creators of the SQLite database, this website tells the possible types of data that can be inserted into and used in the database structure of the project.

(FDPIC), C. (2018). *Background*. Retrieved April 13, 2022, from https://www.edoeb.admin.ch/edoeb/en/home/der-edoeb/rechtliche-grundlagen/background.html. (Cit. on p. 7)

This is an article by the Swiss federal commissioner of data protection addressing the laws in Switzerland regarding the use of data online. Generally, the site says that any personal information can only be shared with the express permission of the data's owner.

Hofer, A. (2014). The sulzer/SLM site in winterthur, switzerland: From the factory to the new town—the reinvention of the city [Num Pages: 15]. In *Industrial heritage sites in transformation*. Routledge. (Cit. on pp. 1, 24).

Jean tinguely [The museum of modern art]. (n.d.). Retrieved April 24, 2022, from https://www.moma.org/artists/5882. (Cit. on p. 3)

The Museum of Modern Art in New York City is a premier art museum. Jean Tinguely is a major artist whose work mostly consists of kinetic artworks.

McDonald, S. J., Bennett Jr, J. R., Merwin, K., & Merwin Jr, G. (2019, June 14). *Cultural tourism in the wake of web innovation: Emerging research and opportunities* [Google-Books-ID: GJGbDwAAQBAJ]. IGI Global. (Cit. on p. 1).

Moropoulou, A., Delegou, E. T., & Avelidis, N. P. (2005). NDT and planning on historic buildings and complexes for the protection of cultural heritage. In *Cultural heritage conservation and environmental impact assessment by non-destructive testing and micro-analysis*. CRC Press. (Cit. on p. 2)

This was a piece of research in the field that introduced new conservation methods to the community. This discusses current non-invasive methods for analyzing cultural heritage items.

Mracek, W. (2008, July 7). *Beispiele neuer kunst im öffentlichen raum* [Korso- das nachhaltige magazin für graz und die stiermark]. Retrieved October 13, 2022, from http://korso.at/content/view/3171/108/. (Cit. on p. 3)

Pye, E. (2016). Challenges of conservation [Publisher: The Science Museum Group]. *Science Museum Group Journal*, *6*(6). https://doi.org/10.15180/160608 (cit. on pp. ii, 1, 2)

Read, M. (2020). A conservator's perspective on the approach to historical clocks. *Chinese Annals of History of Science and Technology*, *4*, 39–60. https://doi.org/10.3724/SP.J.1461.2020.0s039 (cit. on pp. 3, 4)

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SQL language expressions [SQLite]. (n.d.). Retrieved April 13, 2022, from https://www.sqlite.org/lang_expr.html. (Cit. on p. 8)

This is a publication by the creators of the SQLite database and specifies the expressions and code that is valid for use in the environment.

Sustainability of digital formats: Planning for library of congress collections [US library of congress]. (2017, March 28). Retrieved April 13, 2022, from https://www.loc.gov/preservation/digital/formats/fdd/fdd000461.shtml#local. (Cit. on p. 9)

The Library of Congress maintains a large SQLite database of all books in their collection. We plan on using the same database for our project.

van Grieken, R., & Janssens, K. (Eds.). (2014, April 21). *Cultural heritage conservation and environmental impact assessment by non-destructive testing and micro-analysis*. CRC Press. https://doi.org/10.1201/9781482283983. (Cit. on p. 4)

What is a database? [Oracle]. (n.d.). Retrieved April 13, 2022, from https://www.oracle.com/database/what-is-database/. (Cit. on pp. 6, 7)

What is GDPR, the EU's new data protection law? [GDPR.eu]. (2018, November 7). Retrieved April 13, 2022, from https://gdpr.eu/what-is-gdpr/. (Cit. on p. 7)

The webpage was published by the European Union as an informational webpage for the citizens and companies in the EU to inform them of the new regulations related to the GDPR law.

Whittle, D. (2012). The application of a kinetic art assessment template to the conservation treatment of frank hinder's work dark triptych. *AICCM Bulletin*, *33*(1), 12–19. https://doi.org/10.1179/bac.2012.33.1.003 (cit. on pp. 1, 2)
Cited By :1

Winter, T. (2014). Heritage conservation futures in an age of shifting global power [Publisher: SAGE Publications]. *Journal of Social Archaeology*, *14*(3), 319–339. https://doi.org/10.1177/1469605314532749 (cit. on p. 1)

Acronyms

ACAM acoustic camera. xi, 4, 5, 12, 21

ANSI American National Standards Institute. 8

Empa Swiss Federal Laboratories for Material Science and Technology. i, ii, vii, 2, 4–6, 12

GDPR General Data Protection Regulation. 7

HE-Arc CR Haute École Arc Conservation-Restoration. i, ii, vii, 2, 4–6, 16, 23

PII personally identifiable information. 7

RDBMS Relational Database Management System. 8, 19

SQL Structured Query Language. 8

UNESCO United Nations Educational, Scientific and Cultural Organization. 6

A Appendix: Conservator Interview Questions

Focus Areas	Sample Questions
Current Methods	What preventative conservation methods and restoration methods are most often used by this museum, and for what reasons?
	What diagnostic methods are used to test artifact fitness for reactivation?
	How would you go about “reactivating” a mechanism for the public?
Method Decisions	Is there a difference in methods used depending on materials and type of degradation present?
	How does the museum/conservator decide on a method for an artifact?
	Are there sources for learning about methods, or are the methods created on a case-by-case basis to fit the artifact?
	How do you approach conservation of newer artifacts compared to conservation of older artifacts?
	Who is making the decisions? It is a company? What resources do they have (financial and non-financial)?
	Do museums consider the artist’s view? Does the artist want a mechanism to be restored, or to degrade after a certain amount of time?
	Who decides when and how often to activate an object? Do they try to control wear on the parts?
	How much do they depend on existing material? — Compatibility of mechanical properties with movement, can't use some materials and alloys
	Does the restorer use the same or similar material or completely different so the change appears visible?
Project Improvement/ Recruiting	Do you know any other conservators specializing in cultural heritage mechanisms?
	Would you benefit from a public database of conservation methods?

Post-Restoration	How are changes of the artifact tracked on the piece itself? Is there any marking on a new piece used for the restoration?
	Who is doing the maintenance? Is it somebody within the museum or an external restorer? For watches, Is the conservator a restorer or a trained watchmaker?
	What is the forecasted lifetime of the restoration/repairs?
	When we contacted Arc, they specified a difference between functional, functioning, and operational. Do you make the same distinctions for your pieces? If so, how does this change your restoration procedure?
	How do you keep objects safe for the public to use?
	If a piece needs to be replaced, do you make a new part or try to find an original spare part for replacement? What is done with the broken component?
	Does each artifact have a file with the dimensions, state of conservation, intervention, and to what level of detail?

B Appendix: Conservator Interview Questions in French

	Questions
Méthodes actuelles	Quelles méthodes de conservation et de restauration sont le plus souvent utilisées par ce musée, et pourquoi ?
	Est-ce qu'il y a des méthodes de diagnostic pour tester les mécanismes pour leur réactivation ?
	Comment les mécanismes sont-ils réactivés pour le public ?
Décisions de méthode	Est-ce qu'il y a une différence entre les méthodes utilisées, en fonction des matériaux et du type de dégradation ?
	Comment un musée/conservateur/conservateur-restaurateur décide-t-il des méthodes ?
	Est-ce qu'il y a des sources pour apprendre ces méthodes, ou sont-elles créés cas par cas pour chaque mécanisme ?
	Est-ce qu'il y a une différence entre les méthodes utilisées en fonction de l'âge du mécanisme ?
	Qui prend les décisions ? Quelles ressources ont-ils (financier et non-financier) ?
	Qui décide quand et à quelle fréquence activer un artefact ? Essaient-ils de contrôler l'usure des pièces ?
	Dans quelle mesure les méthodes dépendent-elles du matériel existant ?
	Le restaurateur utilise-t-il le même matériau, un matériau similaire ou un matériau complètement différent, de sorte que le changement semble visible ?
Amélioration du projet / Recrutement	Connaissez-vous d'autres conservateurs spécialisés dans les mécanismes du patrimoine culturel ?
Post-Restauration	Comment les modifications de l'objet sont-elles suivies sur le mécanisme lui-même ? Est-ce qu'il y a un marquage sur une pièce neuve utilisée pour la restauration ?
	Qui fait l'entretien des mécanismes ? Est-ce quelqu'un du musée ou un restaurateur externe ?
	Quelle est la durée de vie prévue de la restauration/réparation ?
	Lorsque nous avons contacté l'HE-Arc, ils ont précisé une différence entre les mécanismes fonctionnels et opérationnels. Faites-vous les

	mêmes distinctions pour vos objets ? Si oui, comment cela change-t-il votre procédure de restauration ?
	Comment gardez-vous les objets en sécurité pour que le public puisse les utiliser ?
	Si une pièce doit être remplacée, fabriquez-vous une nouvelle pièce ou essayez-vous de trouver une pièce de rechange d'origine à remplacer ? Que faites-vous de la pièce cassée ?
	Chaque artefact a-t-il un dossier avec les dimensions, l'état de conservation et l'intervention ? Si oui, à quel niveau de détail ?

C Appendix: Informed Consent Agreement for Participation in a Research Study

Form based on template from the WPI Institutional Review Board

Informed Consent Agreement for Participation in a Research Study

Investigator: Herman Servatius

Contact Information: hservat@wpi.edu

Title of Research Study: Developing a Relational Database of Conservation Methods to Support the Maintenance of Functional Cultural Heritage Mechanisms

Sponsor: Empa, Swiss Federal Laboratories for Materials Science and Technology, Contact: Rowena Crockett, Rowena.Crockett@empa.ch & HE-Arc-CR, Haute École-Arc- Conservation Restauration, Contact: Laura Brambilla, laura.brambilla@he-arc.ch

Introduction
You are being asked to participate in a research study. Before you agree, however, you must be fully informed about the purpose of the study, the procedures to be followed, and any benefits, risks or discomfort that you may experience as a result of your participation. This form presents information about the study so that you may make a fully informed decision regarding your participation.

Purpose of the study: The purpose of this study is to study local techniques/methods for conservation and restoration of cultural heritage mechanisms. The study will aid in the creation of a categorical database of conservation methods. This database will help curators and museums learn and choose methods for the conservation and restoration of their artifacts.

Procedures to be followed: In this study, you will be asked various questions about your museum's/collection's restoration and conservation methods. The questions will include information about methods in question, material, degradation type, and age of the given mechanisms. There may also be a need for you to show the housed mechanisms, use the housed mechanisms, or demonstrate all or part of the conservation procedures mentioned. The procedure might include a museum tour, and around 60 minutes of interview. In addition, you may be contacted before and after the interview for clarification questions. You will also be asked if you know anyone else in the field of conservation.

Risks to study participants: The risk and discomfort in this study is none to low, depending one the types of conservation procedures the subject (you) will demonstrate.

Benefits to research participants and others: This research has benefits to museums and conservators in the form of a categorical database that will list, in detail, types of conservation and restoration methods for cultural heritage mechanisms used by Swiss Museums and collections.

Alternative procedures or treatments available to potential research participants: If the study cannot be feasibly completed in-person, there is an option to participate in the interview online, using Zoom or Google Meets.

Record keeping and confidentiality: Records of your participation in this study will be held confidential so far as permitted by law. However, the study investigators, the sponsor or its designee and, under certain circumstances, the Worcester Polytechnic Institute Institutional Review Board (WPI IRB) will be able to inspect and have access to confidential data that identify you by name. Any publication or presentation of the data will not identify you.

Compensation or treatment in the event of injury: Because this study by itself does not require the subject to participate in any activity that poses a health risk, there is no compensation or treatment available. You do not give up any of your legal rights by signing this statement.

Cost/Payment: There will not be any costs or payments that the participants must cover.

For more information about this research or about the rights of research participants, or in case of research-related injury, contact:
IRB Chair, Professor Kent Rissmiller, Tel. 508-831-5019, Email: kjr@wpi.edu
University Compliance Officer, Michael J. Curley, Tel. 508-831-6919, Email: mjcurley@wpi.edu

Your participation in this research is voluntary. Your refusal to participate will not result in any penalty to you or any loss of benefits to which you may otherwise be entitled. You may decide to stop participating in the research at any time without penalty or loss of other benefits. The project investigators retain the right to cancel or postpone the experimental procedures at any time they see fit.

By signing below, you acknowledge that you have been informed about and consent to be a participant in the study described above. Make sure that your questions are answered to your satisfaction before signing. You are entitled to retain a copy of this consent agreement.

_____ Date: _____
Study Participant Signature

_____
Study Participant Name (Please print)

_____ Date: _____
Signature of Person who explained this study

Special Exceptions: Under certain circumstances**,** an IRB may approve a consent procedure which differs from some of the elements of informed consent set forth above. Before doing so, however, the IRB must make findings regarding the research justification for different procedures (i.e. a waiver of some of the informed consent requirements must be necessary for the research is to be "practicably carried out.") The IRB must also find that the research involves "no more than minimal risk to the subjects." Other requirements are found at 45 C.F.R. §46.116.

D Appendix: Template for Museum-contact Emails

To	Museum curators/museums
Cc	gr-ZurichA22-Mechanisms@wpi.edu
Bcc	
Subject	[Interview Request] Restoration of Mechanical Artifacts

Good _____(time of day),

We are a team of undergraduates from Worcester Polytechnic Institute, in the US, working with Haute Ecole Arc Conservation-restauration (HE-Arc CR) and the Swiss Federal Laboratories for Materials Science and Technology (Empa) on a project to help museums and conservation-restoration professionals share how they restore and/or preserve mechanical artifacts.

Our project will culminate in the creation of an open source database of conservation and restoration methods aimed at helping museums and conservators. The first step is to collect data from conservators and researchers from some of the top museums in central Europe. Would your team be available for a short interview in the next month?

The interview should take no more than 1 hour to complete, and we can conduct it in-person or online through Zoom, Microsoft Teams, or Google Meet.

Additionally, in this email, we included a PDF of the questions we would be using during the interview.

Thank you for your time,

Roman Bolshakov
Federico Galbiati
Lauren Hess
Eric Kasischke

Conservator Sample Interview Questions

E Appendix: Museum Contact List

Contacted without response

- Albula Railway Museum
- Mühlerama
- Museum of Watches and Mechanical Musical Instruments (MUMM)
- Artist Renate Kordon
- State Museum Zurich
- Swiss Cable Car Museum
- Swiss Museum of Transport
- Urania Observatory
- Zyttglogge in Bern
- Private Conservator #2
- Private Conservator #3
- Private Conservator #4

Interviewed

- Diana and Stag automaton at the Boston Museum of Fine Arts
- Espace Jean Tinguely - Niki de Saint Phalle, Fribourg
- Heureka Sculpture, Zurich
- Musée Atelier Audemars Piguet, Le Chenit
- Musée de la Machine à Ecrire de Lausanne (MMàE), Lausanne
- Musée International d'Horologerie (MIH), La Chaux-de-Fonds
- Museum Tinguely, Basel
- Tram Museum, Zurich
- Private Conservator #1

Unavailable

- Zytturm in Luzern
- Museum Patek Philippe
- Beyer Watch and Clock Museum
- Museum of Music Automatons
- Musée D'Horologerie Du Locle

F Appendix: Complete Interview Notes

F.1 Museum Tinguely, Basel - 29 September 2022

General Info:

- The Tinguely Museum in Basel is the premier collection of works by the artist Jean Tinguely, with the authority to certify the authenticity of pieces as Tinguely originals. It also offers conservation/restoration advice and services to both its collection and museums around the world.

Preventative Methods:

- Reduction of total movement or movement time
    - Timed foot-pedal activation with a 10-minute break
        - Pedals monitor total running time
    - Sometimes the speed is slowed, but that changes the art

Artifact Onboarding:

- Verification that it is a Tinguely sculpture
- Old videos/ photographs of motion
    - Informs original movement
- Ensure there are no loose parts that impede the movement
- Takes a long time to 'get to know' the piece
    - What pieces are prone to wear, what it should sound like, etc.
- Look at motor type
    - WWII- 1950's motors used different voltage/frequency
        - Changes how the motor can be run to avoid burnout

Conservation States:

- Try to keep all artifacts on display running
    - Acknowledge that the artworks need a break occasionally
- Follow functional, functioning, operational categorization
    - Some pieces have too much risk of damage if run
    - Try to get objects as close as possible to a running state

Materials:

- affect decisions
    - sometimes extra time needs to be dedicated to a particular material
        - (wood, paint, coatings, etc.)
    - Frequently, parts are being used outside of their natural/intended environments
        - Faster/different degradation than expected
    - Rust is left for the look
        - Original pieces were made out of a scrapyard and started with rust
        - Rust offers some lubrication
            - Some pieces changed their sound when the rust was worn off

Decision Making:

- Conservators have a discussion, and frequently disagree
    - Every object is different, so methods are also different

    - Focus on what is best for the artwork/ the future
    - Try to combine multiple points of view and find compromises
    - Goal is always to minimize intervention
    - Occasionally, there are time/event deadlines
        - Conservators have the power to say that they cannot be met
        - Other museums try to only restore for upcoming shows
            - don't think ahead and don't give a lot of time to conduct the restorations
- Try to take Tinguely's words/ beliefs into account
    - Contradictions
    - Determined that towards the end of life, he knew his 'greatness', so wanted to preserve his works for the future

Replacement Policy:

- Depends on the type of material and its visibility in the artwork
    - Will stamp replacements, but
        - Major changes affect the art/ meaning
    - Try to replace pieces with material that is as close to the original as possible
        - Can tell the region that a piece of metal came from by the cuts or other visible features
    - Look online for used parts
        - Some materials are easy, some follow trends
        - Try to get new-old stock
            - Were made back in the day but never used
    - Will let new materials rust to better match the artwork
        - The old/ lower quality material rusts differently

Post-restoration:

- Multiple layers of change tracking
    - Start in word, then PDf
    - Filed on Roche servers and MuseumPlus
    - Concerns with server control and security
- Forecasted lifetime
    - Focus on reversibility to save the object for any upcoming/ future restoration methods that may be better than what we have today

Knowledge Sharing:

- Try to keep up to date on modern methods
    - talk to Hochscule der Künste Bern
- Lots of contacts with well-known, specific skills
    - large focus on collaboration and old-style work
        - Give other museums access to the contacts for their own pieces
    - Focus on networking and good relationships with others
        - Try not to outsource, instead work with outside help

        - Enjoy the different PoVs and their contributions to the piece

Other information:

- The museum makes 'copies' or models for disabled people or children so that everybody can understand and experience the sculptures
    - Use these models as practice for new conservators
- Pieces are worth 45.000-60.000 CHF
- Transportation causes its own conservation/restoration challenges
    - Large pieces must be disassembled over the course of a few days
        - Puts stress on the piece
        - Smaller pieces are transported whole in special cases
    - Boats must be avoided
        - Vibrations can harm the connections
        - Ocean air causes more rust

F.2 Espace Jean Tinguely - Niki de Saint Phalle, Fribourg/Freiburg - 28 September 2022

General Info:

- The museum, housed in a former train depot in the center of the city, contains a collection of works by Jean Tinguely, a world-renowned artist that created kinetic sculptures.

Preventative Measures:

- Limits on the running time of sculptures
- Use sacrificial pieces in order to preserve the original pieces better
    - Use belts that wear faster to prevent damage to harder-to-replace wheels

Conservation States:

- Not currently used, but think it would be a good idea

Materials:

- Polymers are difficult
    - Experiences faster degradation
    - Also hard to change, as it is frequently a crucial part of the artwork
- -Wearing vs. worn parts
    - Wearing= active parts that are critical to the motion (belts, etc.)
        - Generally replaced (part of the sacrificial stuff)
    - Worn= other pieces that cannot be replaced

Decision Making:

- Conservator recommendations
    - museum director has final say

Replacement Policy:

- Mark pieces that are the same material as the original
    - Store the removed pieces
- Try to find parts (especially scrap)
    - will ask others to help remake pieces

Post-restoration:

- Keep a change and maintenance log
    - not all past changes were well documented
- Intervention when the mechanism sounds wrong
- Try to get a couple of decades out of any change/maintenance
- Have guards to keep public and object safe

Knowledge Sharing:

- Generally methods are created on a work-by-work basis
    - Also work with Tinguely Basel
- In the past, work was outsourced to Tinguely confidants (students, friends, etc.)

F.3 Tinguely Heureka Sculpture, Zurich - 27 September 2022

The work of art «Heureka» is on permanent loan in the art collection of the city of Zurich. The KiöR is responsible for it. Until 2019, it commissioned a team from Zurich's Waste Management and Recycling (ERZ) headed by Jürg Fehr to carry out regular inspections and maintenance. He was in contact with the artist and kept the work of art running with his expertise as a mechanic, i.e. he lubricated joints and axles and checked the electric motors.

After the depot was closed, maintenance was contractually agreed with and handed over to an external company, which took over the employees and thus the knowledge of how to take care of «Heureka». During the operating time from April 1st to October 15th, the object is checked monthly with a visual inspection and service work is carried out. During this period, «Heureka» will run three times a day at 11 a.m., 3 p.m. and 7 p.m. for 8 minutes each. In October it will be switched off and properly lubricated. In the spring, the work is checked before it is put into operation and maintenance and, if necessary, minor repair work is carried out with the same or similar materials. Regular checks are therefore guaranteed. If major damage is discovered, KiöR will be contacted by the company to discuss what should be done.

Where possible, the opinion of the artists is included. In the case of «Heureka» for example, the coloring was adjusted because sources could prove that it was Jean Tinguely's intention to present the work of art painted black.

The questions you asked relate specifically to the restoration. So far, «Heureka» has only been restored once in collaboration with experts from the Museum Jean Tinguely. Therefore, we are not the most suitable contact for specific restoration questions. In these cases, we also contact the respective experts.

F.4 Musée Atelier Audemars Piguet, Le Brassus - 23 September 2022

General Info:

- Audemars Piguet is a famous luxury watchmaking company founded in 1875 that maintains a collection of their watches, and runs a repair service for the owners of their watches. They made many innovations in the field of watchmaking, including incredibly thin movements and large numbers of complications.
- Preventative Measures
    - The watches do not run while on display
    - Too much risk in setting and winding everyday
    - Stored under climate-, humidity-controlled conditions
- The private watches are maintained for use
    - no strict controls possible
        - but the watches are expensive, so it is likely that owners will be careful

Artifact Onboarding:

- Visual inspection
- Get watch to working order, using traditional/classical methods

Conservation States:

- Restoration vs. Reparation
    - Restoration:
        - keep as many original parts as possible
        - takes a long time
        - division of the marketing department
    - Reparation:
        - Watch servicing
            - cleaning, oiling, etc. every 2-5 yrs.
        - Get watch to work correctly and tell time accurately

Methods:

- Dozens, used by professional watchmakers
- Avoidance of high-tech intervention methods
- new hires trained on classical methods

Decision Making:

- Conservators, historians, etc. collaborate inside workshop on proper conservation
- all watches Pre-1951 are unique/ hand-made, so all are different and may require different procedures

Replacement Policy:

- try to match the alloy as much as possible
    - minimize visibility of changes

Post-Restoration//Documentation:

- Use Word docs with pictures or published leaflets
    - Works okay, because they only do 60-100 restorations a year
    - Could start a more systematic approach, but there's a lot that needs to go into it
- Large pieces are subtly stamped to verify that it is not original
    - Not feasible for small parts
- Release Certificates of Authenticity that give a list of non-original parts
- No forecasted lifetime
    - There is no way to predict the type of damage that a worn watch will receive

Knowledge Sharing:

- Many repairs are experience based
    - 5 years of training in the company
- Do not outsource much
    - collaborate with other labs inside the company
        - Specific materials (crystal glass, enamel, metal treatments) need to be done outside of company
        - If need outside specialists, they use word-of-mouth to find them
            - Some crafts are hard to find/ are going away
                - Working with other museums/watchmakers to find craftsmen or revive the craft

F.5 Musée International d'Horologerie (MIH), La Chaux-de-Fonds - 12 September 2022

General Info:

- The collection was started in 1865 as a part of the watchmaking school
- It is the most complete/biggest collection of watches/clocks in the world
- 4,000 pieces on exhibit and 2 large reserves
- Open to the public 1902
    - Added to International Consortium of Museums 1967
        - Sets ethics rules for preservation
- First excavated/underground museum in Europe
    - Defined new museum ideals/goals
        - Be open for research
        - Show off restoration practices by having the restoration labs in a 'fishbowl' visible to public

Training:

- All restorers train as a:
    - Watchmaker for 5 yrs
    - Restorer for 2 yrs
    - Engineer for 2 yrs

Preventative measures:

- Monitored humidity, temperature, etc.
    - Underground museum helps make this more efficient
- Visual inspection by restorers regularly
    - Surveillance for any display-related jostling

Received artifacts:

- Good if the clock/watch still ticks
- Buy any missing parts (or make, etc)
- Consult with astronomer for accuracy calculations (especially for astronomical clocks)
- Focus on stabilization
    - Try to get the mechanism complete and secured, not running
- If needed, replacement parts will be built using historical methods

Current states:

- Not all are functioning(or functional)
    - Some were never accurate when new
- Some are used for research and can be activated on request with a very good reason
    - Same with patents– some are used to clear up patent disputes
    - Very technical ones/ unique ones are in working order for study

Materials & effect on method:

- Each object has own requirements
    - Museum calls in specialists for certain materials
        - I.e. wood, glass, fabric, enamel
        - Collabs w/ HE-arc because of the range of specialties available

        - Use connections/ word-of-mouth to find specialists

New methods/ learning:

- Conservation in Europe is highly networked
    - Good cooperation between people
- Canadian Institute for Conservation
    - Keeps library of methods available
- HE-arc
    - Develops new techniques
- Metalpat /MiCorr
    - Library of diagnostic techniques for metals
- Use fancy analysis machines to identify the composition of mechanical elements
- Scientific literature is not used frequently by museums
    - Paid access is pricey (usually only available to schools)
    - When is used, the focus is then on open-access journals

Differences between newer and older:

- Late 1970's
    - Quartz watches w/ battery
        - Polymers and ceramics that are hard to preserve
            - Often undergo irreversible chemical changes over time
- Dangerous materials sometimes used in older watches (governed by regulatory rules)
    - Radioactivity (Radium dials, etc.)
        - Require specially-designed storage space covered by regulations
    - Mercury (used for weighting components)
    - Lead, Arsenic, etc. (used in paints/ enamels)
        - Many restorers prefer to use these paints because of the more vibrant colors
        - Generally minimal concern because of the small relative volume
- Polymers
    - Several degrees of degradation

Restoration decisions:

- Follow ICoM ethics rules
    - As little work/intervention as possible
- Generally depend on money
    - Museum is donation-supported (other than high-level staff, who are paid by the city)
        - Results in creative fund-raising (designing and selling own watch to finance the restoration)
- Focus on authenticity
- What about activation?
    - Decide collectively (between all players at the museum (~12 or so))
        - Try to have 1 or 2 on display that are active

Missing/Broken Parts:

- Use same material if possible
    - More important for internal pieces, as the weight/physical properties matter
    - Depends on how critical the piece is
    - Difficult to completely match an alloy (hard to figure out what to match to without destruction)
        - Will use broad categories like bronze, brass, etc.
    - Some are banned (toxic/radioactive)
- Will try to find a replacement part
    - They keep a stock room of extra pieces (especially common ones)
    - Will make them if needed
    - Marchon boutique in the city also has a stock of watch pieces
- Broken pieces are kept in the archives if original

Post-Restoration:

- Pieces are not marked by restorer
    - Used to happen b/c pride
    - Restorers also used to upgrade the mechanism to improve time-keeping or change the motion to reduce wear
        - A lot of work now to undo these changes and get back to the original design
- Changes/projects are recorded in an in-depth report
    - Also 3D modeling of file to record part location and interaction
        - Able to be animated
        - Serves as a ‘recipe’ for rebuilding the clock after it was taken apart for restoration
    - Use a Switzerland-wide database to keep object information (accessed via VPN)
        - Highly detailed library of the museum inventory
        - Can have other documents (3D models, etc.) linked in
- Forecasted restoration lifetime depends on what was performed
    - Any intervention must be reversible without causing further harm to the object

Advice:

- Focus on independent restorers
    - More likely to use our database for client interactions
    - Might have different ethics
        - How much power does a client have in the decision?
- If email doesn’t work as well as hoped, try a phone call
    - More social interaction and more legit
- Try to rotate people asking questions
    - Makes it seem less intense
    - Try to have more people taking notes

F.6 Tram Museum, Zurich - 7 September 2022

Pre-Conservation

- Many older trams were disposed of or forgotten because the science of restoration and conservation was not commonplace
    - Sometimes found in warehouses in places far from where they came
- First step of conservation is to put the item in a safe place (warehouse, museum)
    - Vandalism and elemental exposure is common, and trams must be scrapped if too affected

Method decisions

- The cost of restoration and conservation procedures is a limiting factor and often one of the first steps.
- The company always intends for the tram to remain in a state where they can move
    - however, some owners use the historic trams for other purposes(a bar) and want them made static
- Tram conservation decisions go through
    - 1. the people with the money (museum benefactors/donors, owners, etc.)
    - 2. the requests of the people actually maintaining the trams-what are they looking to do?
    - 3. the tram/museum consortium– are the changes ‘ethical’ on a preservation standpoint
    - For more expensive projects, museums can “apply for a grant” that goes towards the protection of the object (note– it is not a grant system, but it is similar)

Restoration process / maintenance

- When an old mechanism is received, it is first completed. Any missing parts are either recreated, or the original factory is contacted to make it.
    - Companies will frequently help make parts for the publicity
    - The museum tries to find copies of every piece
    - The cost of buying original pieces is sometimes not feasible
- Mechanisms that are constantly used could be hardy; sometimes cleaning is the only conservation required
    - Mechanisms more reliable than the current digital/ all electric system
        - Only major issues is the occasional replacement of contacts
- Visual inspections are very common and are done by specialists. Only once a mechanism shows wear is restoration considered
    - For example, they know how big a particular part should be, so they can judge the amount of wear by the decrease in size (also how long until it is non-functional, in the case of a contact, this would be when it no longer makes consistent contact where it is supposed to)
    - If a tram is run, it wears more/ needs more maintenance. So it’s a constant balance
    - Trams have to be run to prevent the bearings from flattening
- When an object is made from different materials, it is desirable to modify the object so that later conservation procedures are easier.
    - Generally materials are chosen to minimize wear

- When a part is damaged, it is sometimes better to cut out the damaged area but keep the rest
    - If it is removed:
        - Historical pieces kept
        - Pieces that could be reused somewhere else are kept
        - Broken pieces are usually not repairable and are scrapped

Knowledge of techniques

- Restoration techniques on specific pieces must be passed down from older professionals
    - A lot of the information on the trams/ best procedures is just from experience
        - Every tram is a little different, and little things (like the length of the car) can change how different pieces wear
    - New people trained on the old parts

Documentation

- Modifying objects is documented in detail
    - All in paper– less likely to be deleted or accidentally modified
    - Kept in an archive off-site, generally a collection of rented spaces that can expand as needed
    - If something is moved it needs to be documented
    - Most major pieces aren't marked as replaced (common, original pieces)
    - Other pieces could be marked, but usually are not because there is enough other documentation
    - Major modifications require safety recertifications
        - Are also subject to federal oversight
- There is no distinction between functional, functioning, and operational
    - Although there are special rules created to enable the use of some of the trams
    - In some cases, updating the tram to modern safety standards would decreases the historical value
        - Some trams cannot be run because they cannot break fast enough for modern safety standards
        - Tram-specific mechanism information
- On a tram, the mechanical mechanisms are the handbrake and speed control (mechanical switch that uses different moving pieces to change the amount of power that gets to the motor)
    - Material matters here– the resistance changes the power (so need to use alloys with similar electrical properties)

Database/ Project Improvement

- The database would be useful for training new conservators/ develop more experience
    - Consulting engineers do not research past fixes (not modest enough– they think they can solve every problem by themselves)
    - Interesting anecdotes to fill out narrative

- The electric tram was invented by Siemens in 1879
- The last producer of cog railways is Stadtler (these are necessary for certain grades/slopes)
    - These trains use a higher voltage (Zurich is 600V)
- Trams now use an electric/digital system for controlling speed
- Braking frequently involved reversing the motor into a generator
- San Francisco and Zurich occasionally run historic trams on historic lines
- Place to check out:
    - Association neuchâteloise des amis du tramway
    - https://museedutram.ch/wp/musee-du-tram/histoire-du-musee/

F.7 Private Conservator #1, 6 October 2022

Methods
-Preventative
    -Preparations for transport stability
    -Depends on the object
        -Usually cleaning
            -Mechanical/dusting with brush on surface
            -Use solvents for deeper cleaning
-Reactivation
    -Visual diagnosis of issues
        -involves dismantling (at least in part) to see all pieces
    -Use XRF occasionally if there is unfamiliar decay/ corrosion

Onboarding
-listen to client
    -inform client of replacement risks
    -should have a defined operation frequency
        -make copy of object or video of motion if risk too high (and client agrees)

Materials
-Most objects are highly composite (many different materials)
    -Pay attention to functional vs. aesthetic parts
        -Informs importance
-challenges
    -plastic/rubber cannot be repaired, only replaced
    -metal is dependent on type or lubricant used
        -clean functional/worn surfaces
        -repair with consent of client
            -try to keep the original, but there is a risk of misplacing the piece
            -report of change also has risk of loss
        -mark non-original pieces
    -wood
        -coatings (paint, varnish, etc) is rigid, but wood changes over time
        -must be replaced
    -glass
        -usually found broken
        -can be glued back together

Decisions
-Client/owner has the ultimate decision
    -recommendations presented by conservator
    -finances/deadlines change the possible methods
        -frequently leads to compromise on some methods
        -conservator needs to make good arguments to convince client to spend more on the

conservation

-frequently, the money if given just so the owner can learn more about their artifact

-artist (if available) may be consultant on the restoration (because they sold it, the owner has the control)

Method Learning

-Working groups

-Conferences

-give an intro to new products/ methods

-try out the method and see if it works for the particular application

-Scientific literature and conference proceedings

-can be difficult to access

-Continuing education

Reactivation

-decisions are experience-based (know wear patterns)

-if unfamiliar; find somone who is familiar

-what is normal for these objects, what are weak points, etc

-assess evolution of wear until breaking point

-graphs of continual wear

-sudden restart= high risk of total failure

-important to do a total assessment before reactivation

Replacement & Material Choices

-Use similar materials (not necessarily same composition)

-avoids creating new problems

-job is not to improve the artifact

-different materials have different wear

-try to stamp replacements with date, museum, etc.

Documentation

-Collaboration with other restorers

-share archives and can compare to other works

-Personal library of projects with backups (copy given to client)

-Digital and hard-copy

-Includes pictures to describe complexity, location, material, etc

-easier that describing these in words

Forecasted lifetime

-goal is for restorations to last as long as possible

-more familiarity= a better forecast

-the more often something is activated, the more often it will need restoration/ care

Replacement
-Try to recreate the piece if possible, may ask experts for help
    -other option is to take a piece from another object which is pointless

Categories
-not listed, but have them in mind
    -sometimes making an object function is changing it
        -for private use, the artifact will be changed to enable usability (unlike museums)

Challenges
-larger objects involving more people (specialists, etc)
    -coordination of methods vs. tradition (this is how it was done in the past)
-difficult to access nondestructive analayses
    -increases time pressure (labs take time to process)
-want:
    -analysis that can be done at home
    -specific information about composition or coatings

F.8 Diana and Stag automaton at the Boston Museum of Fine Arts - 7 October 2022

History of object
-renaissance-era automaton
    -part of a German aristocratic collection
        -hidden during WWII
        -ended up in DDR (East Germany)
-had advanced corrosion when uncovered in 1980s
    -exposed to elements and tarnished
    -steel, gears, wood, spring appeared as they do in an archeaological object
    -nonfunctional due to rust/ decay
-cleaned up to make shiny (1980s)
    -superstructure fixed up/ soldered
    -wax impregnation to stop flaking of rust
-returned to owning family 1989
    -sold on art market

State
- motor considered 'accessory'
    -goal to show off Diana, not the 'innards'
    -new mechanism copied from radiographs and the old mechanism
        -not exactly the same, but operates
            -run once and filmed, now separate and kept in storage
-exact 'correct' motion never studied
    -there are roughly 30 Diana and Stag out there
    -could be interesting to study them and compare the movements
-not highly altered

Restoration challenges/ strategies
-mechanism was mineralized
    -changes the shape of the metal
        -could be reshaped to look right, but no reason to do so
-radiographing is standard practice
    -offers multiple views of the object
    -shows distances of gear disks
-use of x-ray fluourescence (xrf)
    -identified mercury-amalgam guilding
    -not used to determine proper alloys
        -not enough resources
-further exploration of material identification
    -live-casting frequently used in the time period
    -did not do 3D scanning of the artifact
-Resource limitations have big effect

-cannot globalize for US
-everything related to money, ultimately
-access to technical/material analysis
-lack of staff

-US used to be leader in conservator training
-scholars, researchers have retired
-understanding of the crafts is lacking

Cleaning of Gold and Silver

-gold is inert, so not likely to corrode
-silver corrodes highly when buried
-most troublesome is silver chloride
-changes the shape of the silver
-requires care to avoid removing gilt, paint, or inscriptions
-silver polished with chalk slurry to avoid corrosion
-but lose some silver with it
-could coat the silver, but difficult to remove the coating later
-avoid chemicals
-can cause more corrosion in the future
-electrolysis occasionally used

Marking

-no reason to- original not touched
-new part is clearly modern
-but would be good practice to mark it mechanically (stamp)
-mechanism not integrated with Diana
-more work/ more potential for harm to Diana
-ran out of time

Documentation

-The Museum System (US exclusive)
-central database
-enables grouping and exhibition planning
-lot of work to digitize everything
-still keep paper copies around
-entries have formatting/informational restrictions

F.9 Musée de la Machine à Ecrire de Lausanne (MMàE), Lausanne - 12 October 2022 (note responses in red)

	Questions
Méthodes actuelles	Quelles méthodes de conservation et de restauration sont le plus souvent utilisées par ce musée, et pourquoi ? Remise en état selon les normes de la profession
	Est-ce qu'il y a des méthodes de diagnostic pour tester les mécanismes pour leur réactivation ? Contrôle approfondi du fonctionnement.
	Comment les mécanismes sont-ils réactivés pour le public ?
Décisions de méthode	Est-ce qu'il y a une différence entre les méthodes utilisées, en fonction des matériaux et du type de dégradation ? Non
	Comment un musée/conservateur/conservateur-restaurateur décide-t-il des méthodes ? Selon la formation profesionnelle
	Est-ce qu'il y a des sources pour apprendre ces méthodes, ou sont-elles créés cas par cas pour chaque mécanisme ? Il existe quelques ouvrages de formation
	Est-ce qu'il y a une différence entre les méthodes utilisées en fonction de l'âge du mécanisme ? oui
	Qui prend les décisions ? le conservateur Quelles ressources ont-ils (~~financier et~~ non-financier) ?
	Qui décide quand et à quelle fréquence activer un artefact ? Essaient-ils de contrôler l'usure des pièces ? non
	Dans quelle mesure les méthodes dépendent-elles du matériel existant ? certains matériaux sont irrécuperablers, donc pas réparables
	Le restaurateur utilise-t-il le même matériau, un matériau similaire ou un matériau complètement différent, de sorte que le changement semble visible ? de préfernce des pièces d'aorigine, Si nécessaire un matériau différent
Amélioration du projet / Recrutement	Connaissez-vous d'autres conservateurs spécialisés dans les mécanismes du patrimoine culturel ? Non pas dans mon domaine
Post-Restauration	Comment les modifications de l'objet sont-elles suivies sur le mécanisme lui-même ? Est-ce qu'il y a un marquage sur une pièce neuve utilisée pour la restauration ? Non

	Qui fait l'entretien des mécanismes ? Est-ce quelqu'un du musée ou un restaurateur externe ? moi même
	Quelle est la durée de vie prévue de la restauration/réparation ? C'est en fonction de l'etat de l'objet
	Lorsque nous avons contacté l'HE-Arc, ils ont précisé une différence entre les mécanismes fonctionnels et opérationnels. Faites-vous les mêmes distinctions pour vos objets ? Si oui, comment cela change-t-il votre procédure de restauration ? Un objet fonctionnel est utilisable, L'opérationnel, permets de démontrer le mécanisme sans vraiment être utilisable
	Comment gardez-vous les objets en sécurité pour que le public puisse les utiliser ? Une partie des objets sont à disposition du public
	Si une pièce doit être remplacée, fabriquez-vous une nouvelle pièce ou essayez-vous de trouver une pièce de rechange d'origine à remplacer ? Que faites-vous de la pièce cassée ? de préference j'utilise une pièce d'origine, si c'est vraiment nécessaire je fabrique. La pièce défectueuse et détruite.
	Chaque artefact a-t-il un dossier avec les dimensions, l'état de conservation et l'intervention ? Si oui, à quel niveau de détail ? Non, actuellement, nous manquons de moyens pour procéder à ce type d'inventaire