COSCH Application

Case of Studies

1. Title

3D Model of the Bremen “Cog” – When Science meets Public

2. Duration

2014-2016

3. Description

The Bremen Cog was discovered in 1962 in the River Weser close to the city of Bremen. It was successfully conserved and restored during the following years by shipbuilders, archaeologists and the Conservation Laboratory of the German Maritime Museum in Bremerhaven. Since 2000 the ship is on display after 3 years of excavation, nearly 10 years of documentation and reconstruction, followed by 20 years of conservation. The focus of the scientific work laid on the reconstruction of the “flag ship” of the Hanseatic League.

Until now, the scientists reconstructed the shape of the vessel with traditional measurement. Dendrochronology gave a hint of the dating – the cog was built in 1380 A.D.! The sensation was perfect: it was the first time that a vessel of the Hanseatic League was excavated. Before this spectacular discovery this ship type was only know from town seals and paintings in medieval manuscripts. It was well preserved over the centuries: the steer board side was nearly complete so that a reconstruction of the whole ship seemed possible and understandable for the public.

This medieval vessel is 24 m long, 7 m wide, 4 m high and belongs to the largest archaeological ships exhibited in Europe with the Vasa in Stockholm (Sweden) and the Mary

Rose in Portsmouth (England). The ship represents one of the founding stones of the Museum and it was and it is an object of national interest and distinction. Currently it is a subject of great matters for the archaeology field, but also for conservation scientists and conservators worldwide, additionally it has been also an attraction for museums visitors.

After 40 years of existence the German Maritime Museum is taking the challenge of competing new models of tourist's attractions in the town. As a member of the research network from the Leibniz Association, it is our role to follow and be active in the media revolution in the museum field. It is of great relevance to offer a new youth to the Bremen Cog and allow the public to see it from a different point of view and give them access to the scientific research results.


German Maritime Museum (Deutsches Schiffahrtsmuseum) -- Bremerhaven

A three dimensional monitoring of the Ship would allow the museum to keep an eye on the ship and wood deformation that occurred in the past and possible ones to come in the future. Until now the Vasa and the Mary-Rose are monitored with a *Total station* using different settings to get a 3D model, twice a year in average, comparing the data to the last measurements in order to monitor and try to understand deformation processes.

Until now no 3D model, considering the surface and the appearance of the wrecks has been collected/acquired. In an era of new media and its new possibility, we should think about such a model, for scientific purposes as well as participative education for the public.

In 2015, the Museum celebrates its 40th Anniversary and an exhibition will be set up and on display open to the public in September.

In 2016 will start an extensive renovation campaign of the museum and the opportunity of having a 3D model of the Ship would be the chance to continue to present it during the building works at the Museum. Also maybe the data may be accessed on the Internet, thus giving the possibility for researchers to gain access to the data. In fact all the building will be renovated and the Bremen Cog will most probably have to be covered, therefore not accessible at all to the public.

After the renovation a 3D reconstruction of the cog in the exhibition could become one of the main attractions for the public.

4. The rationale for and the purpose of proposed case study

In the field of conservation-restoration of large scale objects, Ships represent one major issue. In fact, coming for archaeological, historical or even industrial context, the size of the object, its buoyancy (when still floated) and its technical features are rising great challenges.

The German Maritime Museum owns two 3D absolute coordinate measuring systems: a *Total Station*[1], electronic version of the traditional Theodolite, used on building sites and on archaeological excavation; and a Faro Arm[2], a portable machine used in the industry for quality control and various 3D inspections. Since almost a decade the Faro Arm became the standard for large wooden archaeological object documentation in Denmark (Esbjerg, Roskilde), Belgium (Project Doel Cog Antwerp) and United-Kingdom (Wales- Newport Ship Project).

The presented case study will set an example for the use of three scientific tools:

- *Total Station*
- Photogrammetry
- Local 3D Scans

The 1st action: will consist of a measuring campaign with the *Total Station* and will be done in and by the Museum for conservation matters. It will provide the best accuracy and will be performed 4 times a year, in the first year, and later on twice a year, starting at the end of 2014.

The photogrammetry will produce a 3D model with a surface visualization, which would help study the surface changes.

The local 3D scanning would support the result of the two first named methods and would allow us to fulfill more detailed measurement in problematic zones previously identified from the *Total Station* monitoring and or the photogrammetry.

Having three different data sets involving three different method, would also allow us to underline the strengths and advantages of each, which would lead us to data fusion. The fused data of the three methods will be combined and used to create a precise 3D model of the Cog.

In the field of Archaeology, the use of *Total Station* is largely spread. With this instrument, the data acquisition is counted in days. The challenge of fusing/registering it with other type of data would be a great step forward. The well spread software, Rhinoceros, used with the data produced by *Total Station* and Faro Arm technologies, will be also used in this case study.

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[1] http://en.wikipedia.org/wiki/Total_station

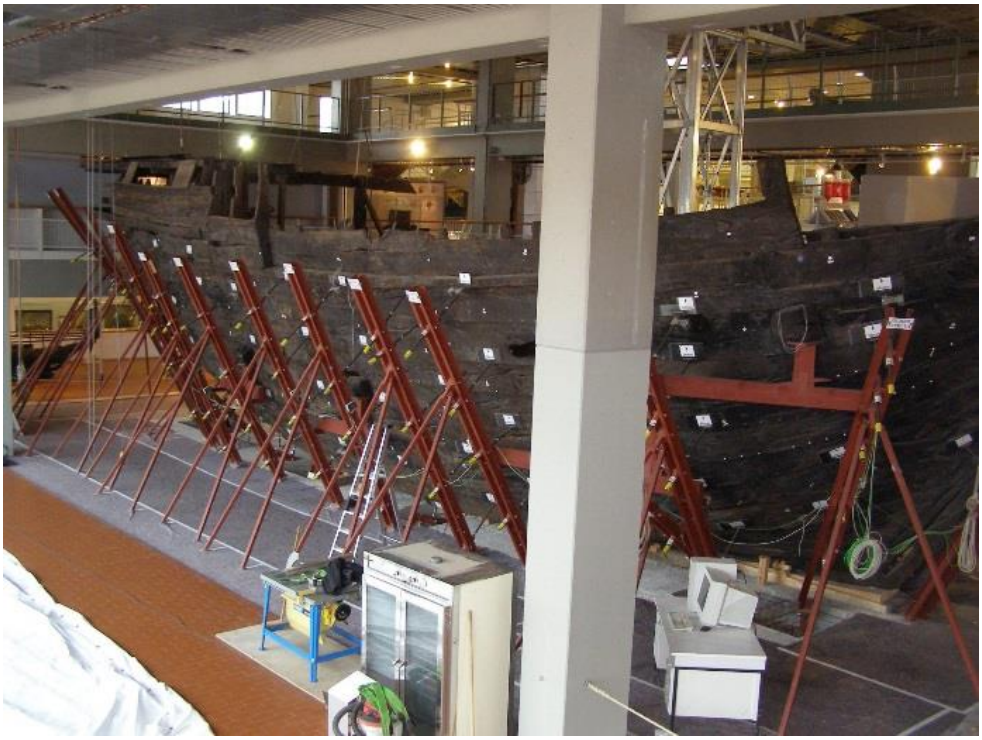
[2] http://www.faro.com/products/metrology/faroarm-measuring-arm/overview

Monitoring huge objects such as the Cog is a big challenge but is a must. The result of different research projects has shown that conserved wood still deforms after treatment. In Stockholm and Portsmouth, our colleagues use the *Total Station* to monitor the Vasa and Mary Rose. This however does not allow the detection of small scale deformation, which is necessary to predict large scale deformation and do not provide any surface visualization, which is also important for conservator.

One other important element in museums today is to be a “window to research”, moreover for a National Research Museum like the German Maritime Museum is, meaning a platform to interact with our visitors. The goal is to be able to present research results but also “on going” research. To achieve that goal, new technologies are an amazing great medium.

This case study will thus not only monitor the Cog with a *Total station* like our colleagues already do, but take the compiled data to visualize the ship. By using an additional 3D scan the 3D model will be a precise digital copy of the wreck, which offers many possibilities for further use. The 3D model can be shown to the public, while the wreck is covered during renovation, but can also serve as a ground stone for digital reconstruction.

Museum professionals must be active in the communication process with the visitors, this case study will built a strong link between conservators and visitors. Since the supporting construction around the Cog is currently aesthetical disturbing, it seems necessary to explain the method to our visitors. In fact the metal bearers cover up a large percentage of the objects surface and can therefore lead to a falsified experience if this is not clearly explained.



We aim to combine the work done by our team at DSM with the optical measurement techniques carried out by our collaborators of the COSCH network. Additional visitor’s

survey on the perception of the Cog as a wreck and 3D model can be carried out by the Leibniz Association for comparison purposes.

This project aims to contribute the data of three different scientific methods and the experience of monitoring and scanning a large scale spatial object within the COSCH European Network.

5. Contribution to the objectives of a particular COSCH Working Group, or Groups, and generally, to the COSCH Knowledge Representation Schema

This work could be of interest for the WG2 as it compares three measuring methods, the fusion methods of different data could be of interest for the WG3, as well as to WG4 in terms of documenting the conservation process and utilizing an imaging method for this purpose and finally for WG5 for the visualization of the object. It is also of interest for the COSCH^{KR} App and serves as a live experience of using the COSCH network for such a project.

This case study could be extended to other objects of the collection in order to validate the methods and datasets used.

6. Target users and their needs

Conservators and or archaeologists: Accuracy

Obtain valuable data about the object for further conservation measures; provide data for reconstruction.

Engineers: Feasibility

The Technicians and engineers involved in the project will profit from the experience of merging 3D data with the point cloud from the *Total Station* and various 3D imaging methods (Photogrammetry, 3D scanning).

Marketing in Museum: Compatibility with media

New visitor's magnet, a model of the covered Cog during renovation.

Museums curators: Costs

Museum educators: Compatibility with different public target groups (Adults, children, disabled people…).

Visitors: Participative Education

The visitors benefit from the case study since they get an explanation for the metal bearers and can experience conservation in the making. They don't just observe the exhibit but get to a deeper understanding for the needs of archaeological objects especially of that size.

Research questions:

- *Can the authenticity of the object be maintained by the digital model?*

- *How can we present a 3D model maintaining research accuracy and relevant museum education tool for the public?*
- *What could we learn from the fusion of heterogeneous data?*

7. Proposer:

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Amandine Colson, M.A. Restorer at the German Maritime Museum, Bremerhaven, Germany. colson@dsm.museum - +49 471 48 207 11

8. Other collaborators: (names, positions, affiliations, contact details; a letter of intent should be appended for each contributor)

Julien Guery, Geoarcheologist and Specialist of Photogrammetry, founder and co-manager of Compagny Captair, Dijon, France. julien@captair.net - +33 6 26 88 45 66

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9. Description, techniques and schedule of the work to be carried out:

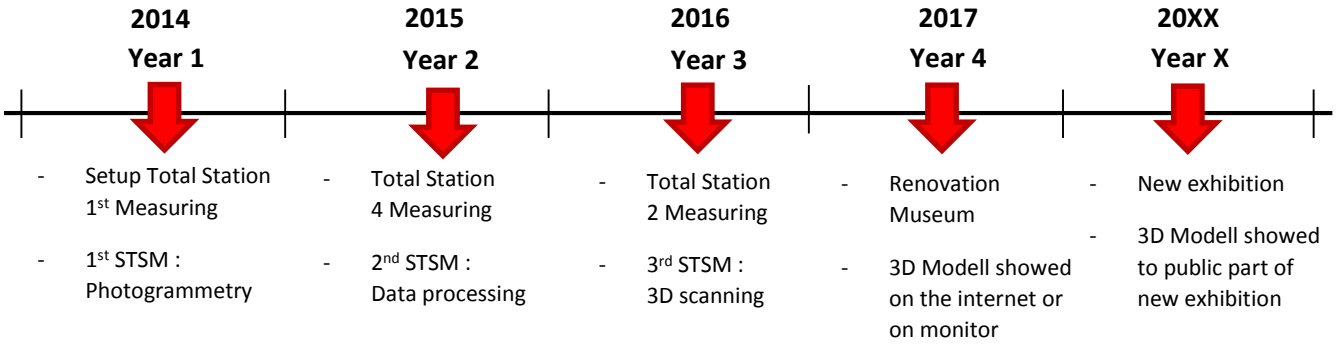
A PhD position is currently advertised on the museum's website concerning Research History of the Bremen Cog, which would for the first time collect all the documentation of the last 40 years, from the archaeological point of view to conservations-restorations matters. The goal is to prepare a new exhibition of the Ship after the renovation campaign.

4 Partners different tasks:
German Maritime Museum
University of Szeged
Captair
I3Mainz

- 2014
  - Setup measuring of *Total Station*
  - First outcome data
  - 1st STSM : Photogrammetry images acquisition

- 2015
  - 4 Measuring *Total Station*
  - 2nd STSM: Data Processing- Fusion *Total Station*/Photogrammetry, Zoltan Kato and Levente Tamás, University of Szeged

- 2016
  - 2 Measuring *Total Station*
  - 3rd STSM: 3D scanning of precise areas
  - Data Processing- Fusion *Total Station*/Photogrammetry/3D scanning
  - Taskforce Meeting: feedback from the COSCH community



10. Description of the main results expected, explaining potential benefits for users and how their needs are likely to be attended and solved

Our goals is to produce a 3D model where measurement accuracy and surface appearance are optimized. Building up relations between coordinate and image based technologies would allow us to make a step further and use the benefit of both for the good of Cultural Heritage.
This project combine experts needs, so as archaeologists, curators, historians and conservators, but also includes the public interests. Our final results would allow us to have an accurate model usable by specialists and visitors.

This model and the process of its development would be an interesting visitor attraction of the museum. The German Maritime Museum is a Research Museum of a Research Organization in Germany (the Leibniz Association), and shall be a window to ongoing research: an opportunity for the visitors to see being the scene. The museum reaches every year nearly 200.000 visitors in a touristic destination in the North of Germany.
The next step would be to conduct survey and ask our visitors their opinion about the model. This approach is already the focus of the Research Group about “Historical Authenticity” from the Leibniz Association, in which the Museum is involved since 2013 (Warnke/Colson).

This pluridisciplinary experience shall produce a precise dataset that would be shared with other technicians and or engineers to improve software and other devices.

We would like to be able to provide at the end of the COSCH action relevant guidelines for monitoring historical or archaeological ships in Europe.

11. Review of earlier relevant research, projects and literature

- Vasa Monitoring :

Jacobson, Jacob. “Measuring the Vasa.” In *The Built Environment*, 65:183–90. Proceedings from the International Conference on Maritime Cultural Heritage. Wessex, 2003.
Horemuž, M (2003): Deformationsmätningar av skeppet Vasa. SINUS, Number 3, pp 5-8
http://www.vasamuseet.se/en/Preservation--Research1/To-preserv-Vasa/Geodesy/

- *Mary Rose*, Monitoring

Medieval Ship conserved with PEG – Monitoring with Total Station and 3D Scanning. (Interview with Eleanor Schofield by Amandine Colson)
Schofield, Eleanor, Glenn McConnachie, and Mark Jones. “Air Drying of the Mary Rose Hull.” In *Proceedings of the 12th on Wet Organic Materials Conference Istanbul*. Istanbul, 2013. To be published

- *HMS Victory*, 18th Century Legendary Vessel from Admiral Nelson

Not published, as scientific articles. Visualization available on the Internet.
https://www.youtube.com/watch?v=QGXBtHDydJQ

- Faro Arm and 3D Models of Archaeological Vessels:

Nayling, N. and Jones, T. (2014), The Newport Medieval Ship, Wales, United Kingdom. International Journal of Nautical Archaeology, 43: 239–278

- Cog

Werner Lahn und Klaus Peter Kiedel, Zur Hansekogge von 1380: Beschreibung der ältesten erhaltenen Schiffstoilette. Mit allgemeinen Bemerkungen zur Entsorgung auf mittelalterlichen Schiffen, in: Deutsches Schiffahrtsarchiv 4, 1981, S. 9-16.

Gabriele Hoffmann und Uwe Schnall (Hrsg.), Die Kogge, Schriften des Deutschen Schiffahrtsmuseums Band 60, 2003.

Werner Lahn, Eine Koggewerft im 20. Jh., in: Gabriele Hoffmann und Uwe Schnall (Hrsg.), Die Kogge, Schriften des Deutschen Schiffahrtsmuseums Band 60, 2003, S. 66-75. Unveränderter Nachdruck aus: Informationen Nr.6 des Fördervereins Deutsches Schiffahrtsmuseum e.V., Herbst 1978.

Werner Lahn, Die Kogge von Bremen, Bd. 1, Bauteile und Bauablauf. 1992.

Wolf-Dieter Hoheisel, Die Kogge hängt, in: Gabriele Hoffmann und Uwe Schnall (Hrsg.), Die Kogge, Schriften des Deutschen Schiffahrtsmuseums Band 60, 2003,73.

Die Bremer Kogge, Hefte des Focke-Museums Bremen, Nr. 38, 4. Verb. Auflage: Rosemarie Pohl-Weber, I. Der Bergung der Kogge, S. 4-21; IV. Konservierung und Aufbau der Kogge, S. 36-40.

Siegfried Fliedner, III. Der Bremer Koggefund, S. 28-35

Rosemarie-Pohl-Weber (2003), Unterwasserarchäologie im Strom, in: Gabriele Hoffmann und Uwe Schnall (Hrsg.), Die Kogge, Schriften des Deutschen Schiffahrtsmuseums Band 60, 2003, S. 52-63.

Siegfried Fliedner (2003), Ein Jahrhundertfund in der Weser, in: Gabriele Hoffmann und Uwe Schnall (Hrsg.), Die Kogge, Schriften des Deutschen Schiffahrtsmuseums Band 60, 2003, S. 44-51.

12. Potential interdisciplinary value of research carried out and any other comments

The potential of interdisciplinary work is complete, the proposers and their partners come from a different field and research topic. The work with science communicators and the value for the visitors is ideal to promote the engineers and technical work.

13. Detailed schedule of proposed work with explanation how each phase is to be funded

The acquisition of the point cloud will be done by the museum team and be part of the costs of the museum.

The 2nd phase consisting of the acquisition of image and the data processing, will be done by Julien Guéry, COSCH WG4 which should be funded by a Short Term Scientific Mission.

The 3rd phase: fusing data from the *Total Station* and from the photogrammetry images will be done by a team member of the University of Szeged, funded by a Short Term Scientific Mission to get the final 3D Model for the use of the conservators and for the exhibition.

4th Phase: Local 3D Scans: funded by a Short Term Scientific Mission

So the costs will be covered via:

- Internal funding German Maritime Museum, Captair, i3Mainz and University of Szeged
- STSM by the COSCH