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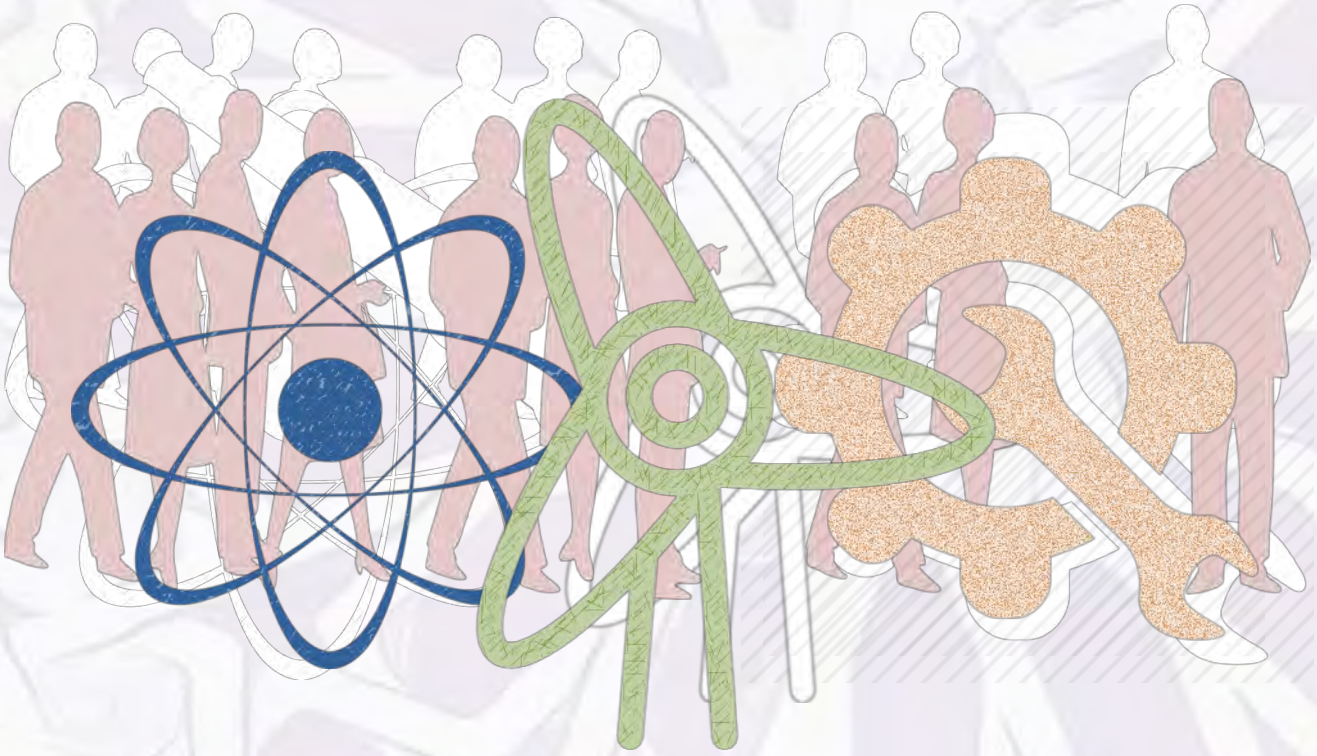
45th Conference of CIMUSET

International Committee for Museums & Collections of Science & Technology

Technical Heritage & Cultural Identity



CNRST - 5th- 8th December 2017

Rabat, Morocco

Ech cherki DAHMALI

Technical Heritage & Cultural Identity

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International Committee for Museums & Collections of Science & Technology

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CIMUSET, the first time in AFRICA

The 2017 CIMUSET annual conference was held for the first time, and for our greatest honour, in an African country: in Rabat City, a World Heritage site and the capital of the Kingdom of Morocco. We were very pleased to welcome our friends and colleagues, in Telecommunication Museum of Maroc Telecom and the Moroccan National Center for Scientific and Technical Research.

Participants came from thirteen counties: Australia, Brazil, China, Denmark, Finland, France, Germany, Hungary, Japan, Morocco, Poland, Slovakia and Slovenia.

CIMUSET 45th Conference debated around a topical theme witch concerns all technical-scientific museums and science centres in the world: "Technical Heritage & Cultural Identity". It was noted that this topic stimulated a particular interest among CIMUSET 2017 participants. This conference was a real forum of exchanging different ideas about the relationship between technical heritage and our different cultural identities. Discussions were very rich between participants and also with Moroccan students in cultural heritage who participated in this conference as volunteers.

The opportunity was given to our colleagues to shear their professional experiences and especially their success stories in the promotion and interpretation of their technical heritage.

Our guests spent also an intense moment, during our "extra muros" activities, in discovering and enjoying the richness and diversity of the Moroccan ancestral heritage.

I wish you a pleasant reading of CIMUSET 2017 conference publication.

See you in our next conference in Ottawa, Canada, October 2018.

Ech cherki DAHMALI
CIMUSET Chairperson
Director of Telecommunication Museum of Maroc Telecom

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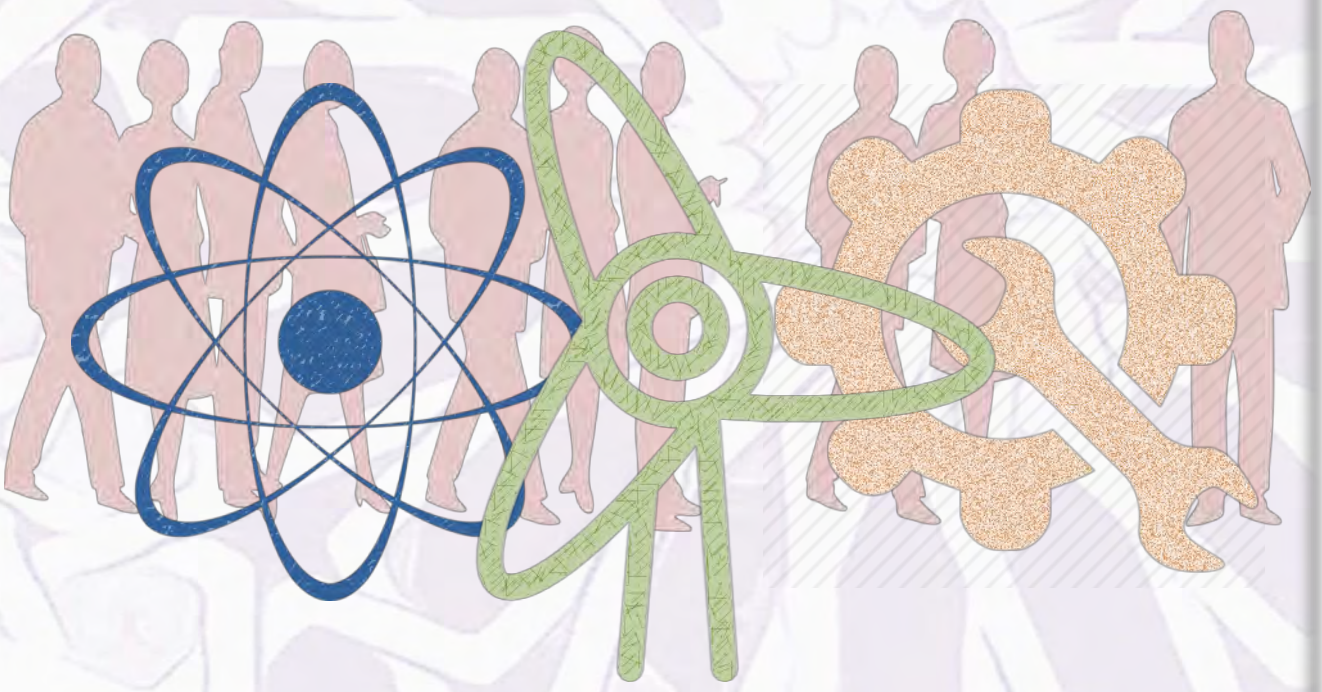

"Technical heritage & Cultural Identity"
CIMUSET 2017 Conference Them

Industrialisation, infrastructure constructions and housing projects have destroyed many historical sites and started transforming many landscapes and effectively delete significant industrial and technical heritage. The majority of former industrial sites have been rebuilt as commercial buildings or became residential areas with no association with previous functions and times. Hopefully, some sites of this valuable technical heritage have been preserved as open air museums trying to preserve and represent the forgotten glory of industrial times through different conservation efforts and exhibition plans.

CIMUSET 2017 conference theme is composed by two significant expressions:

- Technical Heritage: it refers to the physical remains of the history of technology and industry, old factories, mining sites, water-powered mills, warehouses as well as power and transportation infrastructure...
- Cultural Identity: most common definitions of Cultural Identity presented it as a feeling of being included to a group or culture.

According to those definitions, we can have the following questions:

- Do we have any sympathetic felling towards technical and industrial heritage?
- How can technical heritage be a part of our cultural identity?
- Can we consider technical heritage equally important as the other cultural heritage elements (Archaeology, Ethnography, Natural Science…)?

The conference theme referred also to a factual situation of the "colonial" technical heritage in many countries. In fact, during military occupations, different industrial constructions and infrastructures were built by "others" nations (especially in the end of the 18th- 19th century and between the 1st & 2nd world war). The question is: can we consider this legacy as a part of our identity, although we know that independence was peaceful in some areas, and achieved only after a protracted revolution and armed confrontation in other areas. In other words: How can we change this connotation from a "colonial" heritage to a National Heritage?

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M. Abdelmalek Azizi obtained a Ph.D. at Laval University (Canada) in April 1993 in Number Theory. Since this date, he supervises the organization of the Doctorates studies in class field theory and it's applications in Cryptography at Mohammed Premier University at Oujda Morocco. He has several publications published in international reviews (AMS Transactions, AMS Proceeding, Acta Arithmetica, International journal of number theory, Journal of number theory, Cryptologia...). He was Lecturer and invited Professor in several countries (France, Canada, Japan, Italy, South Africa, Kuwait, Germany, USA, Turkey, EAU, Saudi, Indonesia ...), reviewer and organizer of several international conference and summer schools. He is member of several Societies (Hassan II Academy of Science and Technology(2006-2014), American Mathematical Society (AMS), European Mathematical Society (EMS), Moroccan Association of Cryptography (AMC), ,...). Currently, he directs the Center for Doctoral Studies in Science and Technology at Mohammed 1st University.

Abstract:
"Arabic Scientific and Technical Heritage"
The birth of the Muslim Empire had been accompanied by an intellectual development in all ancient scientific fields as well as in the new knowledge which had begun to be formed at that time.
Several other scientific and technical accomplishments were registered in Morocco, such as the notion of a symmetry in geometry which had been used in pavements or Zeliges in several places as in Alhambra of Grenada. Since Saadien dynasty, Moroccans had acquired some technical Material together with the knowledge of how to use that material, in several industrial domains and from several Arab or European countries.
Unfortunately, we find few scientific or technical centers or museums, in the Muslim world, which are devoted to recovering our scientific and technical inheritance, repairing or restoring it. A lot of scientific and technical ideas, however, remains to discover in old books and manuscripts which are abandoned in old family libraries or are still missing.

Arabic scientific and technical Heritage

Abdelmalek Azizi, Mohammed 1st University, Oujda, Morocco

To the memory of Pr. Driss ABOUTAJEDDINE, Director the CNRST

The birth of the Muslim Empire had been accompanied by an intellectual development in all ancient scientific fields as well as in the new knowledge which had begun to be formed at that time.
As for socio-economic needs encountered, among others, while dealing with certain problems of heritage, commerce, linguistics and astronomy, the Arabs had approached several scientific questions in all fields and left us with a golden Heritage in all areas of science and technology such as in Mathematics, Cryptography and communication systems, medicine, physic and chemistry and their technical applications (Clocks; astrolabes; water pumps, ...) as well.

1- Mathematics

Thanks to the work of Al Khawarizmi (~ 783-850) in Algebra and Arithmetic, and especially his contributions in the study of 2nd degree equations, in the development of calculus techniques based on the use of the decimal system and in his gradual manner of resolving problems step by step in a clear order, his name has famously become used in computer science as algorithm; other works of his have been recorded in the Middle East, in Egypt, in the Maghreb and in Andalusia. In particular, we find the remarkable work of Thabit Ibno Qurra (836-901) on the amicable numbers, the works of Abu Kamil (m.930) and those of al-Karaji (1029) in Algebra and Al-Khayam's (1048-1131) on the equations of the 3rd degree.
In the 10th century and after the birth of the first dynasty in Morocco, referred to as the Idrissid dynasty, Moroccans (traders, military, and politicians), had been interested in developing Algebra, Arithmetic, the writing of the integers by means of using new symbols clear or not, ... Then, many results were established by Ibn Al Yassamin (…-1204), Ibn Muneim (…-1228), Al-Hassan al-Marrakchi (…-1262) ,
Ibn Al Banna (1256-1321), Ibn Ghazi al-Meknassi (1437-1513) and others. In particular, Ibn al-Banna's books that include the following results:

Combination of n letters p to p	$C_n^p = \sum_{p-1}^{n-1} C_k^{p-1}$
Switching n letters	$P_n = n!$
Permutation of n letters with repetition of p letters k_1, k_2, ..., k_p times	$P_n^r = \frac{n!}{k_1!k_2!...k_p!}$
Different readings of a word of n letters by swapping vowels and sukun	$S_n = 4S_{n-1} - 3S_{n-3}$
Arrangement of n letters k to k with vowels and sukun and their arrangement in tables	$A_n^k = S_k.P_k . C_n^k$
The formula long attributed to Pascal (1623-1662)	$C_n^p = \frac{n-p+1}{p} C_n^{p-1}$

We find also in the books of Ibn Al Banna several other questions that had been studied in Algebra and Arithmetic such as the characterization of natural integers which can be written in the form of a sum of two squares of integers. In this respect, Moroccans knew that at least the prime numbers congruent to 1 modulo 4 verify this property. The reciprocal of this last proposition was proved in the beginning of the 20th century.

AlKhawarizmi (783-850)

Ibn Al-Banna (1256-1321)
Kitab Raf al-hijab an wujuh a'mal al-hisab

Ibn Al-Banna (1256-1321)
Calculus Tables

Ibn Al Yassamin (?- 1204)
Poetry in Algebra

1. Examples of Arabic contributions in Mathematics

2. Cryptography and communication systems

The use of difficult or unconventional notions to establish Cryptographical algorithms was a tradition among Arab Cryptographers. They used, among other things, poetry as transmission means and used, for example, the difficulty of writing verses of poetry (or pieces of verses) according to a given model or verses that can be read from right to left and at the same time from left to right as the basis of Cryptographic Algorithms. Thus, Arabic poetry was a means of transmission, information, advertising and cryptography.

The Arabs used cryptography even before Islam; but the pillars of Arab Cryptography were built by Al Khalil (718-786) and Al Kindi (801-873). Other Arab scholars had written important documents on Cryptography, including Ibn Dunainir (1187-1229), Ibn Adlan (1187-1268), Ibn Ad-Duraihim (1312-1361) and Al-Qalqashandi (1355-1418).
The Moroccans, following the study of certain linguistic, mathematical and astronomic questions, had developed several cryptographical methods for sending secret messages (military, diplomatic, scientific, distractions). In particular, they had used, for this purpose, the following methods:
i. Methods of substitution and transposition: among these, we find the method which consists of coding the letters by names of birds and after coding the letters, we put the coded text in a poetical form.
ii. The use of the function h, "hissab Al Jommal", to encrypt short messages: the message to be encrypted is transformed by the function h; we obtain a number which is decomposed into a product of two numbers n and m. Then we look for sentences P1 and P2 such that h (P1) = n and h (P2) = m and the multiplication symbol is replaced by its equivalent in Arabic. We thus obtain a text that can constitute the encrypted text (Cryptography of gold invented by the Sultan Ahmed El Mansour, Saàdian Dynasty, at the end of the 16th century).
iii. The third method consists in using the numerical coding by position: it is based on the use of a text that is inserted in a grid, where a letter is replaced by three digits which represent a position of the letter in the grid (it is thought that this method was used to encrypt messages in the 18th century, though we have no proof but we find examples of coding of clear texts with this method).
iv. The fourth method is Telegram secret writing which was used towards the end of the 19th century: it consisted in giving numerical values to the different letters of the alphabet and then transforming the clear text by numerically coding the letters and separating them by a point. The digits are coded by the same numbers with a bar at the top. In addition, some important names or words or phrases have been coded by numbers. This method had been used by the Moroccans, at the end of the 19th century, to write messages of telegram.
v. Use of the function "Hissab Al Jommal" to sign, to leave a digital imprint or to code the name of the author: this was used by some poets especially in the poems of al-Malhoun.
vi. Use of signatures by steganographical methods: this method hides the letters of the author's name in a poetry such as the first letters of verses of poetry or as the second letters of the words of a verse...
vii. Use of special coding of numbers (*Al Kalam al-Fassi*) by judges and by notaries for safeguarding financial or inheritance acts against the possible forgeries:
For more information on his methods, see [5], [6], [7] and [8].

The Sultan Al Mansour
Secret writing letters
Morocco, end of 16th century

Fès Numbers

Ahmad Al Ghazal(..-1777)
Coding using poetry in
Morocco

Secret writing Telegram Manuscript
Morocco, end of 19th century
« ..., *to write by using numbers is the best way to keep a secret we adopted the following method….* »

2. Examples of Moroccan Manuscripts on Coding and Cryptography

3- Medicine

Many theoretical and practical achievements by many scholars, such as those by al-Farabi (950) and Ibn Sina (1037) in the Mashreq, or Ibno-Anafis (1211-1288) in Egypt and Zahraoui (10th-11th centuries) In Andalusia.
Thus, the discovery of the pulmonary circulation by Ibno al-Nafis is a remarkable contribution.

Ibn Al Nafis
(1213-1288)

Abû al-Qâsim Khalaf ibn
al-'Abbâs al-Ansari al-Zahrâwî
(936-1013)
Kitâb al-Tasrîf li-man 'ajiza 'an al-ta'alîf

Ibn al-Baytar (1197–1248)
Kitāb al-Ǧāmiʿ li-mufradāt
al-adwiya wa-l-aġḏiya

Ibn al-Baytar
(1197–1248)
Kitāb al-Kafi

3. Examples of Arabic contributions in Medicine and pharmacology

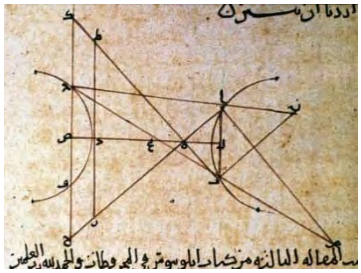
4- Physics, Alchemy and their applications:

The Arab world had made a remarkable development in physics (Optics, mechanics, ...) and Alchemy. This development had yielded its fruits mainly in the technological applications throughout the Arab world from the Mashreq to the Maghreb.

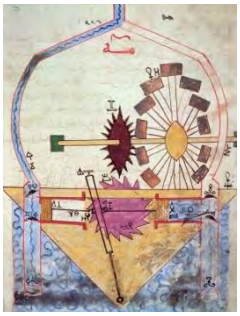
4- Physics, Alchemy and their applications

The Arab world had made a remarkable development in physics (Optics, mechanics, ...) and Alchemy. This development had yielded its fruits mainly in the technological applications throughout the Arab world from the Mashreq to the Maghreb.
This was reflected in the following findings:
- The still and the hydrodistillation in Alchemy,
- The light ray by Ibn Al Haytham (965-1041),
- The (hydro) water pump of al-Jazari (m 1206),

Gabir Ibno Hayan(Geber 722-815)
& his successor Al-Razi (Rhazes 864-925)
Experiments of the distillation process



Ibn Al Haytham(965-1041)
work on the light ray



Al Jazari (…-1206)
Manuscript of his pump

Al Jazari (…-1206)
Book of "knowledge of ingenious mechanical devices"

4. Examples of Arabic contributions in Physics, Alchemy and their Applications

- The astrolabe from al-Khawirzmi to al-Zarqali (11th c.), al-Hassan al-Marrakchi (…-1262) and the Moroccan al-Roudani (17th c.),

Maroccan Astrolabe
(Almohade 1217)

Maroccan Astrolabe
(Alaouite 1720)

Brass astrolabe quadrant
Profatius-Type, by 'Abdallah Ahmad b. 'Ali al-Andalusi, Morocco (1804)

Globe Celeste
With Arabo-Kufic letters, probably built in Morocco , 11th century

5. Examples of Moroccan contributions in Astronomy

- The marvelous clocks: from the Elephant clock of al-Jazari from the 13th century to the water clock of Madrassa Albouanania from the 14th century through the Al-Qarawiyyin clock from the 13th century.

Al-Jazari's Elephant Clock
13th century

Al-Qarawiyyin University
Clock, Fez Morocco 1286/87

Dar al-Magana (water clock)
Fez Morocco 1310 - 1331

6. Examples of Arabic ingenious Clocks

5. Other Disciplines

Several other achievements or discoveries had been made in the Muslim world; we mention for examples:

- The first geographical map by the Moroccan geographer Al Idrissi (m 1165).
- The Moroccan world explorer Ib Battouta (1304-1377).
- Volumes of philosophy and religion of Ibno Rushd (Averroes (1198).
- Volumes of sociology (The Introduction), the father of sociology Ibn Khaldoun (1406).

Al Idrissi
(1100-1165 or 1175)

Ibn Battouta
(1304-1377)

Ibno Rushd-Averroes
(1126-1198)

Ibn Khaldoun
(1332-1406)

7- Examples of other distinguish Moroccan Scientists

Conclusion

Several other scientific and technical accomplishments were registered in the Muslim world and in particular in Morocco, such as the notion of a symmetry in geometry which had been used in pavements or Zeliges in several places as in Alhambra of Grenada (pavement of the space plan in almost 17 different manners and which were all found in Alhambra), the sundial that Al-Hassan Al Marakchi had studied and where he had written, in his book " Jamae al-Mabade ' wal Ghayate fi Ilm al-Miqate ", a chapter on his practical construction. Since Saadiens, Moroccans had acquired some technical Material together with the knowledge of how to use that material, in several industrial domains and from several Arab or European countries.

A lot of scientific and technical ideas, however, remains to discover in old books and manuscripts which are abandoned in old family libraries or are still missing.
Unfortunately, we find few scientific or technical centers or museums, in the Muslim world, which are devoted to recovering our scientific and technical inheritance, repairing or restoring it. It is true that there are attempts of recovery or restoration as Al Karaouiyine's clock and the clock Al Bouenania in Fes, but this remains insufficient.
Our scientific and technical Inheritance is a very important part of the history of our intellectual development which we have to integrate into the programs of our fundamental and technological education and this is done with the hope of allowing the young people to touch the theoretical ideas and the practices of their ancestors to understand them and be inspired by them and do better.
Our scientific and technical inheritance contains many ideas, methods and brilliant practices. With the discoveries of the 12th century, the old ideas, the methods and the practices can be developed to give extraordinary results. For example, we have taken certain ideas of cryptography of our old manuscripts and by means of the computing one can notice brilliant methods of cryptography.
It is also true of the technical instructions which were used to the manufacturing of certain instruments and devices; we can reconstruct them to keep them in museums or in scientific and technical centers or improve them and put them in the market.

References:

1- Al Iraki, A. *Ahmed El-Ghazal literary papers*, Imprimerie Info-Print, Fès Maroc, 1999. (in Arabic)

2- Al-Hassani Salim T.S., *1001 Inventions : The Enduring Legacy of Muslim Civilisation*, Third Edition, National Geographic, Washington, D.C.,

3- Alkhateeb Firas, *Lost Islamic History*, HURST & Company, London, 2014.

4- Al-Manouni, M., *The Aspects of the Beginning of the revival of the new Morocco*, Imprimerie Omnia Rabat 1973. (in Arabic)

5- Azizi, A. Azizi, M. et Ismaili, M.C., *Livre de recherche « Cryptographie : de l'histoire aux applications »*, *Ecole CIMPA de Cryptographie Oujda 2009*. Travaux en cours 80, Hermann Editions 2012.

6- Azizi, A., *Histoire de la Cryptographie Arabe au Maroc. Chapitre du livre « Cryptographie : de l'histoire aux applications »*, Travaux en cours 80, Hermann Editions 2012..

7- Azizi, A. and Azizi, M., *Instance of Arabic Cryptography in Morocco*, Cryptologia, 35:1, pp. 47-57, 2011.

8- Azizi, A. and Azizi, M., *Instance of Arabic Cryptography in Morocco II*, Cryptologia, 37: 4, pp. 328-337, 2013.

9- Ibrahim A. Al-Kadi, *Origins of cryptology: The Arab contributions*, Cryptologia 16 (1992), 97 – 126.

10- Djebbar, A., *Les Mathématiques au Maghreb à l'époque d'Ibn Al-Banna*, Actes du Congrès International Mathématiques et philosophie, Rabat 1982. Editeurs l'ARMATTAN Paris et OKAD, Rabat 1987.

11- Djebbar, A., *Une histoire de la science arabe*, Editions du Seuil, 2001.

12- Djebbar, A., *L'Algèbre arabe, Genèse d'un Art*, VUIBERT-ADAPT, 2005.

13- Djebbar, A., *Les découvertes en pays d'Islam,* Editions Le Pommier Paris 2009.

14- Mrayati, M., *Meer Alam, Y. and At-Tayyan*, M. H., *Arabic Origins of Cryptology*, Vol. 1, 2, 3 and 4, Published by KFCRIS & KACST, Riyadh 2003.

15- Kahn, D., *The Codebreakers: The Story of secret Writind*, New York Macmillan, 1967.

16- Abdelhadi Tazi, *Les Codes Secrets des correspondances Marocaines à travers l'histoire*. Librairie Almaarif Aljadida, Rabat 1983.

Jytte THORNDAHL
Vice-Director, The Danish Museum of Energy

Mrs Jytte Thorndahl is the former President of CIMUSET (2010-2016). She is responsible for Collection and Research at the National Museum of Energy in Denmark since 1987, and Vice-director of this museum between 1988 and 2017. She has a magister Artium of Social Anthropology, from the University of Aarhus in 1977, with ggraduated studies from Cornell University, Ithaca New York, USA 1974-1975.
She was a lecturer and teaching assistant at Social Anthroplogy Department of Aarhus University and external examiner at the Saxo Institute (European and general Ethnology), University of Copenhagen. Between 1985-1987 she was associated in curatorial activities at Moesgaard Museumin Århus with the exhibition 'The Dane and the noble Savage'.(Danskeren og den ædle vilde). In 2016, she was officially approved by Ministry of Culture in Denmark as "Researcher in Cultural History". Jytte THORNDAHL is an author of 11 books and more than 50 articles about Social Anthropology and history of science & technology.
Jytte Thorndahl was the head of the organising committee of the 36th CIMUSET conference in Denmark (25th – 31st August 2008).

Abstract:
" The green changeover of industrial society towards sustainability and energy saving ways of living"
Industrial societies are turning more green these years. There is a changeover in technology and ways of living. Sustainability and green changeover are buzz words for present development not only in Denmark, but also internationally. ... Climate change, global warming, carbon foot prints and CO2 outlet are words that children as well as adults should know and learn through different medias. How can we as museums deal with these new challenges within research, collecting, exhibitions and in guiding and teaching students....I will tell how we at the Danish Museum of Energy try to work with these problems in different ways. The museum has developed a new strategy to cope with these problems – and try out new ways of informing the visitors, as well as planning research about the green changeover – to see how citizens act daily in sorting garbage, using public transportation, tens to save energy with new appliances, changing diets into more green and less meat, growing and buying organic food..

The green changeover of industrial society towards sustainability and energy saving ways of living

Jytte Thorndahl, The Danish Museum of Energy

Industrial societies are turning greener these years. There is a changeover in technology and ways of living. Sustainability and green changeover are buzz words for present development not only in Denmark, but also internationally. In 2014 the Danish Government launched a new strategy "A sustainable Denmark – development in balance". Climate change, global warming, carbon foot prints and CO_2 outlet are words that children as well as adults should know and learn through different medias. How can we as museums deal with these new challenges within research, collecting, exhibitions and in guiding and teaching students.

The green changeover is far reaching from changes of technology providing energy from using fossil fuels into renewable energy as wind, water, biofuel, solar energy and change of life style with eating more locally grown food, spending less energy for transportation etc.

It is very hard for the Danish citizens to understand all these changes and especially the green changeover. A survey showed that every second woman did not know about it and only three out of ten men knew anything about this change. But the majority found it very important to follow this path and 78 % wanted to have a sustainable and energy-saving life.

I will tell how we at the Danish Museum of Energy try to work with these problems in different ways. The museum has developed a new strategy to cope with these problems – and try out new ways of informing the visitors, as well as planning research about the green changeover – to see how citizens act daily in sorting garbage, using public transportation, tends to save energy with new appliances, changing diets into diets containing more vegetables and less meat, growing and buying organic food.

The purpose and strategy of the museum

The museum of Energy is the Danish center of experience and dissemination of energy, future solutions of energy and the green changeover. The center is built on the foundations of the traditional museum. The vision is to turn knowledge into exciting and interesting material for everyone in order to engage and inspire to a more sustainable development. We stimulate Danes' interest in technical and scientific fields with focus on energy, climate and green change. We should stimulate and create interest among children and young people to start and education within science and technology. After visiting the Danish museum of Energy terms like sustainable energy, green change, CO_2 outlet and climate change should make more sense to the visitors. The board of the museum have agreed that this would be the best way for the museum to follow – not a least in order to find partners and funding in business and industries and to attract more visitors.

Focus on green change

Reducing energy consumption, reducing CO_2 emissions and switching from fossil fuels to renewable energy is necessary to ensure a sustainable planet for the future. At the Danish Museum of Energy this should be disseminated in new, exciting and inspiring ways through, exhibitions, events, guided tours, dialogue, seminars, research and publishing.

Exhibitions

Let us look at the exhibitions. In 2016 we opened an outdoor exhibition in four containers and a truck, the subject was to tell about the carbon footprints from the transportation of our daily groceries – for example an I-pad, a T-shirt and tomatoes.

The total amount of CO_2 that some grocery emits is named its carbon footprint. CO_2 - prints - follow your own footprints. In this exhibition you can see the carbon footprints of tomatoes, t-shirts and electronics. A very popular product sold in large quantities is the iPad. Apple has calculated that an ordinary iPad during its lifetime emits 210 kilos of CO_2 corresponding to driving a trip from the most northern site in Denmark, Skagen to Milan in an average car.

Clothes are a gigantic industry. Every year we buy 16 kilos of new clothes as an average. Cotton is the main component in most clothes and most t-shirts and grows on plants. The cotton plant grows in big fields in Asia and Middle America, and needs heat and water in order to grow. After harvesting the cotton, it is cleaned, washes and often colored, before it is turned into fabric and made into t-shirts. Often these processes happen in countries as Bangladesh and Vietnam, where wages are low.

The finished t-shirts are transported by ships and trucks to Denmark, where they are sold in the shops to the consumers. After wearing clothes get dirty. We wash and dry it - wear it again and in the end donates it to recycling or throw it out. An ordinary T-shirt pollute the environment with 2,44 kilos of CO_2. This corresponds to driving 25 kilometers in an ordinary car.

The growing of one kilo of Danish tomatoes emits 9,54 kilo of CO_2, corresponding to driving a car from Aalborg to the Danish Museum of Energy in an average car.
The growing and transportation of one kilo of Spanish tomatoes emits only 0,78 kilo CO_2, corresponding to driving an average car 5 kilometers.

2017 we opened a garden of energy outside our main building

At the museum we have now: Goats in a fenced area, 2 small biogas plants using manure, green waste etc. High beds with vegetables, flowers, different fruits, different spices. An open fireplace for dialogue and cooking, a large tent, a Nordic Lavu for eating, sleeping and dialogue. We have also separation of waste into green, paper, plastic, metal etc.
The garden of Energy is an attempt to show a simple circle of energy – plants absorb the CO_2, people and the goats eat the vegetables and fruits; manure and green waste can be used for biogas (energy for cooking and heating), and the left over from the biogas can be used as manure for growing the vegetables.
We have events and daily programs for school children. Drawing a green circle – green trees and plants, animals, manure and meat, bio energy, Cooking a meal with chicken and vegetables
They can also learn by playing with water, building small wind mills
We also hold events for families: Roasting insects that you can actually taste, serving soup made of Danish vegetables of the season – carrots, parsnip, beets, Jerusalem artichokes, parsley, etc. all locally grown with a minimum of CO_2 outlet. When meeting the audiences personal dialogues with the visitors are very important – we talk and tell about the future possibilities of obtaining protein with less carbon footprints – eating less meat from cattle and lots of green – replacing meat with insects, mussels, chicken to have smaller CO_2 outlet. And most important it should also be fun to visit the museum – so you can take time off to blow big bubbles or use some energy in one of the trampolines.
We also have events on electric transport, for example electric vehicles and segways and electric bicycles that you can try out.

Events and activities outside the museum

Several towns and municipalities in Denmark have chosen specific green strategies for the future of the citizens. Our museum is also involved in such activities for example in the next largest city in Denmark ,Aarhus. At the harbor site the museum planned and opened a small exhibition in containers about climate change and green ways of living. We also offered guided tours for school children in Aarhus in a specific week of September telling about the central heating system, electricity and separation of waste. This was followed up by spectacular science shows 2 time a day close to the town hall where several hundred people took part every time.

Concerning a strategy for collection

In the years to come we focus on the green change and saving energy. So we should collect items for renewable energy production: like wind turbines, panel for solar energy etc. And energy saving appliances such as freezers, refrigerators, LED lamps, electric cars and means of transportation. We will try and collect icons – most remarkable items like one of the wind turbines from the worlds very first off shore park – which happened to be in Denmark. We managed this year with a 450 kw wind turbine from Vindeby off shore which had been producing electricity for 25 years before their retirement.

Research project

For the museum I have applied for funding and also obtained funding for a research project of 10 months which will be carried out next year – the title is 'Living and practicing green change among the citizens of Aarhus'. We got the money and I will start out in January 2018. I will focus on not so much what people say they would like to do, but try to find out what they have done as such and are actually doing in the daily life. And thus using the concept of social practice from sociology and social anthropology*. Working closely with the office and Climate secretary of the town of Aarhus, I will be looking at energy savings in heating, electricity, water and transport, waste sorting, change of eating habits, habits of recycling etc.

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* Shove, Elisabeth, Pantzar, Mike & Watson, Matt: The dynamics of Social Practice. Everyday life and how it changes. London 2012.

The "Museum Ship" Mannheim: A case study in how to safeguard technical heritage via complementary exhibitions and events

Hartwig Lüdtke , Technoseum Mannheim, Germany

TECHNOSEUM

The largest item in the TECHNOSEUM collection is an old steamship built in 1929 and known today as the "Museumsschiff Mannheim" (Museum Ship Mannheim). Anchored in the Neckar River, this well-preserved paddle steamer stands as a prominent example of the region's rich industrial heritage. It operated as a pleasure boat on the Rhine well into the 1980s and today fosters insights into two key aspects connected to the river: on the one hand, it examines the history of shipbuilding, maritime trade and the on-board lives of skippers and their families; on the other hand, it explores the history of tourism and especially the nostalgic atmosphere enjoyed by visitors in the second half of the 20th century on trips down the Rhine on 'old-timer' vessels. The TECHNOSEUM is eager to highlight both of these aspects of the region's industrial heritage.

Since 1986, the Museum Ship has been moored at a pier in the city of Mannheim. The steam engine is still in working condition, that is, it can be used when necessary and for special outings. Visitors are inevitably fascinated by the vessel's old machinery and can walk around the old steam boiler and coal bunker downstairs. Upstairs one finds the pantry – best described as a kitchen –, which was used to prepare meals for the up to 2,000 boat-trip passengers. At the very top of the vessel is the ship's steering wheel, where all visitors are invited to take the helm, look out over the water ahead and imagine they're a brave ship's commander.

However, if one takes a closer look, one will see that many parts of the vessel are in poor condition. In some cases, the only thing lacking is a coat of varnish. In other cases, however, parts of the wall are damaged, the wooden construction is in need of repair, the steel is faltering and the surface is flaking off. Over time, many of the walls have become rusty and weak. At this point, it becomes dangerous when a pole or any similar special device – such as a handrail – becomes loose. The TECHNOSEUM is responsible for repairing all these damages so as to ensure the safety of both the vessel and its visitors.

Today, we have a team of volunteers who perform regular work on the ship. We couldn't be happier to have this group of men and women, seeing as there is a lot of work they can take on as volunteers, including cleaning, painting and the like. Unfortunately, there are other issues that can only be solved at a shipyard or dockyard. Every ten years, the vessel has to be lifted out of the water for special repair work necessary to preserve its heritage: the underbelly of the vessel is cleaned, weak parts in the walls mended and other elements fixed. Every year, the TECHNOSEUM faces the challenge of generating the money required to keep this vessel alive and kicking. The museum is funded almost exclusively by the State of Baden-Württemberg and the City of Mannheim, that is, by taxpayers.

Therefore, in order to increase the ship's recognition and attractiveness among the general public, the TECHNOSEUM organises various activities designed to boost the boat's visibility and prestige.
First of all, the museum created a permanent exhibition aboard the vessel itself. This exhibition presents information about the ship's history, the history of river trade, scuba diving, shipbuilding and other related topics. Second of all, a small "science centre" was created on board that examines water-related themes. Young visitors are invited to experiment with a small floodgate or sluice. School groups are encouraged to fetch water from the river and examine it under a microscope to see what kinds of animals live in the Neckar. Kids can even take various measurements to find out more about the quality and volume of water in the river.
The ship also features a number of other highlights, including a small on-board restaurant where visitors can have lunch or dinner. Indeed, when people experience the fascinating atmosphere of an old steamship, they are more likely to come back to visit the exhibitions. And, last but not least, the ship is used as a music venue during the summer months, sometimes with opportunities to dance as well. The ship has space for 150-200 people who are invited to enjoy pleasant summer evenings on board starting with a visit to the exhibition, then dinner in the restaurant and, to top it all off, a concert featuring music from all over the world.

As already mentioned, our museum staff works to preserve this old vessel as a unique example of our industrial heritage. In order to gain further visibility and acceptance among the public and taxpayers, the TECHNOSEUM organises various exhibitions, a small, water-themed science centre, a restaurant and a range of musical performances. For all of these reasons, we expect to keep this trusty old ship thriving for a long time to come.

Brief history of the National Museum of Nature & Science its role as a communicator of industrial-scientific heritage to the public

Wakabayashi Fumitaka, National Museum of Nature and Science of Japan

Abstracts

National Museum of Nature and Science (*KAHAKU*) was founded in 1877 as "Education Museum" at Ueno Park, Tokyo, Japan. In the same year, the first Japanese National Industrial Exhibition was held in the park. The Museum's name changed to "Tokyo Science Museum" in 1931 because the importance of science and technology was recognized by both Japanese Government and Japanese people after the World War I. In that year, a new main building was built at another site in Ueno Park. This building is now called "Japan Gallery" and was designated as Important Cultural Property of Japan in 2008. The Museum's name further changed to "National Science Museum" in 1949. In 2007, its English name has changed to the present name because the Museum treats both the natural history and the history of science and technology comprehensively. Its organization consists of Administration Department, Museum Activity Development Department, five research departments, *i.e.*, Zoology, Botany, Geology and Paleontology, Anthropology, and Science and Engineering, and three research centers, *i.e.*, Center of the History of Japanese Industrial Technology, Center for Collections, and Center for Molecular Biodiversity Research. A new and large exhibition building (now called as "Global Gallery") was opened partly in 1999, and fully in 2004. In 2015, a part of the permanent exhibition of the Global Gallery was renovated.

Fig. 1. National Museum of Nature and Science, Ueno Park, Tokyo, JAPAN.
This main building was constructed in 1931 and called "Japan Gallery" nowadays.

Introduction

National Museum of Nature and Science, JAPAN (*KAHAKU* : Fig. 1) is a unique Japanese national museum devoted to both the natural history and the history of science and technology. Its Japanese nickname (abbreviation) is "*KAHAKU*" that literally means "Science Museum" ("*Kagaku Hakubutsukan*" in Japanese). It was founded in 1877, *i.e.*, 9 years later after new Japanese western-style government (Meiji Government) was established in 1868. Because 2017 is the 140th Anniversary of the Museum, we introduce the brief history of our museum, and the permanent exhibition of science and technology in this paper. We also discuss the role of the Museum for the public understanding of industrial and scientific heritage.

1- Brief History of KAHAKU

KAHAKU was founded as "Education Museum" on January 26, 1877 in Ueno Park, Tokyo at the site where Tokyo University of the Arts is located now. The museum was opened to the public on August 19, just 2 days before the First Japanese National Industrial Exposition (from August 21 to November 30, 1877) was opened in Ueno Park. The stone signpost of the Education Museum is preserved in Tsukuba Campus of the Museum (Fig.2). The new Japanese Government (Meiji Government) that was established in 1868 had noticed that museum and exhibitions would play very important role to accelerate the modernization, or westernization of Japan by educating Japanese people properly. Many talented Japanese persons had went to Europe and America as delegates or so from the end of pre-Meiji period (Edo period) to the beginning of the Meiji period and had visited many museum such as South Kensington Museum (Predecessor of London Science Museum and Victoria & Albert Museum) and the Smithsonian Institute, art galleries, zoos, and botanical gardens. They also visited the universal expositions in Paris (1855 and 1867), London (1862), Vienna (1873) and Philadelphia (1876).

They noticed the usability of the museums and expositions to the education of Japanese people. For that reason, Meiji Government founded museums and held national industrial expositions from early years of Meiji period (from October 23, 1868 to July 30, 1912). The Education Museum exhibited many teaching materials, educational experimental apparatus, natural history collections, and so on. They also developed teaching materials and thus developed materials were widely distributed to the domestic schools.

Fig. 2. Stone signpost of "Education Museum". Foundation year (1877) was carved on the backside.

In 1886, due to the fiscal crisis of Meiji Government that was caused by their excessive spending to the modernization, they were forced to shrink the museums and to concentrate their education spending to compulsory education. The Education Museum was reduced, and became as an affiliated facility of Higher Teacher's School and transferred to Ochanomizu area, about 5 km south from Ueno Park in 1889. After that, National Art School (now, Tokyo University of the Arts) moved to there and used the museum's building. A part of the buildings of the Education Museum is preserved on the sites (Fig. 3).

In 1914, the affiliated Tokyo Education Museum was abolished and became the "Tokyo Education Museum" under the Ministry of Education. In 1921 it became the "Tokyo Museum", and the character as a science museum was attached. At that time, the Imperial Diet adopted the proposal of the construction of the Physical and Chemical Museum and that construction was embodied as a commemoration project of the Crown Prince (Later, Emperor Showa) Marriage Ceremony. Due to the influence of World War I, the diffusion of rationalism thought had a big influence on the industrial economy, and the development of the country was supposed to require a science museum.

Fig. 3. Education Museum's old brick-made buildings preserved in Tokyo University of the Arts nowadays.

At 11:58 on September 1, 1923, the Great Kanto Earthquake (its magnitude is estimated as from 7.9 to 8.2) hit the Kanto area including Tokyo and Yokohama. Buildings and exhibitions of the Tokyo Museum were not so damaged by the earthquake itself and the museum's staff went back to their homes to take care of their families after confirming the safe of the museum. However, very big fire occurred in the center area and the downtown area of Tokyo after the earthquake because the earthquake was occurred when people were preparing lunch using fire. During the night, the big fire was extended to the Ochanomizu area, and attacked the Museum.

The Museum was completely burnt down except 319 objects that was accidentally loaned to other museums and schools outside the Kanto area during that time. Temporal buildings were soon built and opened to the public.
In December 1924, the director changed to Yasuji Akiho, an architect. Akiho is familiar with the circumstances of overseas museums, and was planning and designing the science museum scheduled for Ueno Park as an Earthquake reconstruction plan. He had a plan of the world-class science museum in his mind, especially Deutsches Museum in Munich. The new museum's construction started in April 1928 and was almost completed in December 1930.

Fig. 4. New building of Tokyo Science Museum (1931) appeared on a science magazine "Kagaku Chishiki (Scientific Knowledge)".

Fig. 5. Shape of the buildings of *KAHAKU* viewed from the sky nowadays. Left: Global Gallery, Right: Japan Gallery.

This building is now called as "Japan Gallery", and was designated as Important Cultural Property of Japan in 2008. Its design was very modern, *i.e.*, in the shape of an airplane when viewed from the sky. It was renamed to "Tokyo Science Museum" in February 1931, and was temporarily opened to the public from July 5. They officially announced its opening on November 2, 1931 and this day is the official anniversary of the founding of *KAHAKU*.
The exhibition was much fulfilled and many visitors came to the museum. But its activity gradually narrowed due to the war from about 1943. In 1945, the museum provided all the buildings to the Japanese army, and closed due to the war damage.
The WWII ended on August 15, and the Museum reopened partly to the public in December 1945. And it restarted as "National Science Museum" under the Ministry of Education, Science and Culture in June 1949.

In 1962, a function of the Research Institute of Natural History was attached to the Museum, and the research departments of natural history were expanded. In 1972, the Shinjuku Campus was constructed and research departments of natural history transferred to there from Ueno Park Campus. In 1994, Science and Engineering research department also transferred to there from the Ueno Park Campus. In 2007, the Museum's English name has changed to the present name because the Museum treats both the natural history and the history of science and technology comprehensively. In 2012, all the research departments and research centers transferred to Tsukuba Campus where Tsukuba Botanical Garden (the Museum's facility) has located since 1976.
In 1994, several exhibition buildings that were constructed after WWII were torn down to construct a new large building there. In 1999, one third of the new building was completed and its permanent exhibition was opened to the public. We call it "the 1st phase". In 2004, the remaining two third was completed and opened to the public: the 2nd phase. After that, the new building has been called "Global Gallery" because its treats mainly the worldwide science and technology, and natural history while Japan Gallery treats mainly the Japan-related ones. In 2015, the 1st phase of the exhibition was renovated and opened for the public.
Annual visitors to *KAHAKU* was about 0.8 million around 2000. However it increased to above 2 million after the completion of the Global Gallery: about 2.5 times in 15 years.

2- The organization of *KAHAKU*

The organization of *KAHAKU* is summarized in Fig. 6. It consists of Administration Department, Museum Activity Development Department, five research departments, *i.e.*, Zoology (17 curators), Botany (15), Geology and Paleontology (13), Anthropology (5), and Science and Engineering (8), and three research centers, *i.e.*, the Center of the History of Japanese Industrial Technology, the Center for Collections, and the Center for Molecular Biodiversity Research, and etc.
KAHAKU has three campuses: Ueno-Park Campus, Tsukuba Campus (ca. 50 km northeast of Ueno Park), and Shirokane Campus (ca. 10 km southwest of Ueno Park). Research sections and Tsukuba Botanical Garden are located in Tsukuba Campus, and The Institute for Nature Study is located in Shirokane Campus. Other sections, headquarters and main galleries are located in Ueno-Park Campus. The number of full-time staff is 126 in 2017. About 20 years ago, there were more than 150 people. That means about 20% staff has been reduced although visitors to the Museum have increased to 2.5times during the same period.

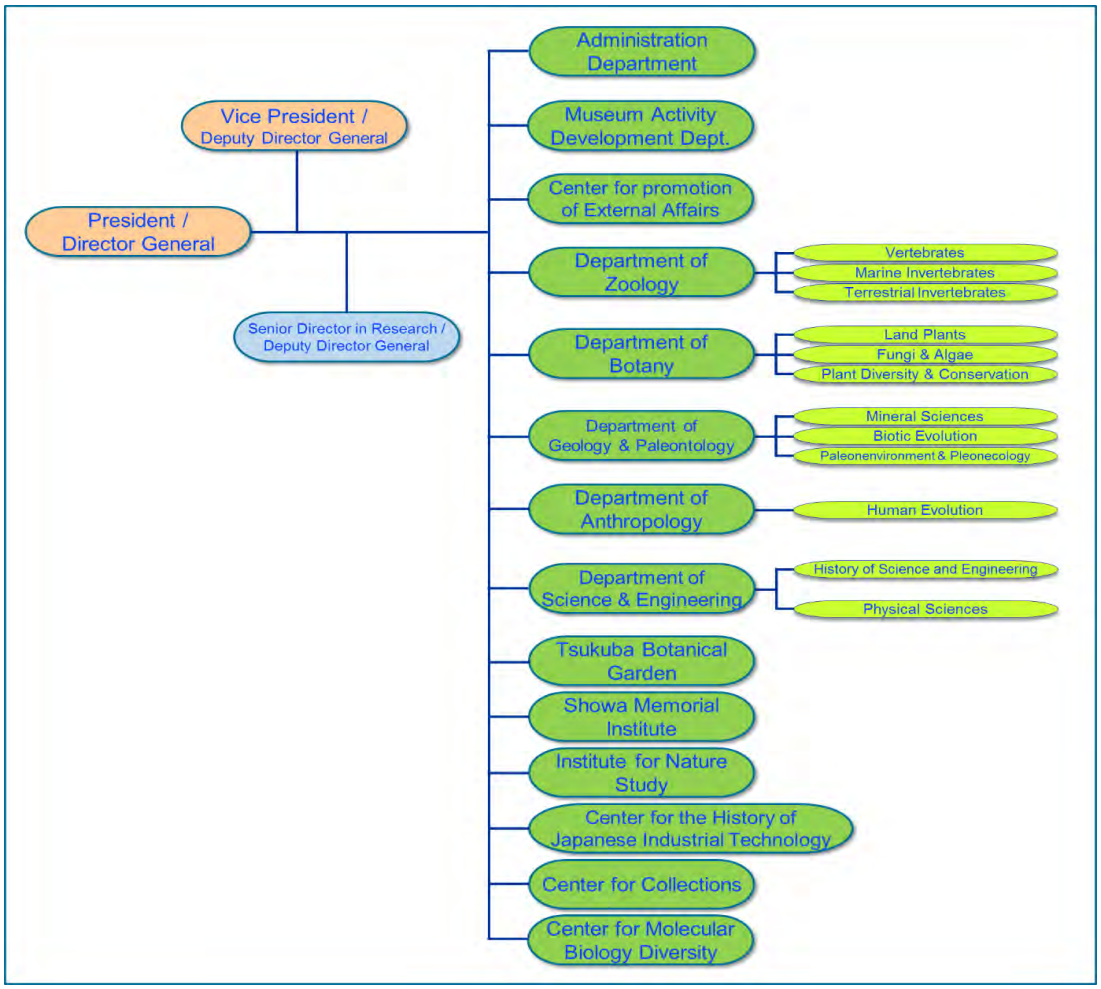

Fig. 6. The organization of the National Museum of nature and Science, Japan (*KAHAKU*).

Fig. 7. Examples of the collections of the Department of Science and Engineering.
Left: Professor Ewing's Tin-foil Phonograph (Important Cultural Property of Japan). Right: Professor Umetaro Suzuki's extracts from rice bran including "Active oryzanin (Vitamin B_1)"
(Chemical Heritage of the Chemical Society of Japan).

3- The Work of Science and Technology-related Sections

Sections related to science and technology are the Department of Science and Engineering and the Center of the History of Japanese Industrial Technology. The former has 8 full-time staff (8 curators) and the latter 2 staff (1 curator). Two staff of the former also serve as the researcher of the latter.

The Department of Science and Engineering aims at clarifying the developing process of science and technology in Japan, by collecting and analyzing historical objects and documents from the Edo period (Pre-Meiji period) to the present day. The collections include 6 Important Cultural Properties of Japan.

The Center of the History of Japanese Industrial Technology surveys the information on the historical objects of Japanese industrial technology remaining in Japan and evaluate their historical value. They select the important historical objects from the surveyed objects and register them as "*Mirai* (Future) Technology Heritage". 240 items have been registered in ten years from 2008 to 2017, and attracted much attention from people.

Several curators of the Department are nominated to the member of the committee of the scientific and/or technological heritage of their own fields. One curator belongs to the committee of "One Step on Electro-Technology" (67 items were selected from 2008 to 2017) by the Institute of Electrical Engineers of Japan and the committee of "Information Processing Technology Heritage" (96 items from 2009 to 2017) by the Information Processing Society of Japan.

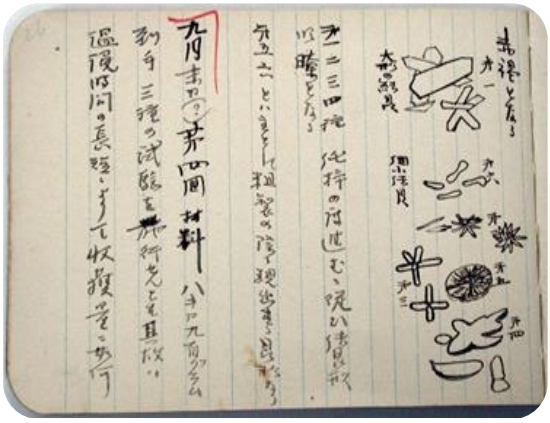

Fig. 8. Examples of the Chemical Heritage: The Experimental Note on the Crystallization of Adrenaline by Keizo Uenaka (1900). Uenaka was an assistant researcher under Jokichi Takamine. This note proved that Takamine and Uenaka crystallized hormone first in the world.

One curator belongs to the committee of "Chemical Heritage" (43 items from 2010 to 2017) by the Chemical Society of Japan.

One curator belongs to the committee of "Mechanical Engineering Heritage" (90 items from 2007 to 2017) by the Japan Society of Mechanical Engineers. They play important roles for the selection and registration of the heritages. Those scientific and industrial heritages have attracted much attention from the public and have been reported by the press in Japan.

Fig. 9. Periodic Table

Fig. 10. The Allotropes of Carbon

4- Permanent Exhibitions of Science and Technology in *KAHAKU*

Exhibitions in *KAHAKU* are introduced on its WEB site (www.kahaku.go.jp/english) and some of the explanations can be read on the WEB sites.

4-1-Permanent Exhibitions of Science

"*Exploring the Structure of Nature —How our world works—*": Global Gallery B3F

Opened in November 2004. It consists of 3 corners: "*Exploring the Laws of Nature*", (a) "*Exploring the World of Matter*", and "*Exploring the Universe*". They treat essential aspects of basic physics, chemistry, and astronomy or space science. Two exhibits of "*Exploring the World of Matter*" are shown in Fig. 9 and 10. Periodic Table (Fig. 9) displays all pure elements except radioactive one: we can see most of the real elements here. Fig. 10 shows the exhibits of the allotropes of carbon: the molecular models and real sample of graphite, diamonds, Buckminster fullerenes (C_{60}, C_{70}, C_{84}), carbon nanotubes (single wall, and double wall).

(b) "*Japanese Scientists*": Global Gallery B3F

Opened in July 2015. It consists of 2 corners: "*Japanese Nobel Laureates in Physics, Chemistry, and Physiology or Medicine*", and "*Japanese Builders of Science with Items from Our Collection*" (Fig.11).

Fig. 11 "Japanese Scientists" in July 2015: Professor Takaaki Kajita's case (left corner) was not installed yet because his award was announced on October 2015.

Fig. 12 Professor Takaaki Kajita (Nobel Prize in Physics, 2015) signed on his panel.

The former corner introduces all Japanese Nobel laureates in physics, chemistry, and physiology or medicine (22 persons in 2017). Just before making the corner (16 persons), three scientists received the Physics Prize in 2014 for the invention of blue LED, and we had to add three display cases quickly. We added further three cases (one for physics, two for physiology or medicine) in 2 years. We try to exhibit the personality or attitude to the research of laureates rather than to explain theirs works in detail. Some exhibits were donated from laureates or the organizations that have a direct connection with the laureate. Some of exhibits are the replicas that were made referring the original objects loaned from the laureates. Some laureates visited *KAHAKU* and signed on their panels (Fig.12). The other corner introduces 6 historical scientists who played important roles for building Japanese sciences. At the early stage of the planning, we had planed to introduce more scientists. However, we had to reduce the number because Japanese Nobel laureates increased so soon recently.

(c)"*Techniques Observing Nature*": Japan Gallery 1F-South Wing.

Opened in April 2007. It consists of 4 corners: "*Astronomical Observation: Astronomy/Celestial Glove*" (Fig.13), "*Earthquake Measurement: Seismograph*" (Fig.14), "*To Measure Time: Clocks and Watches*", and "*Tiny Miracles: Microscopes*". Historical objects relating the development of Japanese science are exhibited here. Historical objects that tell the basic stories of the development of Japanese science are exhibited here.

Fig. 13. Celestial Globe (1697).
Important Cultural Property of Japan.

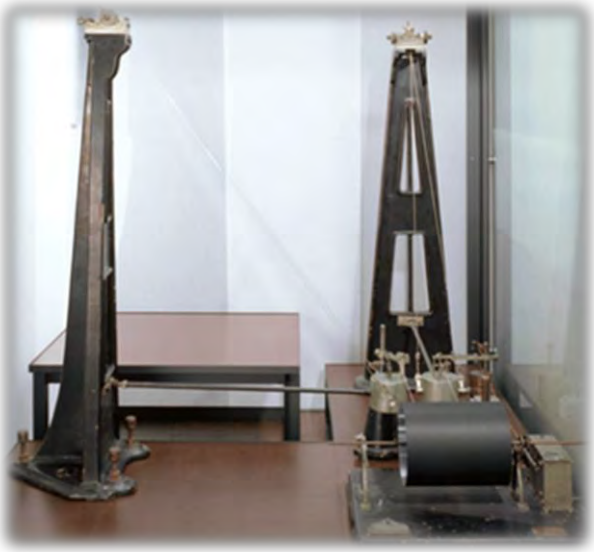

Fig. 14. Omori's Method Seismograph (1898).
Using this method, the data of quake in Alaska was obtained in Japan.

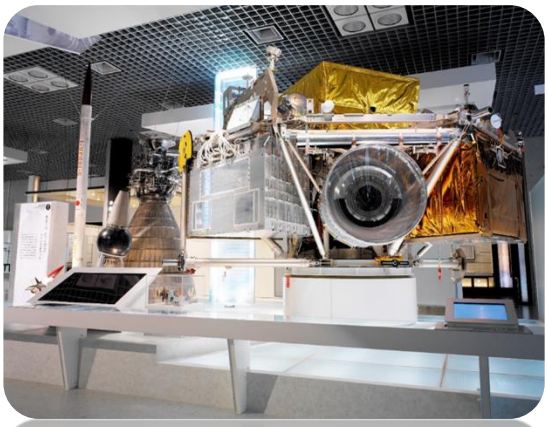

Fig. 15. Space Flyer Unit (SFU) (1995).
It was returned from space by a space shuttle in 1996.

Fig. 15. An early Japanese television system:
Takayanagi television system (ca. 1930).

4-2-Permanent Exhibitions of Technology

(1) "*Progress in Science and Technology*": Japan Gallery 2F

Opened in November 2004. This exhibition shows the progress in technology in Japan during recent 150 years. It consists of 5 corners: "*Introduction to the History of Japanese Science and Technology*", "*Science and Technology in the Edo Period*", "*The Beginning of Modernization of Japan*", "*Results of the Modernization*", "*Further Developments in Japanese Science and Technology*", and "*Past, Present, and Future of Science and Technology*". In this floor, you can see the Space Flyer Unit (SFU) that was returned from the space by a space shuttle in 1996 (Fig.15) and early Japanese television systems in 1930's (Fig.16).

(2) "*Investigation Technology for the Earth*" : Japan Gallery 2F

Opened in July 2015. In this exhibition we shows we can investigate the Earth from the space and the surface of the Earth, using various kinds of electromagnetic waves. The basic physics of electromagnetic waves including light is explained and various semi-real time aspects of Earth and Sun are displayed on a wide interactive screen board.

Fig. 16. GED (Global Environmental Detector).
On this interactive screen board, we can see semi-real time features of Earth and Sun. "Space weather forecast" that forecasts the geomagnetic storm can be also seen.

Fig.17. Physics of Light and Electromagnetic Waves.
You can experience many aspects light and electromagnetic waves.

Conclusions

The National Museum of Nature and Science, Japan was founded as "Education Museum" in 1877, just 140 years ago. Its name and mission have been changing since then, and it is now a unique national museum that treats both natural history and the history of science and technology comprehensively. Its science and technology related sections are Department of Science and Engineering and the Center of the History of Japanese Industrial Technology. They treat historical materials related to the development of Japanese science, technology and industrial technology. They survey, collect, research and exhibit such materials. They also evaluate the historical materials remaining in Japan and register very important materials as scientific and/or technological heritage as the Museum's staff or the member of the heritage committee of each field's academic or industrial societies. In recent 10 years, many historical materials have been registered as scientific and/or technological heritages and attracted much attention from public. Thus, the Museum has been acting as the communicator of such heritages to the public.

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References

1- National Museum of Nature and Science Ed., "Profile of the National Museum of Nature and Science 2017, 30 Pages.
http://www.kahaku.go.jp/english/about/summary/index.html.

2- Profile and History of NMNS,
http://www.kahaku.go.jp/english/about/summary/history/index.html

3- Permanent Exhibitions, http://www.kahaku.go.jp/english/exhibitions/permanent/index.html.

4- National Science Museum Ed., "The Book of 100-year History of National Science Museum, Japan" (in Japanese), November, 1977, 898 pages.

5- Fumitaka Wakabayashi, "Creation Period of Japanese Museums—With a central focus on the National Museum of Nature and Science" (in Japanese), *Kagakushi (The Journal of the Japanese Society for the History of Chemistry)*, 2017, Vol.44, 88-90.

Cases about Taking Advantage of Modern Industrial Heritage and Science Museum Contributions to Rekindle it in China

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Abstracts

Industrial heritage inside and outside of museums are part of the human history. They remind us the fading glory time and can still inspire us if they are well operated.
This paper talks about Industrial Heritage protection and re-using in two directions, inside and outside the museums.
Museums are the bridge between the public and the industrial heritage. There're many industrial collections that are being stored and exhibited in museums, they contribute to help the public feel the history and culture directly. There're also advises given to the museums to improve continually in heritage storage and exhibit-marketing by this paper.
Heritage sites outside of museums is the origin, but how to protect and make good use of the sites is the question.
By studying the abandoned Shougang Group's Steel Plants and its' planned development, the paper conclude some ideals to reuse this kind of heritage. Thus could also be a kind of protection.
Moreover, we are entering the era of 4th Industry Revolution, during the development of Industry 4.0, Iot, Cloud Compute, AI, we have built up more and more industrial wonders sites, such as AliCloud's Datacenter on Qiandao Lake, Hangzhou, ZPMC's full automation dock in Qingdao, they are the living specimen of technique advance.
Today's wonders will be heritage in the future, the paper points out that we should not only focus on the heritage, but also pay efforts on linking the living wonders and the public, this may be more easier than review the passed-by.

Introduction

Industrial heritage consists of Material cultural heritage and intangible cultural heritage. Material cultural heritage can be divided into movable relics and immovable infrastructures.
To protect and make use of the industrial heritage, we can arrange in two directions:
Government in charge of the immovable infrastructures and control the whole situation;
Museums focus on the intangible cultural heritage and movable relics, working as a bridge between the public and the heritage.

The evolution of China's industry and born of industrial heritage

China is a country with a long history of ancient civilization. Modern industry starts and develops in 1860s and 1870s during the Westernization Movement in Qing Dynasty, and then goes through the colonial industrial era. Due to the turbulent statehood, the development of modern industry in these two stages is limited until 1949 when the republic is built. Since then the industry has been evolved quickly and can be concluded as the following stages:

1. From 1949 to 1978, China's industrial foundation is built up with the aid of Union of Soviet Socialist Republics who cut up its aid at 1960. Through a policy of self-reliance and hard work, China becomes one of the world's important industrial powers at the last 1970s. During this stage the government gives more priority to the heavy industry, such as steel manufacture and military industry.
2. From 1978 to 2000, the reform and opening-up policy promoted the industrial structure to a higher level with the promotion of various economic sectors and the upgrading of the consumption structure. China's overall process of industrialization also shifted from the initial phase to the mid-industrial stage.
3. Since 2000, after joining in WTO, China's manufacturing industry has grown rapidly. China becomes a world factory with a business card of Made in China. Since 2013, economic restructuring, manufacture upgrading and transformation are being accelerated.

With the development of industry, Chinese cities are also developing and expand their urban area to the former rural area. Factories especially in the heavy industry are not proper to produce due to their noise and pollution, they have to move away from their old plants in the city, and thus the industry heritage comes into being.

Characteristics of China's Modern Industrial Heritage

* Relatively lacks of heritage before 1949, but abundant of heritage after 1949
* Wide distributed in the nation

Beijing, Shanghai, Nanjing, Xi'an, Luoyang, Xiangyang, Liuzhou, Shenyang and so on. Many cities possess different modern industrial heritages.

* Varies in different industry categories

Such as mining, machinery, metallurgy, chemical, textile, energy, aviation, aerospace, electronics, communications, transportation, etc.

* Diversity of architecture exits

Architectures in many heritages are more likely in groups than a single building, which have:

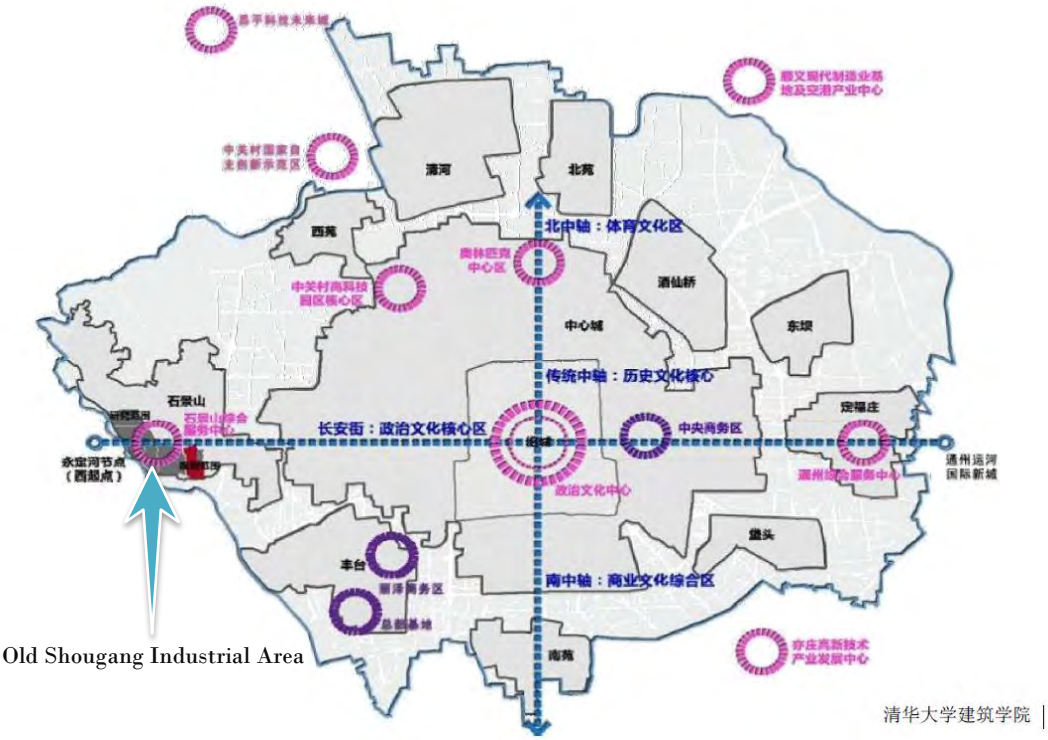
Production facilities such as office, research lab, plant, storage, sewage treatment, machinery, etc.;

Living facilities such as employee domes, clubs, public bath, canteens, kindergartens, schools and parks;

Buildings such as Blast furnace, coke oven, cooling tower, gas cabinet, pipe gallery;
Industrial relics such as working equipment, devices and documents;
Intangible cultural heritage such as production process, scientific research, factory cultures, management rules, model workers deeds.
* Be apt to protection and reuse
Large-scale factories and buildings are very common, which can form scale effect in reuse, and the construction of these industrial buildings is stronger than the normal civil ones, and can be planned for long-time-reuse.

Practical case: Old Shougang Industrial Area Transformation

With its abandoned furnaces and smokestacks, the former Shougang Group site, about 20 kilometers west of Beijing, still evokes memories of the capital's industrial past.



Yet, after extensive renovations to turn silos and warehouses into offices, the complex's western section has been revitalized, with employees of the Beijing Organizing Committee of the 2022 Olympic and Paralympic Winter Games already busy at work preparing for the sporting extravaganza.

* History and studies of this area

Shougang Industrial Area is first established in 1919 when it is called Beijing Shijingshan steel mill affiliated to the Longyan iron mine Ltd, and it is one of the earliest heavy industry enterprises in China.

Shougang Group began relocating from the site in 2005, as part of measures to reduce air pollution in the run-up to the 2008 Beijing Summer Olympics. In the next five years, the steel company gradually moved its entire operations to Caofeidian in Hebei province. Then the Old Shougang industrial area is abandoned and becomes a typical industrial heritage of China.

From 2006 to 2012, this area has received wide spread and sustained attention from the government and research institutes. Professor Liu Boying of Tsinghua University and his team systematically investigated and carried out report and plan of How to make use of this area.

In July 2015, Beijing and Zhangjiakou, in neighboring Hebei province, were named as hosts of the 2022 Winter Olympics. At Dec 15th, Beijing Organizing Committee for the 2022 Olympic and Paralympic Winter Games has been launched and set its office to the north district of Old Shougang Industrial Area.

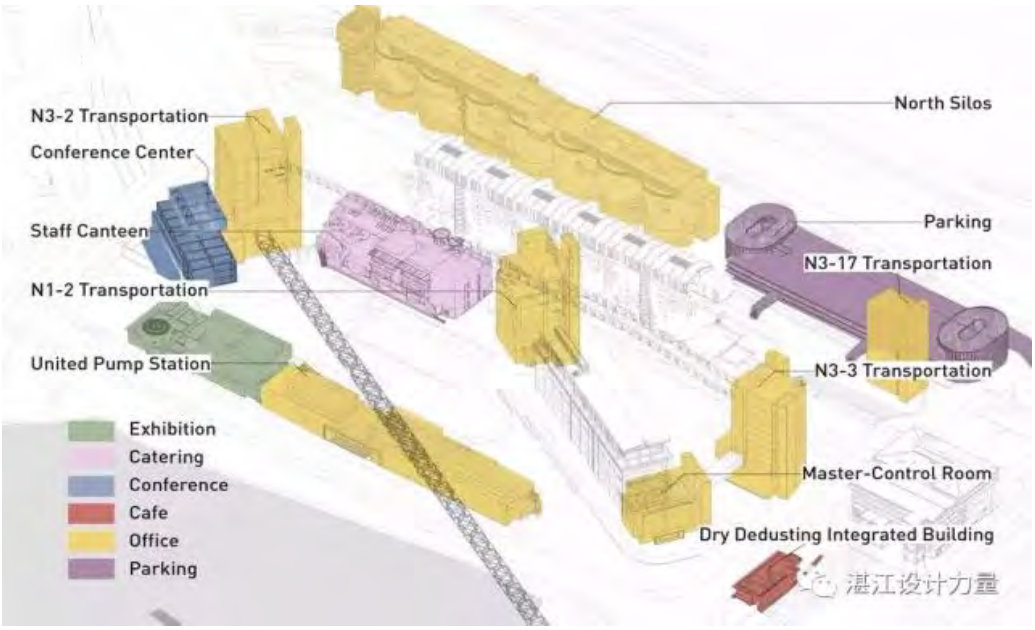
There're five districts planned in this area:

* Winter Olympic Square
* Shijingshan cultural landscape park
* Shougang industrial heritage park
* Public service supporting area
* Innovation workshops for city darning

There're highlight renovation project in the area of Winter Olympic Square:

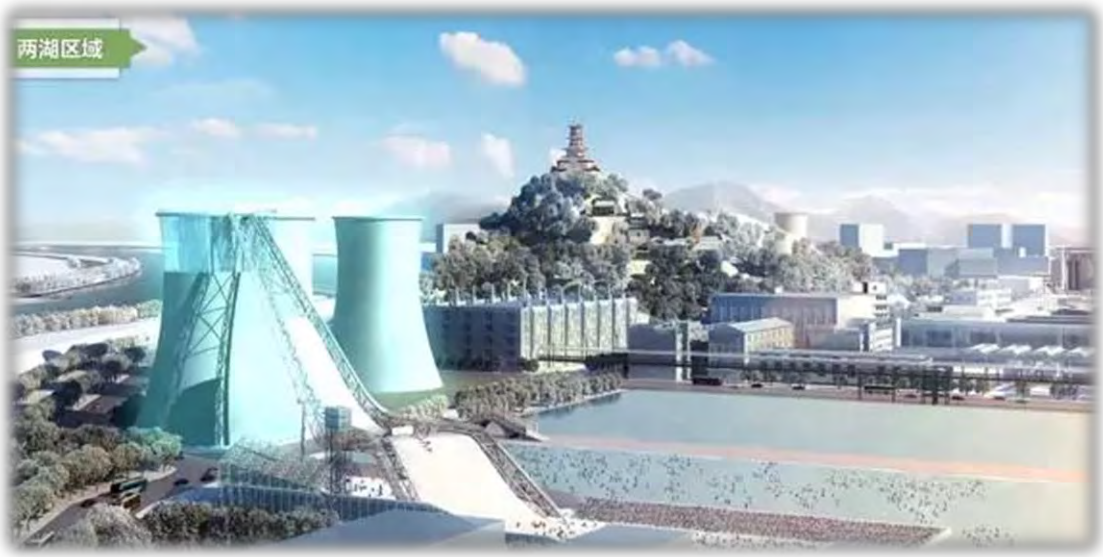
- "**A**" area: the west-ten-silos Winter Olympic Plaza

Serves as the office of Beijing Organizing Committee and has parking, meeting, exhibition and other supporting facilities.



- "'"**B**"area: snowboard platform

It will build up a platform for snowboard training relying on the high and huge cooling tower.



- "C" area: comprehensive Winter Olympic training area

It will be the training courts for short track speed skating, figure skating, curling, hockey, rock climbing, skateboarding, by transforming and expanding the clean-coal workshop and plant flues.

- What can we learn from Shougang's Transform:

* Protection and reuse planning come along with the moving out.
* Earlier studies by organizations help.

The transform project plan is quite proper owe to the earlier studies and discussion by the research institute and other organizations, such as museums. The organizations propose proposals to the government, and the government considers and makes the choice.

* Planning in a sustainable way.

The exteriors of the structures remain relatively unchanged, and inside they have undergone a series of low-carbon refurbishments, including being fitted with solar lighting and facilities for rainwater recycling.

The reconstruction uses a method called darning, which means that we do not destroy the remaining building, but by constructing new small building, extending remaining ones and re-partition huge ones inside, we links the architectures in a brand new series.

The case of Shougang's transforming reflects the industrial heritage's value: historical, cultural, social value, art aesthetic, science and technology, and the economic values.

Inheritance of Industrial Heritage - China's existing industrial wonders

We are entering the era of 4th Industry Revolution when the development of Industry 4.0, Iot, Cloud Compute and AI occurs. we are setting up more and more industrial wonders sites, such as:
Ali-Cloud's Data-center on Qiandao Lake
The biggest feature of this data-center is to adjust measures to local conditions, lake water flows in closed pipelines through the data center, to help the servers cool down, and then flows through the 2.5 kilometers Qingxi brooks, as a city landscape, naturally cool down and goes back to Qiandao Lake. In this process, we have also maintained the pure zero pollution of the lake water, so the energy consumption of refrigeration is saved by more than 80%.
Full automation dock in Qingdao
The dock uses fully automated technical equipment, subverts the traditional container terminal operation mode, management mode, realize intelligent decision-making, production process, operation automation, unmanned scene, green energy.
They are the living specimen of technique advance, and milestones in their respective industries. Today's wonders is the inheritance of industrial heritage and may be heritage in the future. As museum staffs whose main purpose are communicate science to the public, can we make better use of them before they become sites?

Museum's important role

There're measures through different methods museum can carry out to help protect and reuse industrial heritage, take the China Science & Technology Museum (CSTM) as an example, It can be concluded below.
- Collection of relics:
The movable relics are more suitable to be collected and studied by museums. At some of the heritage sites new specific museum can be built using the immovable infrastructures. There're many industrial collection such as Ford Model T, Tokamak device, the Shenzhou five manned spacecraft, etc.
- Research and advice:
The richness of Museums' collections are very helpful for the researcher, and their advice and proposal can help the public and the government make decision. Their studies are the feedback of their collections and protections.
- Modeling and synthesis:
Many relics are too large to be displayed or have been damaged that it can't be exhibited. Museums can design and build model, sand table, and VR gallery to restore the damaged ones.

- Experience help inherit intangible cultural heritage:
There are experience area where visitors can experience ancient ways of rubbings, woodblock printing and paper-making in CSTM's Ancient Glory of China Gallery. Thus help the public experience the history and culture more directly.
- Industrial and technology visit-guide as a service
The most important is to build a bridge between the public and the heritage or other existing wonder, we can build up a platform where museums provide standard and professional services, including guidance, organize events. This helps expand the boundary of museums as a result.
It may be practical at CSTM, because CSTM has a very professional team whose member majored in varies of subjects, and has organized many interesting activities for example "Build Up My Moon Base", "Science City on the Sea", "Little Weather Reporter", this is our advantages.

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[*]Liu Boying, Li Kuang.首钢工业遗产保护规划与改造设计[J], Architectural Journal,2012,(01):30-35.

"That ship was built by us" constructing & presenting intangible & tangible industrial heritage

Aho Mikko, Rauma Maritime Museum, University of Turku, Finland

This article explores intangible and tangible industrial heritage as a process within a community. Co-operation between Rauma maritime museum and the local shipbuilders' community has resulted in, among other things, a co-creative exhibition and oral history interviews of about 120 shipbuilders of Rauma shipyards. Many things that the shipbuilders in Rauma consider important elements of their professional identity are intangible. How do the shipbuilders choose which concepts are to be part of their heritage? The intangible is often communicated by something tangible: innovation may be represented by a modern thruster, a company team sports jersey may signify a sense of camaraderie. How does the community attach intangible values to tangible objects, and what is deemed worthy to represent the shipbuilders' identity?

In September 2013 STX Finland, then owner of Rauma Shipyard, announced that the shipyard would be closed by end of June 2014 and more than 600 shipbuilders would be laid off. Shipbuilding in Rauma has a history of more than four centuries, and especially after the Second World War the two shipyard companies, Hollming and Rauma-Repola had been the town's largest and most prestigious employers. The ships built in Rauma were a source of pride, one of the few things the town is known of nationally and internationally. While the fortunes of the shipyards had been mixed after the two companies merged in 1992, the closure of the yard was a shocking blow not only to local economy, but identity as well. A new company, Rauma Marine Constructions (RMC) has re-opened the shipyard since. While its start has been very promising, the future of shipbuilding is uncertain (Uola 1996; Uola 2001; Rantanen 2017).

The crisis prompted the museum and shipbuilder community to come together in order to collect, preserve and present the shipbuilders' cultural heritage. They had worked together before, collecting oral history interviews in 2009-2011, but now the co-operation took new forms and became much more intensive. It has, at the time of writing, resulted in thousands of objects and pictures added to the museum's collections, a themed exhibition on shipbuilders that was presented from March 2015 to January 2018, and continuation of the oral history interviews. It is an ongoing process, and responsibility for organizing it deciding on what to do has transferred from the museum to the shipbuilders. Majority of the participant shipbuilders had already been retired before STX Finland closed the Rauma yard, and most participants had a long career in shipbuilding. There are, however, some active shipbuilders involved. It remains to be seen if new generations join the heritage community of shipbuilders, or if the activity ceases when the present core group of active participants ages.

This article explores how the shipbuilders construct their identity and how they have chosen to present it in the museum exhibition. It is based on and oral history interviews of shipbuilders and the author's participation in the co-operation as the museum's curator. There have been individual interviews, group interviews and discussion meetings that have involving about 120 shipbuilders in 2009-2017. They have been recorded, transcribed and archived in the museum's collections. While the shipbuilders consider the interviews and discussions primarily a means to record historical information, they also serve a purpose of identity work and community building (Smith 2006; Sivula 2015). The shipbuilders themselves choose which themes, things and events are significant enough to be discussed and thus considered part of their history and heritage.
I have translated the direct quotes from the interviews presented in this article myself. It is impossible to translate nuances of the shipbuilders' distinctive use of the Finnish language, sprinkled with regional dialect and professional slang. I have, however, attempted to communicate the informal and often humorous style of their expression. The original Finnish quotes are presented in the endnotes.

Constructing shipbuilder identity

"It was such a varied and good place to work, I consider shipbuilding one of the greatest industries of all" (1)
"We, kind of, held our head up high when we went to metal work"(2)
"When they talk about closing the shipyard, it makes my heart bleed to see and hear that, an old shipbuilder like me"(3)
Discussions and interviews construct and describe a community that proudly identifies as shipbuilders. It should be noted that while this article concentrates on things that the shipbuilders consider positive and what makes them identify as shipbuilders, they openly discuss problems as well, such as strikes and industrial actions, deficiencies in security and adverse working conditions.
The recorded interviews and discussions consist of input from about 120 individual shipbuilders. Of course, everyone's experience is their own an all conclusions presented here are inevitably generalizations and averages. As the participants are volunteers, who chose to participate on their own accord, it is conceivable that there is a positive bias present in the material. Those whose experience may not have been a positive one or who do not strongly identify as shipbuilders, may have chosen not to participate.
"Kyllä se oli niin monipuolinen ja hieno työmaa, että kyllä mää pidän laivanrakennusalaa yhtenä hienoimpana alana". RMMV 44:38, individual interview.
"Se oli niinko rinta rottingil kuljettii metallitöihi". RMMV 44:49, individual interview.
"nyt ku puhutaan et telakan lopettamisesta ja näin, kyl tämmöne vanha laivanrakentaja, ni kyl mää iha verta tihkuvin sydämin oon kattonu sitä ja kuunnellu sitä" RMMV 44:43, individual interview.

Pride in craftsmanship and professionalism

The narrators have a high opinion of the quality of the ships they built, as well as their own and their co-workers' skills and craftsmanship. Many narrators describe a feeling of pride in being a shipbuilder, in being involved in the construction of such majestic machinery.

"The supervisor was proud to have good workers, and the workers were proud to do their work well" (4)

"Us welders, we had quite strong principles, to do our work well, and to produce good quality"

"When the ship leaves us, everybody can be proud of it, we made it and it works independently out there on the Oceans. Everyone can be really proud of that."(6).

The spirit of innovation

The Rauma yards have produced many highly specialized, technologically advanced ships, like scientific research vessels, icebreakers and military vessels. This fact is frequently highlighted. The shipbuilders believe that Rauma shipyards have been and are among the most advanced worldwide, and have created innovative solutions to challenging technological problems.

[A cargo transfer system designed in the 1970s] "was such great technology, at the time there was no equal to be found anywhere, and the guys had to design all of it themselves, from the ground up"(7).

[On high-speed ferries constructed in the 1990s] "As a result of that project, the knowledge of working with aluminium took a leap forward in Finland" (8).

The good team spirit

Almost all narrators refer to a sense of community and camaraderie as a strength in Rauma's shipbuilding community. They feel everybody's input has been valued. Off-work activities, such as fishing and sports, were instrumental for the construction of this communal spirit.

"The shipyard humor was sometimes rough, but yes, we were well appreciated, and we appreciated ourselves very much." (9).

"Shipbuilding is interesting that way, it never is a one man show [...] this is always teamwork. We do these things together and build the ships. And sales, too, it always involves a relatively big organization." (10).

Persistence and "toughness"

As many other workers in heavy industry (Turtiainen 2014), the shipbuilders take pride in ability to withstand demanding work in adverse conditions. This is most evident, but not limited to, those involved in physical work. Naval architects, for example, take similar kind of pride in their ability to meet deadlines and fulfil demands of customers to their satisfaction. A local, or regional, speciality is the experience of working in the extreme cold of Finnish winter. As most shipbuilders frequently work outdoors, the cold is referred to by almost every narrator.

"We were working somewhere on the deck, there was ten centimeter ice and us there, kneeling on the ice" (11).
"And I've always said, that any man can pull 700 tons on level ground, but we pulled it uphill!" (12).
"Shipbuilding is such hard work, that the human body can only sustain it for a limited amount of time" (13).

Presenting shipbuilders' heritage

The way the themed exhibition on shipbuilders was constructed, resembled a co-creative exhibition process as described by Nina Simon (2010). The question the museum asked was: "Shipbuilders, do you have an idea for an exhibit you'd like to make with us?". The priority was given to the needs and wants of the community, rather than those of the museum.

The exhibition was very important for shipbuilders. It was essential for them that, in addition to the collection work and interviews, there would be tangible results to show for the public. Many participants might indeed have concluded, that without the exhibition nothing at all would have been achieved. The exhibition also gave a sense of purpose to collection work and interviews, and provided a goal easy to understand and communicate, for museum, shipbuilders and public alike. Consequently, the exhibition was given a very high priority, and fewer resources were directed to, for example, cataloguing the collections received from the shipyard.

The exhibition was planned, designed and built together by the museum staff and volunteer shipbuilders. It is often impossible – and in my opinion, unnecessary – to discern one's work from the other's. Broadly, the shipbuilders decided **what** to present, and helped select and locate appropriate objects, pictures as well as other materials, often donating their personal belongings. However, they were generally happy to let the museum staff decide **how** to present them: they were not very interested in discussing things such as the layout of the exhibition room. Comparably to the interviews and discussion, exhibition planning was identity work for the shipbuilders, as they attached meanings and values to the materials they chose to be presented (Smith 2006; Sivula 2015). The limitations of the museum building had an effect on some decisions, as the heaviest machinery is impossible to fit in through the doorways.

The resulting exhibition, called "Made in Rauma", opened on March 19th 2015, and closes on January 6th 2018. Elements of it will be integrated to Rauma maritime museum's permanent exhibition. Presenting intangible heritage in a museum exhibition consisting mostly of tangible objects was to some extent challenging. Some of these challenges are discussed below. Four filmed interviews (14) with shipbuilders were also recorded in order to better present the heritage in the shipbuilders' own words.

Pride in craftsmanship and professionalism

This pride is often expressed in a strong emotional attachment to the ships built in Rauma, particularly those whom the narrators themselves have been involved with. Some shipbuilders can name all ships they have been building – sometimes there are dozens – and some keep tabs on the fortunes of "their" vessels. This resulted in strong and varied opinions about which ships are most important. Predictably, many wanted to see their "own" ships occupying central stage. We chose to present all 621 built in Rauma after 1945 in pictures, but highlight some ships as representatives of their categories, for example, the exhibition includes model on one ro-ro cargo vessel and one passenger car ferry. This resulted in some practical difficulties, as some desired shipyard models were not available. It is noteworthy that ships are remembered for different reasons: some as technologically advanced, some as commercial successes, some simply for being beautiful. "You've seen the movie Titanic, haven't you? In the beginning, when the story gets going, that ship was built by us!" [On research vessel Akademik Mstislav Keldysh, delivered 1981 and its appearance in the 1997 movie by James Cameron] (15)

[Wihuri class built in 1960s and early 70s] "were the last beautiful ships that Rauma shipyards built, after that the only consideration was efficiency" (16).

The spirit of innovation

The engineers who have worked in naval architecture and, for example, deck machinery design, take pride in their involvement in developing advanced technology. Some donated design models of products they had designed themselves, with explanation on what they had been used for, and how. One of the most successful products developed in Rauma is the Aquamaster brand steering thrusters. It begun as a semi-improvised solution for a specially-constructed barge and has become an international success (Tammiaho 2009). The first production model was presented in the exhibition with a video that makes the connection to modern products, as the shipbuilders wanted.

The good team spirit

The team spirit manifested itself in the exhibition planning. Many shipbuilders expressed a wish to see everyone's work presented in the exhibition, not just their own. There are very few tangible objects that are connected to team spirit, especially its everyday manifestations in the workplace. However, there is quite a lot of objects related to, and plentiful photographic evidence of, company sport events, fishing trips and other off-work activities arranged by the companies and trade unions.

The shipbuilders have had a habit of manufacturing household tools, decorations and such out of scrap metal during work hours. While this practice was strictly speaking illegal and against company regulations, it was tolerated by the employer, if it didn't excessively interfere with regular work. Such unofficial manufacturing was common in Finnish industry in general (Pesonen 2014). In the exhibition, some unofficially made objects are presented as evidence of the relatively relaxed workplace culture.

Persistence and "toughness"

It was, of course, impossible to recreate the noisy, smoky, often dirty and sometimes dangerous environment of the shipyard to communicate the experience. However, heavy power tools, protective equipment and photographs and video films of hard work help to make it apprehensible for the visitors.

The experience of improving work safety is often talked about, and seems to be important for the shipbuilders. This is presented with the help of advancing safety equipment and safety-related educational materials.

Conclusion

The occupational identity of shipbuilders is mostly about intangible concepts. They may, however, be symbolized by tangible objects, and communicated by means of pictures and narratives. For the shipbuilders, the tangible monuments also carry the intangible values and meanings. It is, of course, debatable whether these meanings can be communicated to outsiders, for example museum visitors viewing the exhibition, if they have no personal experience of working in heavy industry such as shipbuilding.

Archival sources: Rauma Maritime Museum's collections
Audio recording collections
RMMV 44 interviews with shipbuilders

Video archives: RMMF 239 interview with a shipbuilder
RMMF 242 interview with a shipbuilder

Bibliography

- Pesonen, Pete. 2014. Firabelityö ja suomalaisen työelämän murros 1900-luvun alusta 1960-luvulle. Turku: Turun yliopisto.
- Rantanen, Janne. 2017. Paikallispatriotismi elää Raumalla. In Länsi-Suomi, January 8. Rauma: Länsi-Suomi.
- Sivula, Anna. 2015. Tilaushistoria identiteettityönä ja kulttuuriperintöprosessina – Paikallisen historiapolitiikan tarkastelua. In Pyykkönen, Miikka (ed.) - Kulttuuripolitiikan tutkimuksen vuosikirja. Kulttuuripolitiikan tutkimuksen seura r.y.
- Simon, Nina. 2010. The Participatory Museum. Santa Cruz: Museum 2.0.
- Smith, Laurajane. 2006. Uses of Heritage. London: Routledge.
- Tammiaho, Erkki. 2009. Ruoripotkurilaitteiden liiketoiminta Suomessa. Helsinki: TEKES.
- Turtiainen, Jussi. 2014. Metalliin kietoutuneet muistot: metallityöläisten maskuliinisuus toisen maailmansodan jälkeen. In Väänänen, Ari & Turtiainen, Jussi (ed.) Suomalainen työntekijyys 1945-2013. Tampere: Vastapaino.
- Uola, Mikko. 1996. Meidän isä on töissä telakalla Rauma-Repolan laivanrakennus 1945-1991. Helsinki: Otava.
- Uola, Mikko. 2001. Hollming 1945-2000. Rauma: Hollming Oy.

RAUMAN MERIMUSEO
RAUMA MARITIME MUSEUM

1- ”Kyllä se oli niin monipuolinen ja hieno työmaa, että kyllä mää pidän laivanrakennusalaa yhtenä hienoimpana alana”. RMMV 44:38, individual interview.
2- ”Se oli niinko rinta rottingil kuljettii metallitöihi”. RMMV 44:49, individual interview.
3- ”nyt ku puhutaan et telakan lopettamisesta ja näin, kyl tämmöne vanha laivanrakentaja, ni kyl mää iha verta tihkuvin sydämin oon kattonu sitä ja kuunnellu sitä” RMMV 44:43, individual interview.
4- ”Työnjohtaja oli ylpee, kun sillä oli hyvät työntekijät ja työntekijät oli ylpeitä, kun ne tekivät hyvää työtä” RMMV 44:39, individual interview.
5- ”meillä hitsareilla oli aika kovat periaatteet siinä, että työt täytyy tehä kunnolla, ja laatu täytyy olla hyvä” RMMV 44:39, individual interview.
6- ”kun meiltä laiva lähtee ulos, ni siittä voi olla kaikki ylpeitä, et me se tehtiin ja se toimii itsenäisesti tuol maailman merillä ni. Siittä saa kyllä kaikki olla tosi ylpeitä.” RMMV 44:47, group interview.
7-”Se oli jotaki niin hienoo tekniikkaa, et ei sillon maailmassa ollu tämmöstä, pojat joutu kaiken säveltään itte” RMMV 44:14, individual interview.
8-”tämän projektin seurauksena, ni alumiini-osaaminen on Suomessa kasvanu sillon hyppäyksenomasesti.” RMMV 44:69, individual interview.
9- ”Mutta oli siellä huumori kova ja kyl meit arvostettiin. Me arvostettiin itteemme oikein hirveesti.” RMMV 44:30, individual interview.
10- ”laivanrakennus on sikäli mielenkiintost, et täähän ei oo yhden miehen show [...] vaan tää on koko ajan tiimi— tiimityötä. Ja yhdes näitä asioita tehdään ja rakennetaan ne laivat ja samaten se myynti, niin se on aina kohtuullisen iso organisaatio, joka siin on mukana.” RMMF 239, individual video interview.
11- ”Oltiin jossain kannel töissä ja jäätä oli kymmenen senttii ja polvillaan seistiin siinä jään päällä” RMMV 44:6, individual interview.
12- “Ja mä oon aina sanonu, että joka mies nyt 700 tonnia vetää tasamaalle, mutta me vedettiin ylämäkeen!” RMMV 44:20, group interview.
13- ”Kyl se telakkatyö on niin raskasta työtä, et ihmisruumis ei kestä sitä ku määrätyn ajan” RMMV 44:16, individual interview.
14- The intervies can be seen at tinyurl.com/madeinrauma (in Finnish with English subtitles).
15- ”Sähän olet nähny elokuvan Titanic? [...] Siinä, mistä tarina alkaa, näkyy se laiva, ni me olemme sen veistäneet” RMMV 44:32, group interview.
16- ”Juu se o oikeestaan viimene kaunis laiva ku o tehty Rauma-Repolan tai Rauman telakoilla se ei tämä jälkee ni ruvettiin kattomaan vaan sitä tehokkuutta” RMMF 242, individual video interview.

The Polish industrial heritage - its protection and interpretation

Wyka Ewa, Jagiellonian University Museum, Poland

Polish industrial heritage, when viewed chronologically, mainly consists of artefacts from two different historical periods: between the years 1795-1918 when Poland was partitioned by three neighbouring states - and after independence in 1918. There are differences between these two groups of objects - both on the level of the technologies used and our understanding of the industrial infrastructure.
The preserved objects of Polish industry and technology from the 19th century reflect the political and economic situation in the Polish lands during that time. The industry in the three partitioned areas developed according to the economic level of the partitioning states. The most developed industry is seen in the Prussian part (Silesia). Both mining and the metallurgical industries matured there. In the Russian partition, in the central part of Polish lands, the Kingdom of Poland was established in 1815, where textile and metallurgical industries developed. The southern part of the Polish lands, under Austrian rule, was underdeveloped; salt and oil were mined.

Technological and industrial monuments: 19th century -until 1918
The 19th century industrial heritage still preserved in Poland consists mainly of:
* The remains of ironworks in Silesia and historical mines in the Małopolska region
* Within the former Russian partitioned area, technological objects like Plater`s ironworks (Chlewiska, 1890), the steelworks (Maleniec, 1784, rebuilt 1834), and Ludwik Geyer's textile factory, (Łódź, 1828, now a museum) are all preserved
* Existing in the southern part of Poland are the first mine and oil refinery in the country (Bóbrka, 1854,) and the salt mines of unique value (from the 13th century, Wieliczka, Bochnia
* In the area of the former Prussian partition, a few distinctive monuments of engineering art are still preserved, such as the 15th century harbor crane (German name - kranton) in Gdańsk and the water channel known as the Elbląg Canal, from the mid 19th century, designed by Jacob Steenke to facilitate communication between East Prussia and the Baltic. It was built to transport both crops and the timber used to build ships. The canal is still a tourist attraction.

Technological monuments: 1918 - 1939
After independence in 1918, the newly formed Polish state began intensively developing the nation's industry. A new port city, Gdynia, was built. In the central part of Poland, the Central Industrial District was established covering 15% of the country's area. Here, metallurgy and metallurgical industries were advanced. The railway network was developed. Over the years, most of these facilities have undergone systematic modernization, expansion and many of them have functioned as modern enterprises preserving their historical provenance.

These factories have gained new modern machines but most of them remained in their original, now historical buildings.

Technical objects after 1945

After the end of the Second World War, the Polish economy, and hence industry also, was developed in cooperation with the Soviet Union, and with the countries of the socialist bloc. With this came an economic policy that was more focused on building new plants than modernizing old ones.

In Poland, the most important industrial investments of this period were the Metallurgical Ironworks in Cracow called Huta im. Lenin, Huta Częstochowa (Częstochowa Ironworks), Katowice Ironworks and Aluminium works. Shipyards were built in Gdańsk and Szczecin. Heavy industries and coal production continued to be expanded. In 1988, one year before the transformation of the political system in Poland, there were 6250 industrial plants - of which about 30% ceased to exist as part of political reforms that followed. Many technologically outdated factories were closed. Some of them taken over by foreign concerns and incorporated into a global network; most are still active. Many smaller private factories were shut down, unable to withstand the competition. Their buildings have been demolished or are now being adapted for residential, commercial or cultural purposes. This process is similar to that in other European countries.

Current state

It is estimated that currently, in Poland, one-third of all monuments are industrial monuments. The number of these is determined at eighteen-thousand items. In addition to industrial plants, mines, steelworks, factories, gasworks, breweries, distilleries, mills and other types of buildings - a large number are movable monuments in the form of machines and devices, and often also entire technological production lines. According to statistics from 2016, two-thousand five-hundred industrial monuments are registered in the Register of Monuments. This number is not high compared to other registered monuments (12,920 – sacred; 19,650 – inhabited; 5,254 - palaces and residences). There are 15 Polish monuments on the UNESCO list, but only two are monuments of Polish industry: Wieliczka Salt Mine (entry 1978) and Tarnowskie Góry Mine (since 2017).

Today in Poland, different ways of dealing with industrial monuments are employed, depending on the historical period from which they come and the condition they are. The earliest, 19th century, are mostly preserved as museums and historical spaces. These include significant mines, forges, small metallurgical plants, and others. The post-war factories which have finished their production have mainly become shopping centres, apartments or cultural institutions. This direction is similar to many other places in Europe. Good examples include factory adaptations named according to their former function, such as Stary Browar in Poznań (Old Brewery - shopping centre), Manufaktura in Łódź (former textile factory, now city centre), Gdańsk Granaries in Gdańsk (National Maritime Museum) or Goetz Brewery in Cracow (apartments).

Legal protection of monuments of technology

Formal protection of industrial monuments under the law was achieved by the Act of 23 July 2003 on the protection of monuments and care for monuments (Journal of Laws of 2014, item 1446) as amended with last changes in 2017. According to the Act protection covers monuments, regardless of their condition, including technical facilities; especially mines, steelworks, power plants and other industrial plants. The last amendment of the Act of 2017 introduces the establishment of the National Monument Protection Fund, from 2018. This fund is to be a state-owned special-purpose financial mechanism, administered by the Minister of Culture and National Heritage. The funds will be used to save objects damaged as a result of floods or fires.

There is also a register of immovable monuments, including monuments of technology. The legal basis is implemented by the "Regulation Of The Minister Of Culture Of 14 May 2004 On The Registration Of Monuments, National, Provincial And Municipal Records Of Monuments And The National List Of Monuments Stolen Or Exported Abroad Illegally" (Journal of Laws No. 124, pos. 1305).

Registers are run by municipal and provincial conservators of monuments. Protection and care, through entry into the registry, includes objects regardless of their condition. The poor technical condition of a building is not a basis for negating its historical value and abandoning its entry in the register of monuments. Entry into the register of monuments is one of the basic forms of protection for monuments as stated in Polish legislation. It is based on an administrative decision issued by the Voivodeship Conservator of Monuments. The initiator of the proceedings concerning the entry of a monument of immovable property is the Voivodeship Conservator of Monuments or the owner of a monument or a perpetual “legal right” on which a permanent monument is located. The state conservation service operates at all levels - municipal, city, voivodship.

The National Heritage Institute (The NID) is also responsible for supervision of monuments, including monuments of technology in Poland. The institution has been operating since January 1, 2011, and was established in cooperation with the Minister of Culture and National Heritage. The tasks of the Institute include: collecting and disseminating knowledge about the heritage, setting standards of conservation and preservation of monuments. Also, the NID issues expert opinions and reviews on activities relating to monuments, monitors and analyses threats to heritage, and works out ways to counteract these threats.

Activities for the protection of industrial heritage are also undertaken by non-governmental organizations such as associations and social organizations. Poland is a member of European Route of Industrial Heritage (ERIH). The list of ERIH thematic routes includes 20 industrial monuments in the following industries: mining, iron and steel, textiles, production and trade, energy, transport and communication, and industrial landscapes. These are the items that represent the main directions of industrial development in Poland since the 19th century.

Poland is also a member of the International Committee for the Conservation of Industrial Heritage. The Polish Committee for the Preservation of Industrial Heritage is established as a national branch of an international organization. At present TICCIH President is a Polish professor Sławomir Łotysz.
There are also local associations for the protection of industrial heritage, such as the Polish Society of History of Technology (since 1983), the Cracow Society for the Protection of Historic Monuments (1994, Cracow), the Foundation for the Protection of Industrial and Technical Monuments (2000, Warsaw) and the Foundation for the Preservation of Industrial Heritage in Silesia (Wrocław). Unfortunately, they do not cooperate with each other.
An important project for the protection of industrial heritage is the Industrial *Monuments* Route in Silesia, which has been in operation since 2008. On the trail route, there are 42 objects, including museums of technology and plants - either functioning or adapted for other purposes with the preservation of original historical matter. Technology trails have also been established in other cities such as Cracow and Bydgoszcz. However, the popularization of technology heritage and industrial tourism is still under-developed in Poland.

To conclude:
1. Polish legislation adequately protects historical immovable industrial objects before decommissioning and destruction. A separate issue is the observance of the applicable regulations and the protection of immovable technical objects, which are not included in the register of monuments.
2. It is necessary to educate society of our "technical culture", to be sensitive to the cultural value of the surrounding technological objects, not only historical but also contemporary, which very quickly become "historical".
3. It seems to be necessary to promote industrial tourism, which will shape the sensitivity of society to the value of the heritage of technology.

Muzeum Uniwersytetu Jagiellońskiego
Collegium Maius

Slovak Mining Museum in Banská Štiavnica and its technical monuments included on the UNESCO World Heritage List

Jozef Labuda, Slovak Mining Museum

The Slovak Mining Museum (SBM) protects and presents some of the most valuable technical monuments of Slovakia, documenting the history of mining and the processing of precious and non-ferrous metals (gold, silver, lead, etc.). These monuments can be seen in the exhibit entitled *Mining in Slovakia,* located in the former Chamber Court building in the historical centre of Banská Štiavnica. Technical monuments are also displayed in an authentic environment at a former mine outside the town – the area of the Ondrej Shaft and Bartolomej Tunnel. This is the SBM's open-air museum, having both surface and underground parts.

Banská Štiavnica's inscription on the UNESCO World Heritage List was approved in Cartagena, Columbia, in 1993. The inscription applies not only to the 12th to 19th c. historical buildings of the Town Monument Reserve, but also to the technical monuments of the town's surroundings, including the system of water reservoirs (tajchs), spoil tips, mine tunnels and shafts. In addition, historical miners' houses and buildings and sites connected with ore processing, smelting, and mining administration are included on the List.

In 2017, the SBM's historical exhibits – the Bartolomej and Michal mining tunnels, and the Glanzenberg hereditary adit – became part of the Underground Europe project, managed by UNESCO in Paris. Visitors to Banská Štiavnica are extremely interested in seeing the SBM's exhibits; in 2017, some 140,000 people saw our exhibitions. At the moment, we are working on a project in the open-air mining museum where we are planning to add interactive elements in the museum's underground section. The purpose of the project is to allow visitors not only to learn about miners' lives, but also to have a direct experience with their "stories". The Slovak mining museum is managed by 8 exposures: in tours Banská Štiavnica and Handlová.

The open-air mining museum

The most visited exposition of the Slovak Mining Museum offers the surface and groundwater exposure of the area of mining and quarrying of The Theresa Vein and the educational geological exposure – The Geology in Slovakia. The exposure is very popular because of the visitors experience of mining underground – to Bartholomew tunnels and The Ondrej Shaft- the oldest parts are dated back to the 17th century. Visitors receive a helmet, jacket and a lamp before going down into the underground.

Hereditary adit glanzenberg

The latest exhibition of SBM (Slovak Mining Museum), opened in 2003 to the public. The Glanzenberg Tunnel is one of the oldest tunnels in the region of Banská Štiavnica. It is famous due to visits of several monarchs in the past (The Habsburgs) and many celebrities at the present times. In honor to the most important of them, there are memorial plaques placed in the tunnel. Visitors enter the tunnel dressed in a cloak, with a helmet and lamp - in effect to create an authentic environment.

Kammerhof - mining in slovakia

It is the largest building complex in the city center, the former residence of main "chamber- county" office. In the premises of Kammerhof - in its 14 rooms, today there is the Exhibition of Mining in Slovakia representing the history of mining, mining science, mining technology, mining education at the academy in Banská Štiavnica and also imperial visits to the city, etc. The most interesting exhibits are measuring devices, working models of machinery, ceremonial mining robes, gowns and the mining insignia. In the building complex, there is also the exposure called The History of Book Culture.

Berggericht - mineralogical exhibition
The former residence of the Mining Court, later used for the needs of the Mining Academy. Nowadays, there is the mineralogical exposure presenting more than 400 kinds of minerals from all over the world and also raw materials in Slovakia. Within the survey, it is possible to visit the Michal Tunnel - available in the length of 75 m. There is also the Information Center of Banská Štiavnica in the building of Berggericht.

The old castle
It is a textbook of architectural styles of the 13th-19th century. The oldest part of the castle is originally a Romanesque basilica, at a later stage rebuilt into a fortress against the Turks and The Chapel of St. Michael. The collection fund of The Old Castle is represented by its exposure units: Archeology, Baroque Sculpture, Shooting Targets, Blacksmith, Pipe Craft, Clock exposure, Visit of the tower, prison and torture chamber. The Old Castle, thanks to its unique atmosphere, is a place of many cultural events nowadays.

The new castle
The prismatic structure, built as a fortress against the Turks, thanks to its typical but unmistakable architecture dominates the city. New Castle was built between 1564 - 1571 as a part of the town fortifications. Today there are exposures called Slovakia during the Turkish Expansion and The History of the Voluntary Fire Brigade/Department.

The jozef kollár art gallery
It is located in three restored buildings from the 16th century in the heart of Banská Štiavnica- on The Trinity Sguare. Except regularly changing exhibitions, the gallery exhibits more than 200 pieces of the most valuable works of art that arose during the 15th – 19th century. At the same time, the gallery represents the art of the 20th century, mainly represented by the works of Edmund Gwerk and Jozef Kollár. Thanks to Jozef Kollár, Banská Štiavnica is called Kollár ´s Štiavnica.

From the history of mining in the banská štiavnica region
The Banská Štiavnica region, located in the centre of Slovakia, ranks among the most important mining regions in Europe. The region was renowned not only for the extraction of silver ore, but also gold, lead, copper and other ferrous metals, too. Another outstanding feature of the region´s past was a span the extraction of ores has been going on for. It is believed that the mining had its beginnings in the Celtic period from the 3rd to the 1st century BC , and both mining as well as settlement of the region have been continuously happening since the 12th century until today. The above suggests how big ore supplies must have been.

The development of mining technology went hand in hand with the quantity of exploitation and the changes in the landscape appearance. The 13th century is considered as an era of mining boom followed by a period of prosperity of the town. German settlers - miners were granted privileges by the then king which led to massive accumulation of workforce and encouraged intensive construction as well. The existence of two major Romanesque structures from the first half of the 13th century just 300m from each other clearly demonstrates this fact. In those days, miners built technical facilities (designed for testing and smelting) in the proximity to the settlements due to the availability of water and wood. The landscape looked chaotic because both houses as well as technical facilities were built directly „on the ore". For example, Banská Bystrica had its mining facilities 10 km north-east of the town (Špania dolina, Staré hory).
The second stage of mining boom can be linked to the introduction of the gunpowder in 1627, which had its effects in the urban shape of the town. The golden age of mining in the Banská Štiavnica goes back to the 17th and 18th centuries. For instance, in 1690 Banská Štiavnica smelters produced 29,000 kg of silver and 605 kg of gold. Moreover, the system of water reservoirs, 60 in total, was completed then. The reservoirs were connected by a network of ditches (120 km in length) and the water provided energy for mines, ore processing and smelting. A unique pumping technology invented by J.K. Hell and S. Mikovíny set a good example for other mining regions in the world.

In the first half of the 18th century steam atmospheric pumping machines, under the supervision of Izák Potter, were applied. These required enormous supply of wood thus causing deforestation of the landscape. The above can be seen on the mining maps from the 18th century. Paradoxically, although from the environmental point of view the mining area was devastated (the construction of reservoirs, the presence of dumping grounds, the operation of smelters containing harmful substances ....), it proved to be effectively exploited from the economic point of view. The 19th and 20th centuries saw a decline in the extraction of ores, resulting in the infiltration of greenery. Today, 22 lakes which have been preserved serve as reservoirs of drinking water or simply as recreation areas. Not only for the architectural marvels of the town itself, but also for the preserved technical monuments, Banská Štiavnica and its vicinity was designated a UNESCO world heritage site in Cartagena (Columbia) exactly 25 years ago, in 1993.
So, the Slovak mining museum, the Town of Banská Štiavnica, its residents and many visitors will celebrate this year anniversary also by exhibition in Old castle.

REFERENCES

1 - Labuda, J., 2009: *L ´influence del ´industrie miniére et sidérurgigne sur le paysage de la région de Banská Štiavnica. In Les paysages de la mine, in patrinoine contesté.* Lewarde, 2009, s. 90-93.

2 - Labuda, J. – Tomeková, M., 2011: *Slovak mining museum and its share of development of tourism in region Banská Štiavnica.* In Konferencja muzeów górnicznych i skansemów podziemnych w Polsce, Wieliczka, s. 164 – 176.

3 - Labuda, J. – Michna, O., 2014: *Banské múzeum v prírode – Banská Štiavnica/Open air mining museum – Banská Štiavnica.* In *Múzeum*, 2014, roč. 60, č. 2, s. 12.

4 - Labuda, J: - Harvan, D., 2016: *Starý a Nový zámok v Banskej Štiavnici – história, súčasnosť, budúcnosť/ Old and New castles,* in B. Štiavnica – *history, present and future/*. In Múzeum 2/2016, ročník LXII, s. 22 – 25.

Creating a cultural identity through the heritage of technology an inseparable relationship on the example of Wieliczka

Kinga Stabrawa-Powęska, Cracow Saltworks Museum, Wieliczka, Poland

Introduction

Cultural identity of the man may be inseparable from technical heritage. This phenomenon is especially visible in places where industry has developed. An excellent example showing such a co-relation is Wieliczka, in which the salt mine from ages constituted its integral part.

A work place brought together, but also distinguished the employees from the rest of the society, which enabled generating a set of characteristics setting the group apart. The work of miners, the ethic norms they obeyed by and their way of life caused that people living in Wieliczka stood out against other groups of people and developed their own folklore. Today, in the town there is a high percentage of families linked for generations to the salt mine and the town. The old folklore has been cultivated up to this day through some rites and habits. Despite the fact that currently the mine is, first of all, a tourist attraction as a monument of technology, it enjoys a high place in the perception of the town residents.

The legacy of the Royal Salt Mines has become an essential element joining the worlds of technology and culture. The dialogue between these seemingly disconnected spheres made it possible for a community to form which is distinct to the present day.

Both ethnographic observation and other academic materials available, among others, in the museum collections, indicate a strong co-relation between the cultural identity of people connected with the salt mine and their place of work, recognised as a monument of technology already years ago. The example of Wieliczka makes it possible to analyse in detail the relations between the technological heritage and cultural identity.

Cultural identity

While searching for a definition of culture, one may encounter many, often similar, descriptions, assigned to different meanings. The multiplicity of definitions of culture shows that it is multi-layered, which may stem from the fact that it is a subject of many fields of study, in which different elements are the focus of attention. Therefore, in my opinion, in the attempts at defining culture it is important to verify the definitions through empirical studies.

Many researchers have already tried to define culture. Already in 1952, Alfred Louis Kroeber and Clyde Kluckhohn collected over 100 definitions of culture. Yet, in a description of the meaning of the word 'culture' a few aspects may be highlighted.

First of all: *"culture is a set of phenomena, whose mutual inter-relations, determinants and influences can be described and analysed, but never appraised"(1)*. Referring to the definition of the field of cultural anthropology, we learn that: *"Culture - a term referring to a general scope of creations of man, structured creations of man, structured as an independent aspect of a social life of both the human species as a whole and of particular societies, ethnic and local groups, as well as different social strata and classes in their historically diverse and changing reliance on the environment*"(2). At this point it is worth mentioning the first academic definition of culture by E.B. Tylor: *"Culture, i.e. civilisation in a broad ethnographic understanding, is a complex totality of knowledge, beliefs, art, law, morality, customs and all other capabilities and habits acquired by a man as a member of a society" (3)*.

Analysing and drawing on many definitions of culture, some re-occurring elements may be specified. Firstly, it should be stressed that culture is connected with man as its creator and, at the same time, its recipient. Next, it should be emphasised that culture is a social phenomenon, that it is regular, or else that it is a set of innately taught and learned/studied/acquired phenomena. Depending on what the researcher wants to present, he/she may look for characteristic elements and make the definitions more detailed. For example, one may direct attention to the temporal dimension – since a characteristic feature of culture is that is stretches over a long period of time – or to its spacial dimension, or else highlight the fact that it is a system which constitutes a totality of sorts. Culture may be taken as the man's adaptive mechanism in the world of nature, in the natural environment of man.

Similar problems are related to defining man's cultural identity. Referring to the collective definition from the Ethnological Dictionary, the reader may find out that cultural identity is: "*the most important type of group identity consisting in the historically conditioned, cultural means of preserving by a given community the existence and continuity of the species, as well as its biopsychical balance. It is constituted by: 1) the elements of heritage, even invalid, whether in part or in total, 2) the kind, proportion and structuring of the elements constituting a given culture considering discreteness of cultural characteristics and the level of economic universals, as well as those linked to civilisation, within a given culture, 3) the exterior context of equivalent or unequal contacts with other cultures, which may occur with varying intensity in the past and present*" (4). Similarly as in the case of the definition of culture, we deal hear with a large generalisation.

1- E. Nowicka, *Świat człowieka – świat kultury*, PWN, Warszawa 2002, p. 57.

2- Słownik etnologiczny, Ed. Z. Staszczak, PWN, Warszawa-Poznań 1987, p.187.

3- Ibidem, p.190.

4- Ibidem, p. 351-352.

However, what draws attention in this case is the meaning of collectivity, influencing how the identity is shaped. What is important here is to focus on the elements characteristic to a given community and verification, through the analysis of the existing materials and, if possible, through the empirical studies of the given community.

To sum up the definitions describing the cultural identity, the latter may be said to be a fixed identification of a specific group of people, visible in their convictions, opinions, customs and habits and in their axiological system. Based on this, the functioning of people in particular groups makes it possible to specify them as a special totality, a community.

Wieliczka is a good example illustrating how the society linked to a specific enterprise developed its culture and cultural identity in relation to the place where it is located and which it created.

Short history of the town of Wieliczka

Wieliczka is a town which was granted a charter as early as in 1290 (5). Yet the history of this place begins much earlier, at the moment of the first people arriving in this region in search for salt. Archaeological excavations show that the oldest signs of human activity in the region of Wieliczka and Bochnia date back to the Palaeolithic Age. Various research make it possible to specify that forming of the deposit took place over 200 thousand years, 13.6 m years ago. Owing to the numerous archaeological discoveries, we know that the saline springs contributed to the development of this region. In spite of the long history of the saltworks industry in the area of Wieliczka in Bochnia, the time of fundamental progress falls on the 13th century when the deposit of rock salt was found (6).

Discovering the rich strata of the rock salt in Wieliczka and Bochnia caused the biggest changes in the organisation and technique of soil production in the two mining towns of the Lesser Poland. As a result, the mines and saltworks in Wieliczka and Bochnia were together, up to 1772, one of the main industrial centres in the Poland of old – one big saline enterprise called the Cracow Saltworks. Its legislators, owners and disposers of the acquired income were Polish kings – up to 1772, when the Polish Crown began to gradually lose the territory belonging to the state (7).

The large – in comparison to other contemporary enterprises – Cracow Saltworks were probably founded at the end of the 13th c. and owe their organisational beginnings to the wise politics of the Duke Bolesław the Chaste. The proof of great importance of the presence of soil for Wieliczka are the special documents that were drawn up.

5- A.Jodłowski, *Żupa solna w Wieliczcze*, MŻKW, Wieliczka 2000, p.44.

6- Ibidem, p.28.

7- Ibidem, p. 58-72, 85-101.

The first was the *Statute* of Casimir the Great from 1368 – the first mining ordinance for the saltworks enterprise of Wieliczka and Bochnia. The document issued by the Ruler enacted old customary norms and introduced new regulations with the aim of improving the functioning of the saltworks and increasing their profitability. The principles formulated at that time were in force in the Cracow Saltworks up to 1649, i.e. until a totally different mining ordinance was issued. That document was immensely important for the community linked to the mine and the saltworks. Pursuant to the regulations from 1368, the rules governing the ownership, working conditions in the mine, the salt trade, the level of the soil production, taxes on the trade in salt and the conditions concerning the export of salt, were described. It may also be inferred form the document that the king took the very miners into his care as well (8).

The fast progress in the Cracow Saltworks in the 16th and 17th c., led to technological enhancements, including greater diversification of technological and social organisation of these works and the necessity of a change in organisation of the sales of the salt.

The partially reorganised and modernised mining enterprise became, pursuant to the partition treaty of 05.08.1772, a property of the Habsburg Monarchs for over 146 years. The system-wide political changes, as well as others concerning the law and the state, undoubtedly influenced the development of the salt industry in Galicia. They were especially visible in the organisation and in the legal relationships in the salt industry in the Lesser Poland.

The administration system was changed substantially, with some specific functions being dissolved, such as the office of mine administrator and its deputy, replacing them with the State Saline Authority with an administrator at the head, to whom both the mines (Wieliczka and Bochnia) would be subjected in the scope of salt production and sales. This led to far-reaching changes in quantity and quality concerning organisation and administration, techniques and technology (9).

The next considerable stage in the history of the region was the turn of the October and November 1918, when the Poles started to take over the rule of the territory belonging to Poland. The Polish Liquidation Committee, established on the initiative of Polish deputies, already 1 November 1918. took over the Cracow Saltworks. From that point on, each of the mines constituted an independent enterprise with a warden, later a director, at the head. The inter-war period was a time of stabilisation for the former saltworks, connected with further progress and development of the mines. On the other hand, the 5-year period of German occupation went down in the history of the mines as a time of increased mining and, in the case of the mine in Wieliczka, an attempt of the Germans to launch an underground production of parts for the weapons industry (10).

8- Ibidem, p. 45-48.

9-Ibidem, p. 101.

10- Ibidem, p. 112-113.

Due to the exhaustion of the salt deposits and the resulting unprofitability of the mining, in the 2nd half of the 20th c. the production on an industrial scale was gradually discarded. The exploitation of the deposit in the Wieliczka mine was finished in 1996 and the mine was transformed into a tourist attraction and a health resort, operating to this day.

The technology heritage and the cultural identity on the example of Wieliczka

The extraordinary historic and natural value of the salt mine in Wieliczka caused that it was entered already on the First UNESCO World Cultural and Natural Heritage List in 1978. In 2013, the entry was expanded to include also the mine in Bochnia and the Saltworks Castle in Wieliczka. From then on, they are jointly called the Royal Salt Mines in Wieliczka and Bochnia.

The uniqueness of the rock salt Mine in Wieliczka as a monument of technology consists in capability to display all the historical stages of the development of the mining technology between the 13th c. and the 20th c., and the preserved machinery and tools document old systems of deposit exploitation, transport, dehydration, lighting and ventilation of the mine in a unique way on the world scale. They have been, as a whole, described in the historical context, disclosing the fight of the man with the nature. The mines, together with the Saltworks Castle in Wieliczka, document the history of the royal mining enterprise of the Cracow Saltworks and the material and spiritual culture of the miners.

Along with the mine, the town of Wieliczka also developed, and with it – the community centred around their place of work. Analysing the records of the researchers and the materials in the collections of the Cracow Saltworks Museum in Wieliczka, one can observe the development of the cultural identity of the residents of the Wieliczka region. Illustrations of it may be found in the rich spiritual culture and folklore. The analysis of the materials is more interesting considering that many of the examples are still valid.

One of the spheres having a tremendous impact on the cultural identity of the Wieliczka residents was and still is the religion. The religiousness of the miners was considerably influenced by the awareness of the danger posed by the miners' work. It stemmed from the need of protecting their lives and of the material security of those close to them. Strong commitment to the religion was visible especially in the religious practice, but also in rites and customs, making it a folklore religion. Stefan Czarnowski remarks that: *"A religion once adopted strives to mould the societal environment according to a scheme it brings about. This society, however, is not a passive matter, but a living and simultaneously active commune, driven mightily towards self-expression, as full as possible, in all domains, and in such a pursuit, it leaves its mark on the religion.*

It introduces elements of foreign beliefs and rituals into the religion, associates the religious practice with societal values with which they have nothing in common; It transforms it so that it fulfils the goals of the society, reflects its own image and likeness" (11). A range of examples proves it.

An instance of striving to stay in daily contact, with the things sacred, were places of worship: underground chapels, altars, shrines, figures of saints, paintings. In the mine there was a custom, up to the middle of the 18th c., to participate in the mass every day before work. Later, the masses took place only on the most important holidays and anniversaries. Independently from various administrative and political situations, the works were always commenced with a prayer (12). The miners' very way to work would be accompanied by singing, mainly of religious songs. Underground, the miners greet each other, today as in the past, with the words "God bless". Ludwik Młynek wrote in his book: *"A miner in Wieliczka prays before he goes down to the mine, while he is going down and during chopping the salt with a pickaxe"* (13). In the collections of the Museum, there are many pieces of a sacred character, such as holy paintings or crosses found underground. To show their respect for religion, miners built underground chapels. The biggest underground site of a sacral nature in Europe, which can be found in the salt mine in Wieliczka, is St. Kinga Chapel, filled with sculptures made of salt, telling the story of Jesus. Archival pictures show whole mining families participating in celebratory masses in this chapel. The commitment to the catholic church showed also in the cult of saints. One of the most characteristic figures associated with Wieliczka is St. Kinga, patron saint of salt miners. Kinga was a daughter of the Hungarian king Béla IV, wedded to the Polish Duke Bolesław the Chaste. As a founder, she contributed to the development of the Lesser Poland – the region where the former Polish capital and Wieliczka are located. Her life may be held as an example of religiousness and modesty. After her husband's death, she entered the Order of St. Clare in Stary Sącz, which was established by her, and where she died on 24th July 1292. Her life and activities bear testimony to her sanctity. In recognition of that, Kinga was proclaimed blessed already in 1690, and in 1999 she was declared saint. Her holiday is celebrated pompously on 24th July, on the day of her death (14).The figure of the Duchess Kinga is prominent not only regarding the religious and historic aspects of her life. In the Polish culture, and in that of the Lesser Poland in particular, there is a legend connected with her that still lives on. It tells the story of how the princess threw her wedding ring to the mine shaft in Hungary and already in Poland, near Wieliczka, she told her people to dig in the ground. According to the legend, one of them found a lump of soil in the soil and in it – the princess's ring. In this way, Kinga was to bring the salt to Poland. The legend is well known in whole Poland and often told, especially to children.

11- S. Czarnowski, Kultura religijna wiejskiego ludu polskiego [in:] Kultura, Warszawa 1958.

12- U. Janicka – Krzywda, *Górnicy wielickiej kopalni*, Kraków 1999, p. 22-23.

13- L. Młynek, *Dzieje parafii wielickiej w zarysie*, Kraków 1935.

14- U. Janicka – Krzywda, *Górnicy wielickiej kopalni*, Kraków 1999, p. 29-31.

The memory of this figure is still alive not only among the miners themselves, but in the whole region as well. The salt mine has the biggest underground salt chamber of her name, in which there is a large sculpture of St. Kinga with her attributes, i.e. the ring and the lump of soil. Regular masses are held there regularly, as well as sacral or classical music concerts. Many iconographic depictions of her can be found in the museum collections. The celebration linked to the commemoration of the patron saint are an important mining tradition, but also a big family holiday for a wider group of people.
Another patron saint of immense importance for miners is St. Barbara. St. Barbara is a patron saint of all miners and people having a hard, dangerous job. As reported by the lore, she died a martyr's death, determined not to abandon the Christian faith. She is a patron saint of the most important Polish mining holiday – the so-called Barbórka (St. Barbara's Day). It falls on the 4th December and is very solemn in character. During the celebration, a grand mass is held in St. Kinga's chapel. The miners are wearing uniforms, the orchestra is playing and the old mining songs are played and sung. It is also on this day that accomplished miners are awarded swords and other distinctions, as well as mining ranks. In addition, a feast is held along with the accompanying games and customs typical for mining. A most characteristic one is jumping over the leather, which has a function of an initiation. A young entrant has to jump over the leather, which is an element of the traditional mining uniform, and in this symbolic way he is admitted to the professional community of miners (15).
These convictions belong to representations of the supernatural, which are typical in professional groups working in conditions posing a life hazard. On the one hand, they existed with the purpose of throwing light upon unknown phenomena encountered by them at work. On the other, they were to regulate the behavioural norms spelling out what was acceptable and what was not.
One of the most frequently appearing figure in the beliefs of miners was the Treasurer, also known as the Ghost or He. Various tales relate that he appears under various disguises, e.g. a man with a beard, a miner in the uniform or as animals such as a cat, dog or mouse. In the Polish culture, the Treasurer is a good ghost, taking care of the miners working underground, safeguarding their safety and watching over just division of work and earnings. However, he becomes cruel and threatening when he imposes penalties for various faults, e.g. cheating while working or cursing. Sometimes he is vicious, e.g. he hides the miners' tools in order to remind them of his existence and command respect.

15-Ibidem, p. 27-28.; cf. A. Bęben, *Górnicza lampa się pali*, AGH, Kraków 2008, p. 106-108.

The Treasurer is also a figure helpful to honest miners, to whom he points out salt of a better quality. In the contacts with the Treasurer, a miner's honesty is tested (16). At present, the figure of the Treasurer is still known in the region. The memory of the beliefs is, in this case, upheld by the museum itself. The stories about the Treasurer are also included in educational classes for children.
A figure linked to the underground Wieliczka, which can be found in the folklore, is also a White Lady. She is, most likely, the only she-demon associated with the underground, which can be encountered in the mining environment.
At present, the figure of the Treasurer is still known in the region. The memory of the beliefs is, in this case, upheld by the museum itself. The stories about the Treasurer are also included in educational classes for children.
A figure linked to the underground Wieliczka, which can be found in the folklore, is also a White Lady. She is, most likely, the only she-demon associated with the underground, which can be encountered in the mining environment. The mining folklore depicts the White Lady as a definitely malevolent spirit, causing damages, bringing evil and stalking others. She is usually portrayed as a woman in a white dress, trying to disturb the miners' work and to talk them into breaking mining regulations (17). In this case we are dealing with convictions about the paranormal, blamed for inappropriate conduct of miners: it is not them who broke the rules– they were led to do it by an outside force.
The most frequent motifs proving the contact with supernatural powers underground are connected with the idea of protection over those working there. One can equally often happen upon the theme of a reward and punishment for bad behaviour, neglecting work or flouting the accepted standards. Sources of such beliefs are to be found in pre-Christian traditions and folk culture.
All the given examples of people related to the folklore or things sacred are present in the contemporary social consciousness of the residents of Wieliczka. An illustration may be their presence in various festivities and cultural events. It is the norm that people belonging, for instance, to a folk music band, dress up as these characters and stage chosen scenes featuring them. Furthermore numerous places are named after these figures in Wieliczka, such as the Park of St. Kinga. The community of Wieliczka takes part in the celebration of mining holidays and identifies with the customs surviving up to this day. In Wieliczka, the most important professional group have been the miners. In the past, as it is today, they are characterised by religiousness, distinct attire and customs. However, as a result of ending the exploitation of the salt deposit, concentrating on protecting the underground and development of tourism, a new professional group appeared – guides. They are often retired miners, having a first-hand experience of working in the mine.

16- U. Janicka – Krzywda, *Górnicy wielickiej kopalni*, Kraków 1999, p. 35-38.
17-Ibidem, p. 38-39.

Some of them are children of miners for whom the mine is a place of a special importance. They are both men and women. They must attend a few months training, ending with an examination. The majority of guides come from mining families, for whom the mine was something more than simply a place of work. Owing to the personal attitude to this place, the guides coming from mining families not only know the specific mining terminology or interesting stories about the mine – they are able to enrich their tales with the context which is a product of the experience of those close to them or their own. Therefore, they possess all kinds of knowledge: from the mining technology, to historical facts and legends. The personal approach to this place, of both the visitors and guides, demands from the latter to exhibit extensive knowledge and respect for this place, which is something more than an attraction – it is a place which brings members of the community together, connected with many generations of families of Wieliczka.

In Wieliczka, the tradition is visibly cherished also through festivities, which can be seen not only underground, but also in the town. It is often a sight of revelry, though not always directly linked with the venerations of saints. But the celebrations organised do draw back on the salt and the history of the town. The events are of various character. Sometimes they are concerts, at other times – festivals at which people in attires from different epochs carry out works done in the past. One of the occasions for celebration in town are the festivities in honour of the patron saint of salt miners, the already mentioned St. Kinga. It is an opportunity not only for having fun in the whole town, but also for artists, numerous in the region of Wieliczka, to present themselves.

Another example of the celebration is the event "Feast of Salt", organised by the Cracow Saltworks Museum. The annual feast takes place in the yard of the Salt Works Castle. During the celebration, one may see how salt was obtained from brine, how people dressed in medieval times and what professions were practised then. One may also get to know how the Cracow Saltworks operate and why salt was called white gold. During the festivity, a range of artistic performances, including the mining orchestra, may be seen.

Events of this sort are also an occasion for family gatherings, facilitating even stronger identification of the participants with the communality of Wieliczka. The celebration engaging many generations can also be witnessed in mass attendance or passing stories broadly connected with the subject of salt and the history of the region. Because of that, the whole society of the Wieliczka residents may identify with the culture and traditions which developed through the ages owing to the presence of the salt mine.

In Wieliczka, there are many more instances of identifying with the culture and tradition having their basis in the mining industry. An illustration of that is, say, the town's emblem (with mining symbols), street or park names referring to the prominent

personages of the region or the common knowledge of much of the mining terminology and sayings using the motif of salt. The residents, whose families have been closely connected with the salt mine for generations, constitute a distinguishable social group.
The importance of the place where a local community lives is also visible through the institutions which were founded to educate and keep the memory of this place alive. One of such institutions was the so called *Sztygarówka* – a Mining School (1898-1933). Its task was to educate the middle technical management for the purposes of the development of the local mining industry (18).
Another one, being is the Cracow Saltworks Museum in Wieliczka. Museum is a state cultural institution established in 1951. Its mission is to preserve and popularise the rich history of salt mining in Poland, which is perceived as a lasting legacy of humanity. The idea of saving the Wieliczka Salt Mine, as a monument of nature and the work of Polish miners was presented by Alfons Długosz - an artist and a teacher from the local school.

Conclusion

From the analysis of the examples given above and academic materials it undoubtedly follows that the technological heritage of the salt mine in Wieliczka is inseparable from the identity of the town's residents since it is its source.
The case of Wieliczka shows how the work place – the salt mine – extending over many centuries, has affected the development of the commune characterised by specific features. They show it through language, beliefs, customs and attitude to tradition, the catholic faith, and also through the historic knowledge connected with the mine. The examples given in this article are only a small sample of the abundant individuality characterising the communality of Wieliczka.
There is no more salt mining carried out in the town, but the cultural identity of the region stands firm. The residents are aware of the various spheres of the mine's importance. On the one hand, it is commonly valued as a withdrawal facility, and on the other – it is seen as an important monument of history. The proof for it is that the tradition is upheld by the younger generations, also linked to the mine, e.g. tourist guides, employees in the health resort, musicians in the mining orchestra or other such enthusiasts. It is an evidence of the fact that today, there is still strong affiliation between cultural identity of those connected with the mine and their place of work, recognised years ago as a monument of technology.

18- M. Międzobrodzka, P. Krokosz, Górnicza Wieliczka. Przewodnik po mieście, Wieliczka 2013, p. 24-26.

Bibliography:

- Bęben A., *Górnicza lampa się pali*, AGH, Kraków 2008.

- Czarnowski S., *Kultura religijna wiejskiego ludu polskiego* [in:] *Kultura,* Warszawa 1958.

- Janicka – Krzywda U., *Górnicy wielickiej kopalni*, Kraków 1999.

- Jodłowski A., *Żupa solna w Wieliczce*, MŻKW, Wieliczka 2000.

- Międzobrodzka M., Krokosz P., *Górnicza Wieliczka. Przewodnik po mieście*, Wieliczka 2013

- Młynek L., *Dzieje parafii wielickiej w zarysie,* Kraków 1935.

- Nowicka E., *Świat człowieka – świat kultury*, PWN, Warszawa 2002.

- *Słownik etnologiczny*, Ed. Z. Staszczak, PWN, Warszawa - Poznań 1987.

The Advancement of Scientific Culture in Cultural Landscapes A Study of the Pattern of Relating Scientific and Industrial Heritage with Science and Technology museums in China

Ren Jie & Feng Xiaojing, China Science and Technology Museum

Abstract: The scientific and industrial heritage of a country has high historical, scientific and cultural value as it reflects the scientific-technical development of a society, bears witness to the brilliant scientific achievements of the industrial age, and enriches scientific culture. Science and technology museums, whose main function is to advance scientific culture, have moved from the initial collection and exhibition of scientific and industrial products to the production of exhibits of all kinds based on their science-educational function, thereby communicating scientific knowledge and scientific methods to the public. And it may be advantageous to even extend the range of objects considered worth to be looked at from a museum's point of view.

In contemporary China, which advocates green architecture and ecological city construction, the scientific cultural value of the scientific and industrial heritage has become an attractive point for a city, a point that has a unique charm. While the traditional way in which museums worked was to collect artifacts, bringing them into a museum and presenting them to visitors, many parts of the scientific and technical heritage are simply too large to move them into a museum or they may fit better in their original environment. It may thus be preferable to make such buildings or objects part of a museum at the site where they are – as is done in other areas of culture with objects such as palace buildings, monuments or natural habitats. We may think of prototypical industrial plants of the past, scientific labs in which famous scientists have worked and major advances have been achieved or paleontological excavation sites, for example. Such sites may didactically be used as case studies demonstrating to visitors the connection of S&T with the social context and the process of scientific inquiry and technological development.

As China makes continuous progress in its social and economic development and its industrial transformation and upgrading, it is beginning to place the protection and utilization of scientific and industrial heritage on the agenda. Science and technology museums could make a valuable contribution to conserving this scientific-technical heritage, bringing it to the attention of citizens and making it a valuable resource for the development of a scientific culture. This would lead to a closer relationship between science and technology museums and their social context. The scientific and industrial heritage also has value as a typical resource for science popularization. Its use as such cannot only expand the number and variety of ways of science popularization thus facilitating the improvement of public scientific literacy, but also help preserve this heritage and utilize it reasonably in the process of science popularization.

This paper analyzes the present forms and possible extensions of the ways in which scientific and industrial heritage can be related with science and technology museums in China and the practical significance of this relationship in terms of communicating scientific culture and popularizing science. To that end, a review of current examples of such linkages of scientific-technical heritage and museums in China is compiled. Furthermore, examples from other countries are analyzed and their relevance as models for China assessed. Based on that review, the paper develops new ideas of how to sustain and expand the scientific cultural value of scientific and industrial heritage in China's science and technology museum development.

Introduction

Throughout the historical development of mankind, the industrial society did not survive long, only lasting for merely 300 years. In China, the industrial age approached much later, although it was short, culminating in a complicated development process. Once upon a time, those huge workshops and gigantic machines which witnessed the pride of human civilization get ruined and displaced with time, turning into the pronouns of oldness or obsolescence. Some century-old classic architectures and remains that could even speak for the industrial age are now regarded as the scars of city and are to be razed to the ground by bulldozers.

Definition of Scientific and Industrial Heritage: industrial heritage is made up of the industrial cultural remains which are endowed with historical, technological, social, architectural and/or scientific values. Such remains consist of buildings, structures, machines, workshops, factories, mines, warehouses or storerooms, energy production, transmission, utilization and transportation facilities and all underground structures and sites; industry-related public activity venues and sites (such as residential area, religious sites or educational institutions) are also categorized as part of the industrial heritage (1).

Broadly-defined Scientific and Industrial Heritage: relatively antique remains, including the remains from the handicraft industry, processing industry and mining industry before the Industrial Revolution. It is also believed by some that such remains should include prehistorically sizeable stone ruins and large-scale water conservancy projects or mining sites.

Narrowly-defined industrial heritage: it refers to the industrial remains made by steel and iron as new materials, driven by coal and oil as new energies and characterized by mechanized production descended down from the Industry Revolution in the 18th century, UK.

1- TICCIH *Nizhny Tagil Charter* July 2003

Values of Scientific and Industrial Heritage

Historical value: they are the remains of history and the witnesses of industrial development and lives of people in the period of social transition. By virtue of the messages carried and the uniqueness, they become the industrial footprints of modern social civilization along with the growth of cities as well as the carriers of historical images.

Social value: the industrial production is a vital constituent part in our lives. It is the exact embodiment of the social value of the industrial heritage to record such activities, to reflect the roles of people in production activities and the influences on the production by politics and community. The industrial heritage signifies the meanings of percept, education and impartiality.

Artistic value: the artistic value of industrial heritage is mainly instantiated in following manners: buildings or structures embodying the styles, genres and features of architectural art prevailed in a certain period of history; works created by renowned architects; artistic expressions, appeals and aesthetic value manifested by industrial buildings or structures and facilities or equipment; architectural design or high-quality planning expressing the progressive nature of the time.

Economic value: industrial buildings mostly are sturdily structured which, unlike new constructions, is instrumental in saving the spending on main structures and part of available infrastructures and with shorter construction period required for transforming such buildings. Meanwhile, the industrial heritage can also be taken as designated infrastructure for rational use to maintain its existence and generate ripple effect in multiple dimensions.

Discussion

2.1 Histories and distributions of Chinese industrial heritages

	International	China
Development History	Research and protection of industrial cultural heritage sprung up in the UK – the birthplace of the Industry Revolution In early 1960's of the 20th century, the existence or abolishment of London Euston Railway Station triggered a nationwide industrial heritage protection campaign in the UK.	In April, 2006, the State Administration of Cultural Heritage held the 1st China Industrial Heritage Protection Forum in Wuxi. The proclamation of Wuxi Recommendations proposed the concept of industrial heritage protection in China for the first time ever and gave the definition of the industrial heritage as "the industrial heritage is an important constituent part of cultural heritage, referring to the industrial cultural remains with historical, social, architectural, technological and aesthetic values".
	In 1973, the British Industrial Archaeological Society was founded. The opening of the 1st International Industrial Monuments Preservation Conference marks the inception of the cause of international industrial heritage protection.	On May 12th 2006, the State Administration of Cultural Heritage issued the Notification on Strengthening the Industrial Heritage Protection.
	In 1978, the 3rd International Industrial Monuments Preservation Conference held in Sweden proclaimed the establishment of the international industrial heritage protection committee which became the world's first international organization committed to the promotion of industrial heritage protection.	The industrial heritage was brought into the scope of archaeological survey for the first time during the 3rd national archaeological survey in 2007.
	In July, 2003, international industrial heritage protection committee accepted the international norms developed dedicated for the industrial heritage protection at Nizhny Tagil Meeting in Russia, called the Nizhny Tagil Charter which defined the basic concept of the industrial heritage.	On July 28th, 2008, "the 1st Industrial Heritage and Social Development Academic Conference" was held in Harbin, at the meeting, issues like the industrial heritage protection and development in China, social values of industrial heritage and industrial heritages in old industrial base transformation in Northeast China were discussed.
	Of which, the declarations of international instruments such as the Venice Charter, the Nairobi Recommendations and the Washington Charter played significant roles in expediting the protection and utilization of industrial heritage.	In August, 2009, the Ministry of Culture issued the Cultural Relic Verification and Management (Tentative) Measures which categorized the "industrial heritage" as the cultural relics for the first time.

2.2 Case study: to convert Scientific and industrial heritages into theme museums

Science and technology museum is a protection-oriented business pattern in museum display form to preserve the industrial heritage based on its current state at original site. Such pattern usually runs by setting up different types of industrial technology halls and specialty venues on the basis of such heritages' inherent industries and product properties to record collect and display the industrial resources, industrial technologies, and industrial development. For instance, the Ruhr industrial Base in Germany has opened 6 national-level museums; nonetheless, similar venues are springing out in China as well. Industrial remains of Jiangnan Shipyard and Nanshi Power Plant: as the historical witnesses for the inception of the Chinese industrialization in the 19th century, they with new visages stand firmly by the bank of Huangpu River at World Expo in the 21st century.

Tsingtao Brewery Museum

The preservation of industrial architectural heritage and spatial reuse are the means of resource utilization for urban sustainable development. Architectures built in early times and industrial remains in Tsingtao Brewery reflect the key technical characteristics of industrial buildings in Qingdao during the German colonial period. The architectures built in early times here refer to the general office building and saccharification building preserved up to now since the founding of Germania brewery, both buildings set up the main halls of the museum. As important components of the Tsingtao Brewery Museum, the surrounding environment is harmoniously planned and the architectural heritages of Tsingtao Brewery are well preserved and the spaces are reused by means of authenticity preservation of architectural entities and details and substitutional utilization of inner spatial functions (i).

Chengdu Industrial Civilization Museum

The museum is reconstructed grounded upon the old workshop infrastructures of the Chengdu Southwest Radio Appliance Factory. It, officially founded on December 30th, 2005 and renamed the Chengdu Industrial Civilization Museum in April 2007, is the first theme park and museum built on old factory buildings integrated with industrial civilization history exhibition and cultural industry. By means of scene settings, pictures, text, objects and sculptures, the ups and downs of industrial development of Chengdu from 1950s to 1980s are highlighted, which are deemed as treasures of the history of Chengdu.

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i- Liu Shan, Cheng Shuai, Tan Dake; Explorations on Tsingtao Brewery Early Architectural Heritage Protection and Spatial Reuse [J]. Industrial Architectures, 2017, 47(7): 68-72.

Hebei Tangshan Qixin Cement Plant Museum

Hebei Tangshan Qixin Cement Plant Museum, located at the former site of Tangshan Qixin Cement Plant, covers an area of 94.5mu with floor area of 51000m^2 and is the first cement industry-themed museum in China. It is introduced that the plant grew out of the Tangshan Fine Cotton Soil Plant and up and ran in 1891. It is the first self-operated cement plant in China, known as the "cradle of Chinese cement industry". In January, 2011, Hebei Tangshan Qixin Cement Plant Museum and the 1889 Cultural Creativity Industrial Park commenced the construction at the former site of Qixin Cement Plant, striving for creating the century-old Qixin cement industrial base and Tangshan industrial civilization exhibition base in line with the "restoring the old as the old" renovation principle.

Chongqing Industrial Museum

The old workshop area retained for the Chongqing Industrial Museum reaches over 40000m2, including the facilities of large-scale steel rolling workshop built in 1940, the main power room built around 1985 and office building and canteen built in the 1980s. Although all get preserved are workshops, the cultures are inherited from within.

Shenyang Cast Museum

The Tiexi District in Shenyang is usually known as the "Ruhr in China" where the China Industry Museum is located next to the No. 14 Weigong St. N. (at the junction between Beiyima Rd. and Weigong St. in the district). The museum is expanded from the original cast museum (at the former site of Shenyang Casting Factory), covering an area of 80000m^2 and floor area of 60000m^2. It is currently the largest comprehensive industrial museum in China co-built by the provincial and district governments, filling up the gap of no such kind of museum in China. On May 18th, 2011, the museum construction was kicked off and built by combining old buildings with new architectures on a whole. On May 18th, 2012, the phase I of museum opened three halls of comprehensive history, machine tools and casting techniques. The phase II later covers the halls of metallurgy, heavy-duty equipment, automobile and electromechanical equipment as well as Hong Kong pavilion, car model hall and Tiexi hall. In addition, catering, recreational, experiencing and interaction spaces are opened to further improve the functions of those halls.

2.3 Result: Future Development of Scientific and Industrial Heritage :

Significance of Industrial Heritage Protection

Industrial resources protection and utilization is conducive to expediting industrial achievements transformation which is an important moment to improve the urban functions and elevate the comprehensive capacity of city.

1- To realize balanced development among the society, sciences and cultures and the environment through comprehensive utilization of industrial resources.

2- Industrial resources protection and utilization is conducive to inheriting the history of advanced industrial technology and enriching the popular science resources.

2- Industrial resources protection and utilization is conducive to inheriting the history of advanced industrial technology and enriching the popular science resources.
3- To explore the values of industrial heritage to the utmost to turn waste into wealth for sustainable development.
4- To develop industrial heritage sites and build venues for popular science dissemination and industrial heritage scientific educations and activities.

Measures

1- To establish an impeccable industrial heritage general survey system. Same like the cultural relic preservation in ordinary sense, conducting general survey as well is the first step to industrial architectural heritage protection. The process of conducting general survey is also an important experience to promote the special value of industrial architectural heritage and its protection significance so as to mobilize the mass public to participate in the cause of industrial architectural heritage protection.
2- To study and formulate industrial heritage protection related polices, regulations and schemes. Government departments concerned should carry out the making of industrial architectural heritage protection related laws and regulations as soon as possible so that there can be laws for people to abide by in protecting such heritage.
such protection, the features of the industrial architectural heritage shall be put into account to effectively protect the heritage's authenticity and integrity. Moreover, potential threat to the industrial remains shall be forecast along with corresponding countermeasures prepared.
3- To strengthen the industrial heritage protection to realize the protection-oriented reutilization of architectural heritage**.** Industrial heritage cannot be renewed or replicated. Once an industrial heritage is identified and acknowledged, feasible and practical means shall be taken immediately to protect such heritage. Besides, the protection of industrial heritage shall go along with the urban construction and the social and economic development such that it can be well protected and its functions can exert positive effects.
4- To encourage mass public to proactively participate in the protection and reutilization of industrial heritage. The protection and reutilization of industrial heritage is a long-term and arduous task. Government's efforts and more importantly the proactive participation of public society are needed to do the industrial heritage works better.
5- The protection of industrial heritage with abundant technological content can be figured into planning of infrastructures for popularization of sciences. The industrial heritages can used as tools to build technology museums, industrial museums or even science centers, which firstly can break the deadlock of less land for science museum construction in downtown areas; secondly can mitigate the situation of no sufficient emphasis placed on technological museum and industrial museum in China and thirdly can be instrumental in changing the homogeneity of science museum in China and heading for a diversified development.

Museums as people's places: Making exhibition-processes based on inclusiveness and multivocality

Jacob Thorek Jensen, Danish Museum of Science and Technology

This paper will present the experiences and knowledge generated through the new exhibition 'Smartphonemania' at the Danish Museum of Science & Technology. It's the biggest exhibition project at the museum for the past 20 years. The exhibition is part of a strategy to transform the museum into an institution, which is more in tune with the contemporary society and its citizens. The aim of this transformation is to establish a new national museum of science and technology in Denmark.
We are using the existing museum as a laboratory and studio to produce knowledge about how to construct a new museum focusing on generating enthusiasm and debate about science and technology and inspire to innovation and creativity.
This paper thus addresses the following: How can museums develop exhibitions that reflect the complexity that characterizes the citizens of the present society? This includes a new framework for how we curate exhibitions by surrendering the power of the museum and its employees and inviting citizens to co-curate the exhibition by bringing in their knowledge and experiences.

About the museum
The museum is the national museum of science and technology in Denmark. It was founded in 1911 by the organizations Danish Industry and The Craftsman Association in Copenhagen making it the oldest special museum in Denmark, which is under the judicial governance of the Ministry of Culture. The museum is a self-governing institution, but receives funds from the local and national governments, while the museum also generates money from different museum-related activities.
The museum has a collection of more than 30,000 objects covering areas such as transportation (cars, bikes, airplanes, bicycles), infrastructure, communication, industry, crafts, inventions and science. It's the biggest and most important collection of its kind in Denmark. Some of the highlights in the collection are the world's oldest functioning car from 1888, the original LEGO from 1958 and the first computer in Denmark.
The museum is located north of Copenhagen in the city of Elsinore. It's located in the outskirts of the city making it difficult to reach by public transportation. The museum is placed in old industrial facilities, which gives space to the huge objects such as cars and airplanes. This makes it impossible to heat during the winter season making it a very cold experience for the visitors during that time of the year. This underlines the need to construct a new museum reflecting the needs of a modern cultural institution.

About 'Smartphonemania'

The exhibition 'Smartphonemania' is developed as a collective curating process, which is based on multidisciplinarity and an interdisciplinary approach to technology and humans. The exhibition is developed as a social learning space taking its starting point in contemporary challenges and issues. The heart of the exhibition is thus the citizens of today and the future, which are invited to participate in the research processes and are invited to share knowledge about the role of technology in the society.

The exhibition is about communication and how technological devices effects people's behaviour. The starting point of the exhibition is the modern smartphone. We investigate the evolution and innovations of the smartphone. Those are everyday devices such as radio, television, telephone, computer and phenomena such as electricity. The central themes are communication history, innovation, sustainability and design.

The major issues and questions that the exhibition addresses are: what does it mean that mobile devices connect billions of people? How does this effect how people express themselves, find information and knowledge and entertains themselves? How does this influence the society and world of the future?

We have designed the exhibition as a multifunctional space, where colours and light are used as elements to enhance the users desire to explore the different themes and areas in the exhibition. This means that the themes have different visual identities.

Being relevant to more people

The museum had in 2016 around 52,000 visitors. The typical visitor group is parents or grandparents visiting with their children or grandchildren. There is a majority of older users and men.

There are huge groups in the society that never visit the museum – or visit any other museum (Jensen and Lundgaard, 2015). That's a democratic challenge that we need to address in order to be relevant to all kind of different people. This challenge is not new for the museums in Denmark – and anywhere else. But museums are public institutions and must address the needs and interests of all people without regard to ethnicity, spirituality, gender, sexual orientation, interests, lifestyles, or political views.

In order to be relevant to citizens, who do not usually visit the museum, we needed to change the way we normally develop exhibitions. We knew that we needed to bring in new competences and knowledge in order to develop a new kind of exhibition. An interdisciplinary exhibition team was formed with resources from both within and outside the organization. The team had professional competences within the fields of techno and visual anthropology, learning design, graphics, history and museology. It was in this space of different competences that we have developed an exhibition, which addresses the complexity that characterizes the citizens in the society.

In designing the exhibition, we wanted to focus on the process and not the product (the exhibition). It was the process of how the exhibition was designed and what would happen in the exhibition after it opened that was interesting and not the opening of the exhibition itself. This ensured that we could work dynamically and hermeneutically to ensure that the exhibition and programmes were up to date all the time and reflection the issues that were interesting to people and their daily lives.

An open inviting process

Co-creation with people was the heart of the project. We want to be a participatory museum, defined by Nina Simon (2010) as an institution in which visitors can create, share, and connect with each other around content. To accomplish this goal, co-creation influenced every part of the development phase.

To be relevant to new user groups, we knew that we needed to win their hearts and minds and to change their image and perception of the museum (Black, 2012). We invited people from all of Denmark to take part in the creation of the exhibition. Two important aspects of our user involvement and co-creation at the museum were listening to external advice and sharing authority.

Voices from outside the museum

People are interested in different disciplines and bring different knowledge and experiences with them, when they visit museums. People learn in different ways. Diversity and inclusion thus became two important keywords for our work.

The interdisciplinarity wheel constructed by Martha Fleming (2013) proved to be a useful tool for understanding the complexity of people, their skills, and interests. The wheel comprises three concentric rings inscribed with disciplines within the fields of humanities, sciences, and arts. Spin the wheel and different personas line up, such as a person interested in art history, agronomy, and fashion or economics, botany, and music. Understanding the complexity of people in this way underlined that we needed to create an exhibition fostered by the critical reflection of each user, and we knew that we needed to have as many different voices as possible represented in the exhibition to develop an attractive space for different groups of people.

Multivocality is an important concept in modern museum practice. Russian philosopher Mikhail Bahktin's definition of multivocality inspired us very much. That is based on two important factors: the diversity of voices from different social, cultural, and linguistic backgrounds and a great volume of different voices developed independently (Dysthe, Bernhardt and Esbjørn, 2012). This is a practice that is very common in educational programmes in museums, but we wanted to take this practice of multivocality and also implement it in an exhibition.

The educational role of the museum

We have carried out different surveys in the first month after the opening of the exhibition. That is to gain knowledge about how users use the exhibition in formal and informal learning situations. Let's turn to the formal educational programmes first.

We have developed two educational programmes in connection to the exhibition. One focusses on the smartphone and digital competences and the other focuses on electricity. Several classes have participated as test classes to shape the content and design of the programmes. All the students have evaluated the programmes after they finished them. More than half of the students highlights the design of the exhibition as a positive factor. They say the exhibition design is cool, it's a nice learning environment, it's a relaxing ambience and informative. The students also highlight that the programme about digital competences got them to reflect on how they behave online and to think about what they share on social media.

We have also carried out surveys in relation to the users who do not participate in educational programmes. We have made some observation studies to see how long time the users stay in the exhibition. The users stay 23 minutes in average in the exhibition. That covers users that stays in the exhibition only a few minutes and users stay around an hour. We can see in the survey that users coming in groups with very small children don't stay long in the exhibition, while users, who are more than ten years old tend to stay longer in the exhibition. 88 % of the users came in groups with children or young people. The exhibition is still very new and we still need to do a lot of more research into how users are using the exhibition in formal and informal learning situations. But we can see that the users are using the exhibition differently compared to the other exhibitions in the museum.

New approaches to museum practice

We still gain new knowledge everyday about how the users are using the exhibition. We can see that parts of the exhibition are working very well, but there are also parts that need adjustments. But the design of the exhibition was planned to be very dynamic from the beginning. That was done so we could easily re-curate themes in order to be up to date with the issues people care about.

The exhibition 'smartphonemania' is a studio to gain new knowledge and experiences about how we can create more relevant exhibitions in the future. This means new approaches to exhibition design, the collection, research and the users. The Danish Museum of Science and Technology are committed to make exhibitions, activities and educational programmes that reflects issues relevant to the society and its people. It's a journey that we have just started and the end goal is a new national museum for science and technology in Denmark, which will set new international standards for museum work in science museums.

References

1- Black, Graham (2012) *Transforming Museums in the 21st Century*, Abingdon: Routledge.

Dysthe, O., N. Bernhardt and L. Esbjørn (2012) *Dialogue-based teaching. The Art Museum as a Learning Space*, Copenhagen: Skoletjenesten.

2- Fleming, Martha (2013) 'Open Minds – Open Doors', in J.T. Jensen and I.B. Lundgaard (eds) *Museums – Social Learning Spaces and Knowledge Producing Processes*, 148-171, Copenhagen: Danish Agency for Culture.

3- Jensen, J.T. and I.B. Lundgaard (2015) *Museums – Citizens and Sustainable Solutions*, Copenhagen: Danish Agency for Culture.

4- Simon, N. (2010) *The Participatory Museum*, Santa Cruz: Museum 2.0.

danmarks tekniske museum

Danish Museum of Science & Technology

Saving today for tomorrow
Documenting Hyvinkää Railway Workshop

Elina Holopainen, Finish Railway Museum

Hyvinkää workshop, owned by Finnish State Railways company VR, was opened in 1949 and will be shut down by the end of 2018. Finnish Railway Museum, in collaboration with VR, started a documentation project on purpose to save a piece of today for further generations.

Today is tomorrow's history – everyone knows that. Still we often overlook the importance of what happens today. Museum professionals are so busy with the historical museum collections that they don't have time to think what would be important to save from today for the future generations. Usually we realize the importance when something is going to end or disappear and it's almost too late to preserve it. That is rarely ideal situation to do the contemporary documentation. In the case of Hyvinkää workshop, the documentation had to be carried out in circumstances where some production was moved to other workshops and depots, some was outsourced and some was run down.

Especially when collecting the contemporary, you have to explain carefully the importance of the chosen subject. Why this particular subject has to be documented and not the others. Without a doubt Hyvinkää workshop is important in Finnish railway history. It was a central workshop in Finland where most of the trains were maintained and repaired. It also was a big employer in the city of Hyvinkää and had much impact on local culture. Most importantly, the discussion with museum's audience showed how meaningful the workshop was for the local and professional communities.

When starting a contemporary documentation project the first step is collaboration. Collaboration with the company is often prerequisite. Workshops and industrial sites in general are closed areas where photography is not allowed. In the beginning of our project we discussed with VR company about the aims and objectives of the project. The company let us choose the methods and themes and do the documentation without restrictions. It is also wise to combine forces and cooperate, so we started a collaboration with Hyvinkää City Museum and local associations.

The main focus in our documentation project is on the work, technical know-how, production and processes of the workshop. We also try to document something more intangible, like working culture, workplace and the community. Important and challenging part of the documentation is to document the change in work and working culture.

Contemporary collecting is quite similar to ethnographic fieldwork. Both use various methods: for example photographing, filming, observing and interviewing. In the museum context the most traditional method is collecting objects. Nowadays a big question for every museum is: should we collect physical objects or just the alternative forms of representation, like audio-visual recordings and digital photos etc.

There are some challenges especially when collecting industrial and technical objects. Many key objects in industry are impossible to preserve at the museum. In our project we collect very limited amount of objects. We prefer self-made tools and instruments that are specially designed for the Hyvinkää workshop or Finnish railways, or objects with an interesting context and history. Dialogue with workers is important when making a decision of what objects to collect.

Strictly speaking the contemporary collecting is present-day documentation. In our project we also collect memories by interviewing workers and ex workers and asking them to write short memoirs. In many cases it is difficult to separate past, present and future. In people's stories those all tend to mix together.

Why should we collect the contemporary? We have a lot of information and informants available about the contemporary phenomenons, and a lot of objects still in good condition. I guess we all have in our museum collections some old machines and instruments with a very little or any knowledge about how they were used. When collecting the contemporary, we have a possibility to document the use of the machines simply by videoing it.

Maybe the most important thing in contemporary collecting is that we have a possibility to document diverse views and opinions in society. We can also document people's personal experiences and feelings, aspects that are often lost forever when collecting the past. We are not collecting just the organizations official story but also the various stories of the employees.

With the contemporary documentation projects we can engage the communities to preserve their own history and foster their cultural and group identities.

There are some things that have to be taken in account when planning a contemporary documentation project. We have plenty of information available of the contemporary phenomenons. It could be difficult to choose which subject to document and which material to collect. Only time will show what will be important in the future.

There could be a huge amount of digital material produced in one project. Museums should have enough resources not only for collecting, but also for selecting, cataloging and storing the collected material.

In contemporary collecting there's no distance in time, which can cause some problems. People may not speak so openly in the current situation, especially about sensitive topics. Collecting and using the contemporary material can be restricted because of the company's trade secrets or legal and privacy issues. Internet publishing could be restricted, so we have to think are we collecting material for today's (web) publishing or just for the future research.

Contemporary phenomenons are complex and difficult to understand. The phenomenons are changing very fast, especially the technological ones. Museums in general are slow, traditional institutions. How are we able to document rapid changes?

There must be money in the bank

Jørgen Burchardt, , Danish Museum of Science and Technology

For technical museums, the goal of preserving cultural heritage for the future—for instance, for the year 2217—is to be able to reconstruct all products and their means of production in 2018. Although optimistic, that goal can act as a guiding principle for the work of technical museums. Of course, such collections can maintain only a fraction of all possible artefacts, typically selected for their quality and representativeness.

However, recent achievements of that goal have been severely impaired for several reasons. For one, technical museums in many countries currently do not prioritise collections compared to other tasks such as communication, and many museums collect far fewer items and information than they did 20 years ago. From another angle, if we analogise museums to banks, then more funds are being withdrawn than deposited, and, in time, the bank goes bankrupt.

Although this paper describes the situation of technical museums in Denmark, their development has been largely similar to other such museums the world over, partly due to the condition of their cultural departments and partly because accommodating trends of post-industrial society has become a major challenge for technical museums.

The disappearing narrative

History has always been a narrative of changes. Although the changes that history records have occurred for as long as humanity has existed, they have usually materialised gradually throughout extended periods. For example, whether born in the year 800 or 1400, a person would have had nearly the same options for transportation—that is, on horseback or by wind-powered boats. With industrialisation, however, new modes of transportation emerged. A person born in 1840 would have been able to migrate also by rail and steamship, and by 1900, travelling time would have greatly decreased and possible distances greatly increased. By the mid-20th century, people became able to travel around the world relatively quickly and easily by airplane or, for shorter distances, by car.

At the same time, industrialised mass production has made products cheap and provided new opportunities for products by using components and chemical substances in new combinations. Briefly, production operates in a market in which competition pushes players to continually develop better products. That market mechanism has long persisted, even if pressure for such changes has altered over time. In recent decades, the rate of change has become unusually rapid. As products become cheaper, they also become more expendable and, with new models, replaceable. Today's culture of consumption and waste has influenced and been influenced by the characteristics of most products. For example, very few consumers now use smartphones more than 10 years old.

A million different products

Industries for mass production have also changed in recent decades. A century ago, large factories often produced many different products for a local market. However, with the increase in global trade, a single factory became able to supply the entire world, and in time, the trend has allowed specialised production in which a single factory produces only a few different products of high quality at low cost. Moreover, today's international distribution system distributes those goods to nearly uniform businesses worldwide.

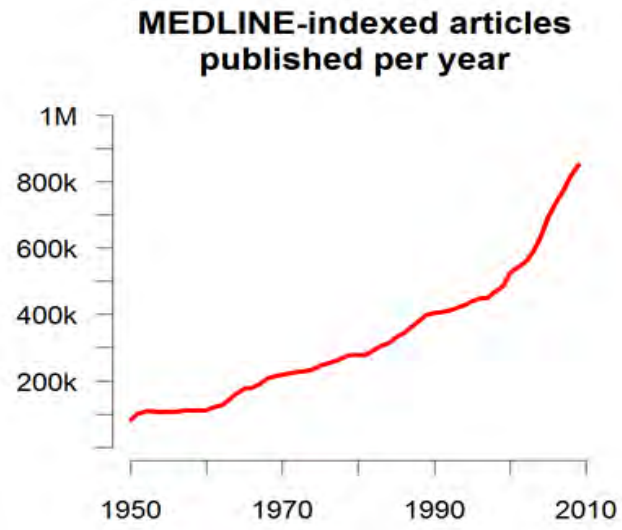
Thus, a large supermarket in a wealthier part of the world can supply more than 100,000 different items. Although some of the products are the same yet packaged in different quantities, many products nevertheless remain that today's museums have to be able to review and select from. In more specialised areas, the possible range of products includes several types. A pharmacy, for instance, typically offers 10,000 different products, and a supplier of tools for the plumbing sector can offer as many as 350,000 units. On top of that, many other industries have their own unique products as well. Although an inventory of the number of current product types remains unavailable, the number is likely far greater than 1 million.

Rapid change

The array of products is responsible for only some problems at today's museums, whose list of tasks includes preserving knowledge about production. A host of different products are often manufactured at a host of different factories, which, in the current era of mass production, are often so specialised that they may manufacture only a single component. Once that component becomes obsolete, however, so does the factory. Although some factory buildings can be re-purposed for other means of production, most workshops, laboratories and production facilities are ultimately demolished. As a case in point, giant factories have been constructed to produce electronic components expected to be useful for only a few years. Samsung's factory that produces fourth-generation 3D V-NAND flash memory chips in 64 layers is a good example. Built in Pyeongtaek, South Korea, and commencing production in 2017, the factory makes small 256-GB solid-state drive (SSD) memory chips that will be commonly used in the next few years. The chips are both 30% faster and 30% more energy efficient than the previous generation of 48-layer chips. Because the small SSDs largely outperform traditional hard drives, manufacturing plants of heir predecessors have become outmoded and have closed. Similarly, in the coming years, a new technology will likely replace the 256-GB SSD memory chips. If technological advancement continues at the same pace—and that pace is liable to accelerate—then Samsung's plant will become outdated within 7–10 years

Growth in knowledge

At the same time, the rapid speed at which technologies change is also not the only problem for today's museums. Each specialised mode of production also requires specialised knowledge that places great demands upon museum personnel who have to be familiar with such knowledge. For example, in 1950, more than 100,000 articles addressing medicine were published, whereas nearly 70 years later, more than 1.2 million articles in the field are published each year. The scope of medical knowledge has thus increased by more than 1,000%. China and many other previously under-developed countries have supported that boom in knowledge, and their activity can partly explain the rapid acceleration in research since the mid-1990s. Whereas annual growth in research in 1950 was 1.5%, that rate in the past 10 years has more than doubled, and the increase in knowledge in other areas of science has likely occurred at the same rate. As an example, electronics giant Samsung has increased its research output by 12% or more per year.



Vast, coherent systems

The problem for museums is exacerbated also by the fact that industrial production occurs in ever-larger, more complex systems. Often, the systems have become so complicated that only a few individuals understand the connections therein. For example, most people could not explain where the electrical power in their living rooms originates or comes to power their appliances.

The team at the National Museum of Science and Technology has documented a case in point: the Stålvalseværket, a Danish steelworks. The Stålvalseværket is an industrial company that manufactures its products on three machines with the support of a range of smaller tools. By contrast, the three machines – the furnace, the rolling mills for plates and rolling mills for rods - are all gigantic, and the largest of the plateau's many rolling chairs weighed more than 600 tonnes.

Even the hidden history disappears

If we were to preserve all objects of the present as well as knowledge of their production, in 100 years we would likely have only fragments of that knowledge. Because most information is archived in digital form, only if museums continuously convert data from one system to another can the data remain readable. Although conservation systems have been developed in response to that dilemma, information risks being lost via its conversion. For example, data about computer-aided design and manufacturing systems could be lost if those systems are not fully compatible with future filing systems.

More importantly, digital data can disappear completely. In the traditional storage of data, a hard disk or SSD can suddenly stop working and its data become irrevocable. Fortunately, that problem can be avoided in the ordinary storage of information by establishing parallel data storage so that if stock should disappear, it can be re-created from a copy. However, increased data in continually more advanced chips used to control machines and tools cannot be copied, and the information is liable to suddenly disappear or the component become so unstable that the tool can no longer work.

Of course, those possibilities portend not only the destruction of the historical value of products. They often also extend to new materials that unfortunately wear down or decompose over time, as does rubber and many other chemical products. The vast array of new materials means that developing knowledge about how they can be preserved and their breakdown stopped is beyond realistic. Worse still, many materials are often assembled where waste materials from the decomposition of one material help to destroy others.

As a result, it is likely that museums 100 years from now will be unable to demonstrate how one of today's drones works. If only one of its components fails, then the drone cannot fly. Paradoxically, we will more than likely be able to show how a steam engine from 1840 worked, as well as how iron was processed and incorporated into the primitive machines of the time.

Internal problems at museums

The ability of museums to preserve technology and related knowledge has also unfortunately diminished in recent decades. Although such decline varies from museum to museum, the following description provides a reasonably general picture.

Over-crowded magazines

First, the magazines of museums are over-crowded and leave little room for the many and often large objects of today and the future. Museums have traditionally collected in concentrated amounts in their first years of activity, and as decades pass, their collection rates drop but nevertheless continue at a reasonably high level. Thus, whereas new museums do not experience that problem, the magazines of 100-year-old museums are well stocked, if not nearly saturated.

Although the problem of over-crowded magazines affects all types of museums, tech museums particularly face problems on that account, because their objects are often of considerable size. However, it is possible to counteract or delay the problem by way of selective disposal. Danish museums, for instance, have begun to pursue coordinated disposal; they have their collections in a common database, and by comparing the items, they can identify copies and discard the physically worst artefact or the artefact with the weakest provenance. Although only a small percentage of museum objects have actually been discarded, possibly half of the magazines can be freed by an effective, albeit costly, process of comparing data. In any case, however, such measures can only postpone the overriding problem that there will always be growth in the conservation of physical objects and, consequently, that access must be limited.

Clearly, museums have to respond to such diminished awareness, which often happens by means of offensive measures involving improved dissemination. Nevertheless, it is difficult to compete with widespread commercial productions on the Discovery Channel and SCI and the many historical pictures on Pinterest.
That altered priority, however, helps to tip the balance of the internal lives of museums, where research is conducted and collected less as internal resources are channelled to dissemination necessary to maintain the attention of museums.

Less public support

Signs of weakened support and attention to technical museums also unfortunately abound. In certain circles, interest in technology remains high, although in broad segments of the population, technological development is no longer fascinating. People are aware of new products, and their outmoded counterparts are simply useless.
That trend is a consequence of the culture of consumption and waste in which the old is no longer repaired or saved. Previously, local history was strongest in areas with a geographic and perhaps family-related connection to products and factories. Such local associations have of course lessened as ownership has been outsourced or channelled into anonymous equity funds.
The products also shed their unique local connection when they consist of components and materials from foreign factories. The downward trend of public interest in history is clear. In Denmark, the state has introduced a general cut of many areas that has affected historical museums, which can save 2% per year over a set number of years; however, because museums do not have the opportunity to rationalise through mechanisation, such policy has meant staff cuts.

Responding to challenges

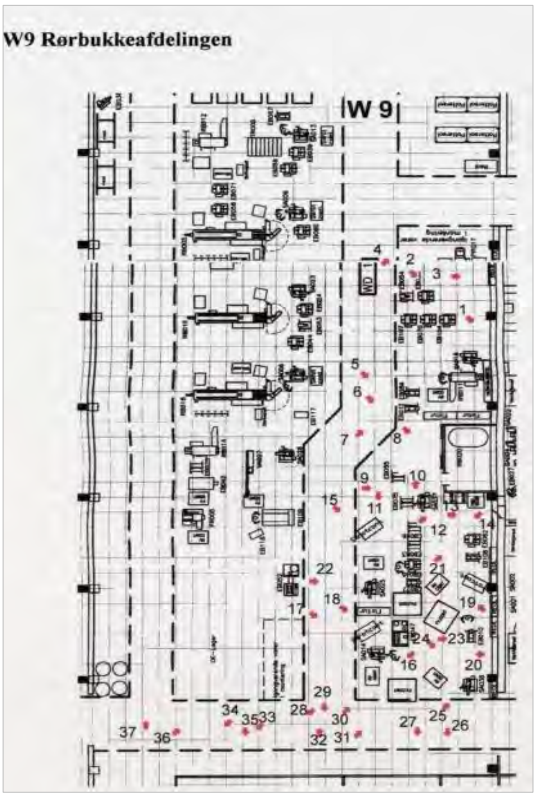
To continue fulfilling their task of securing industrial and cultural heritage, technical museums collectively have to respond to the mentioned challenges. At the same time, each museum needs to develop its own solutions for renewal.
However, such actions, both collectively and individually, will only begin to guide museums along an ongoing process of conversion. Technical museums need to change their strategies in two particular areas: becoming specialised and documenting the present. Although both areas are connected, I refer to them separately in what follows.

Contemporary documentation

In 1987, I helped to preserve Bruunshaab Papfabrik as a working factory. The buildings were constructed in 1909, and many of the machines from 10 years later, when the company manufactured cardboard, still work today. Schoolchildren and tourists can pay visits to observe a completely authentic factory as it worked in the 1950s. The company's production is specialised, and the sale of its niche products, together with revenue from the factory's visitors, can afford an economy that ensures the survival of the factory.

However, it will likely remain impossible to maintain a functioning factory from our present time. As mentioned earlier, it will also prove impossible to preserve many of its physical objects. As an alternative, it is necessary to document the physical artefacts. Current rapid changes described earlier also require the documentation of companies while certain forms of production are still in operation.

To reiterate, we simply cannot preserve a great deal of today's technology. The steel mill's three machines rank among such machines. Accordingly, museums need to document what is in use while it continues to be used. Doing so poses the great advantage that all players involved in the activity, who can remember the reasons and means of production during recent decades, remain available for consultation. Via internal networks at companies, researchers can familiarise themselves with everyone involved in the production at some level. Employees today still know the companies and technicians who installed the systems, the managers, the representatives of trade unions, bankers and investors and the roles that they played, what official authorities were involved and, in the case of approvals, the certification institutions. Today presents a unique opportunity to learn about all aspects of human activity that will become possible in 30 or more years. Some of the present can and should be saved, however. Digital archives have now become relatively cheap to maintain once initial setup costs are paid. As a result, organisations and institutions can store all of their technical drawings, email correspondence, minutes of meetings and much more. At the same time, the activities can be maintained in photographs and on video. Again, although the possibilities for conservation are great, it should be remembered some work other than that dedicated to actual recordings is required in registering materials.




Walker Danmark - historie 5

WI-01
Svejseafdelingen
Opslagstavle for svejsegruppen
Inden svejseanvisninger fra kvalitetsafdelingen, th. besked for den manuelle svejsegruppe; tv. resultatskonstavlen

WI-02
Afklæmning på svejsekabinerne
De orange gardiner skærmer for svejselyset. Diverse emballage; th. lækketestmåler (ude af drift) bagved filebænk

WI-03
Svejsekabinenr. 11
Underudluftningshætten; grønne ruller bordet til opstilling af svejsefixturer.

WI-04
Svejsekabinenr. 12 (nr. 13 findes ikke!)
Emballagemedlet til et lydklæmperset. Fixturens blå farve viser, at det er OE-produktion.
Afmærkesedlen ses, at nogle af bøsserne indeholder 200 stykker.

WI-05
Svejsekabinenr. 9
Svejsning af dele. Fleksible rør til dieselbiler.
Bemærk ventilatoren - optaget i en periode med undertiden mere end 30 grader.

WI-06
"Kontor" bagved svejsekabinerne.
Lille terminal for personalet.

My experience from contemporary documentation at the National Museum of Science and Technology shows that the resource consumption for a document of a company of 200 employees comprises two full-time equivalents of 1/3 academic staff and 2/3 for a registrar, a photographer and secretary, among other personnel. If the company is high tech, then the dual academic effort can be used to obtain an overview of the area's most important scientific background.

After documentation, it is possible to select the most important items from the company. Selection has to retain the possibility of communicating with the company at exhibitions and should focus on suitability for later research. Many companies (e.g. power plants, food companies and pharmaceutical outfits) will be unable to deliver products to preserve; their products have to be documented in alternative ways—for example, via statements from consumers.

"Standard" documentation (middle sized factory, 200 emp.)
2,000 photographs
10 hours video
30 linear meters archive
100 interviews
40 GB data archive
200 artifacts
3 months fieldwork

Contemporary documentation is problematic not only in terms of its high cost. It is also a new, difficult form of work. In a way, technical museums perform industrial espionage for the future, even if the acquired knowledge can be misused by outsiders in the future. It is therefore necessary to have a high degree of safety in the work. Technical museums will also discover major conflicts that plague all jobs, and in response, they need to promise both their chief executive officers and staff that personal information may be disclosed only under certain conditions. I have also observed problems with public authorities at all of the companies in which I have conducted contemporary documentation. The circumvention of food authority requirements and the violation of competition law could have dissolved several of those companies, just as violation of security law could have halted their production for longer periods. Information therefore needs tight conditions for publishing, and involved parties will certainly require protection periods of 50 years or more. Technical museums have to live with that inevitability, even if it means that they cannot exhibit the results of their hard work because doing so could present problems with maintaining revenues.

Contemporary documentation also presents the problem of lack of time. Museum personnel need to be critical of collections method and be exceptionally careful in selecting subjects and conditions to be examined. Museum personnel also need to take care to not only consider current situations but also ensure that their efforts can be used by people in 100 years, 200 years and even further into the future.

Funding for cultural heritage is unfortunately also tied to political desires that are often not based on academic research. Nationalism and nostalgia have fuelled a great deal of financial appropriations and will doubtless continue to do so in the future. Therefore, technical museums collectively need to convince funding bodies of the distinct necessity to perform contemporary documentation even if such necessities conflict with current political wishes.

Specialisation and internationalisation

Technical museums can no longer aim to treat all areas of technology as they could have 100 years ago. The array of industries and business types makes it entirely unrealistic for a single museum to cover fields.

Along with the increase in tech fields, knowledge in individual fields has also grown. With such a vast amount of knowledge, technical museums need to gain greater insights into the topics in order to manage their tasks. Because such profound knowledge can be achieved only in a few areas, individual museums have to become specialised if they seek to collectively treat all kinds of businesses and industries.

It is therefore necessary that the world's technical museums pursue committed international co-operation. Knowledge exchange about qualified efforts performed by technical museums needs to be far greater. It will ultimately counteract duplication and the wasted resources could be used to preserve information from other areas.

Engineering museums, for example, could establish co-operation based on industry divisions such as information technology, medicine and textiles. In that arrangement, a museum would have chief responsibility for communication among other museums working on the same subject.

Each year, their co-operation could be discussed in connection with the meeting of CIMUSET. By doing so, technical museums can effectively shift from being national to international institutions.

Knowledge without frontiers

Irena MARUŠIČ & Estera CERAR, Technical Museum of Slovenia

Introduction

NEMO (Network of European Museum Organisations) issued a publication in 2016 – *Museums, migration and cultural diversity, Recommendations for museum work (1)* as a response to the migration crises that we've been faced with over the last few years.

In the foreword, it states that millions of refugees have recently come to Europe and many will stay (2). But migration is not a new phenomenon; on the contrary, it has always been a part of human history. Even the vocabulary in different languages supports this fact: there are numerous separate words with which different categories of migrants are described (immigrants, emigrants, refugees, aliens, 'illegal' or 'legal' migrants…).

Regardless of the actual reasons for these movements of people (economic, social, religious, ethnic, climate…) it has an undeniable and permanent influence on society. Despite the fact that we live in a globalized world and so should be more prepared to accept these influxes and changes, many of us are still struggling to accept the notions of "foreign", "different" and "unknown", with which we often associate migrants. The facts are, our society is changing and public opinion is divided, politicians and the media are, for obvious reasons, sensationalistic and the outcome is that people are confused.

But there is good news: we have museums!

This is the moment when museums can (and should) react and prove how valuable they can be to society.

Over time, the role of museums has changed many times. Nowadays they must move beyond an educational and entertaining role to embrace socially relevant missions. They are public spaces where different perspectives on contemporary issues can be brought together within a historical framework to offer a measured perspective on how societies have dealt with similar issues in the past (3). Being a socially responsible museum means addressing issues of relevance to one's community, as well as identifying issues and challenges where a museum's expertise can make a positive difference and impact. The first part of the ICOM definition of museums sums this up perfectly: "A museum is a non-profit, permanent institution in the service of society and its development…" According to the ICOM Statutes, adopted by the 22nd General Assembly in Vienna, Austria on August 24th, 2007:

1- Museums, migration and cultural diversity, Recommendations for museum work. Original edition published by: Deutscher Museumsbund e.V., Belrlin, February 2015. English edition published by: NEMO- Network of European Museum Organisations, Berlin, May 2016.

2- Idem, p.3.

3-Rhiannon Mason, Identity and heritage. http://www.theheritagealliance.org.uk/tha-website/wp-content/uploads/2014/11/Heritage-and-Identity-talk-Rhiannon-Mason.pdf Last visited: Nov, 2017

"A museum is a non-profit, permanent institution in the service of society and its development…" (4) Whilst the ICOM Code of Ethics (5) refers to the topic in chapter 6: "Museums work in close collaboration with the communities from which their collections originate as well as those they serve." (6).

Knowledge Without Frontiers

In seeking to achieve this, the Technical Museum of Slovenia is preparing a project titled "*Knowledge Without Frontiers*", which will highlight the *positive* impact of migration on society, and aim to show a strong link between technical and scientific heritage on one side, and cultural and national identity, on the other. We will present a number of successful individuals across different fields of science and technology who migrated to or from Slovenian territory from the 16th century to the present day.

Scientists and inventors have been moving to and from other countries for very different reasons and quite often of their own free will, but often because they were forced to do so. Sometimes they moved in order to improve their living conditions and working opportunities or "just" to broaden their knowledge.

However, history is also witness to the fact that one can become a 'stranger' even without moving to a foreign land. States and their borders can change, and our own Slovene territory is a perfect illustration as this has happened many times in the previous century alone. From the Austrian-Hungarian Empire to a part of Yugoslavia, then the recently independent Slovenia and becoming part of the present day European Union. There are many scientists and inventors who were born in one country, lived in another and died in a completely different one - all because the borders were moved or the countries changed. When preparing this project we had to select just a few from a great many potential candidates. A number of criteria were used in the selection process, and for simplicity's sake we decided to exclude offering information about the reasons why these selections were made simply because there were too many.

1. Our first criterion was obviously a connection to immigration or emigration, whether this be direct, or indirectly through their ancestors.
2. Slovene ethnicity (direct or through Slovene ancestors) and those who worked and stayed within Slovenian territory.
3. By including different periods in history (from the 16th century to the present day) we wanted to stress that this is not a new phenomenon, but quite the opposite, whilst also making the selection feel relevant to the present day and the younger generation.

4- According to the ICOM Statutes, adopted by the 22nd General Assembly in Vienna, August 24th, 2007:"*A museum is a non-profit, permanent institution in the service of society and its development A museum is a non-profit, permanent institution in the service of society and its development, open to the public, which acquires, conserves, researches, communicates and exhibits the tangible and intangible heritage of humanity and its environment for the purposes of education, study and enjoyment.*"

5- ICOM Code of Ethics for Musuems, ICOM, 2013

6- Idem, p.10.

4. We included a wide range of scientific disciplines including chemistry, physics, astronautics, telecommunications, electronics, medicine and computer science.
5. Male as well as female individuals.
6. An important "elimination" criterion was a lack of artefacts in our existing collections and whether there was a realistic opportunity to acquire any.
As a result of this selection process we drew up a "short list" with fourteen individuals, eleven men and three female, some of them very known in Slovenia and almost recognised as celebrity icons, and others known only to a handful of experts.
Self-evidently, we could have dedicated an entire exhibition to each individual, but that was never our aim. Within Knowledge without Frontiers they will be introduced with brief insights into their private and working lives and carefully chosen individual achievements.

Each of them will be presented by:
*A short biography, with special attention to their "migration".
* Their main professional achievement(s).
* Highlighting one achievement that has had a profound impact on our lives, or that holds special validity within the history of science and technology (preferably presented by an object).
* A curious or surprising fact that is less well known to the public.
The exhibition will open on 1st March 2018. It will be the result of teamwork, with an interdisciplinary approach and calling upon experts from various fields and different institutions. It will be aimed at different target groups, with many interactive elements, some especially orientated towards the younger generation. Through public programmes (workshops, talks, guided tours, round tables, quizzes) as well as outreach and learning activities, we will offer our visitors the opportunity for social dialogue and to express their own points of view.

We are aiming to achieve the following:
* To break down at least a few stereotypes connected to migration.
* To help people understand that, in one way or another, we are *all* migrants.
* To show the positive side of this fact through the achievements in science and innovation known throughout our communities.
* To have constructive and meaningful debates with different target groups.
* To bring together and connect various stakeholders.
* To promote science and technology from a different perspective.

Identity and heritage

Can we talk about a connection between national identity and technical/scientific heritage? We believe the answer is yes. Our project was built around this fact.

Now, probably this is not unique to us Slovenes, but we are very proud of "our" scientists when they succeed abroad and yet, on the other hand, we are more restrained when "foreigners" are successful in our country. We are trying to make people understand how misleading and narrow-minded this assumption can be, and this was one of the reasons for using the life stories of 14 individuals, who not only made a difference with their achievements, but did so as a consequence of migration.

Two examples that illustrate the challenge: the record-holding astronaut, Sunita Williams was born in the USA to an ethnic Indian father and a mother descended from Slovenian immigrants. However to Slovenes she is considered a "true" Slovene and is often featured in the national media and it seems like we are all very proud of her. She won over even the most sceptical by taking a traditional Slovene sausage up to the International Space Station! However, at the other extreme there is Fritz Pregl, who provokes mixed emotions in Slovenia. He was born in Ljubljana (the capital of Slovenia) to a Slovenian father and a German mother. However he studied and worked in AO empire and in later years in Austria (due to collapse of the empire), his working language was German and people considered him "not Slovene" enough. For decades he was left out of our science history records and books - although he is the only Nobel prize winner with Slovene ethnicity to date.

We would like our visitors to question themselves about the relevance of dividing the world into "ours" and "theirs", in to "us" and "them", to help them understand and appreciate that almost nothing is forever and what today is "ours", might be tomorrow "foreign". We would like them to look beyond the known, to move across different borders, both the visible ones, but even more importantly, the invisible. An old African proverb says: "A thought does not travel further than the view".

To conclude

This whole project is a product of various facts, obvious ones and peculiar ones: the refugee "crises" in Europe, that eternal question of how to make this world a better place and questioning the role of museums in society today.

And to conclude, I would like you to hear a Slovene rap song called 'From People to People' by Murat & Jose. These few words from their song sum up the aims of the exhibition perfectly:

"It does not matter where you come from, what counts is what's going on in your mind" (7).

7- The translation of this lines from Slovene language is by authors of this paper. The original goes like this: « ..ni važno od kje kdo prihaja, važ'n je kaj mu v glavi dogaja,.. »

An "African" coda

As this paper is presented at the 2017 CIMUSET conference, held for the first time on the African continent, we would like to take this opportunity to present Anton Codelli (1875-1954) who worked and lived in Togo.

He was born in Naples, Italy, to parents of Slovene and German ethnicity and grew up in Ljubljana and Vienna. He briefly served in the Austrian navy, sailing as far as China and Japan. He was discharged from the navy due to health problems and dedicated himself to mechanical and electrical engineering.

In 1911 he started working for Telefunken in the German colony of Togo in West Africa. At the start of the First World War he was captured by the French and sent, along with his wife, first to Porto Novo in Benin and subsequently to Algiers. In mid-1916 they were relocated to France. Later they lived in Switzerland, where they remained until their return to Ljubljana in August 1920. In 1945 threats by the Yugoslav authorities led him to retreat to Porto Ronco, a town near Ascona in Switzerland, where he died and is buried. As a mechanical and electrical engineer, Codelli was captivated by technological innovations and developed into a multifaceted inventor with many patent applications at home and abroad. He was also a sailor, adventurer, and even the first Slovenian film producer ('White goddess' was filmed during his stay in Togo).

One of his biggest achievements was the construction of a radiotelegraph station in Togo for the company Telefunken. In 1911 he and his colleagues started preparing the terrain for the installation of nine antenna towers in Kamina, a village near Atakpame. In parallel, they constructed the central building for the steam engines, generators, and other technical equipment. The work was largely completed by the end of 1913, when they made the first radio transmission between Africa and Europe. This was an extraordinary achievement for that time and a landmark in the development of telecommunications.

At the beginning of the First World War the Germans blew up all the buildings with dynamite and tore down the antenna towers. The remains of the radiotelegraph station are visible to this day and marked with a sign explaining its history. The full name of only one person appears in the text on the sign – Anton Codelli.

He was utterly fascinated by Africa and he decorated the study in his Ljubljana mansion with artefacts that he brought back from Togo. His African collection is now held by the Slovene Ethnographic Museum.

TMS
TEHNIŠKI MUZEJ SLOVENIJE

RéMuT: The French National Network of Museums and Technical Collections

Isabelle Proux, Musée des Arts et Métiers – Cnam, France

RéMuT is one of the last Scientific, Technical and Industrial Culture networks set up in France (2011). Today, it brings together more than 400 museums on the national territory and has opened since 2016 to foreign museums.

Why this network, among an already rich offer? RéMuT fulfils the mission entrusted to the Conservatoire national des arts et métiers and its museum to federate technical museums on the national territory, in order to better respond to their specific needs and to contribute to a better dissemination and greater sharing of scientific, technical and industrial culture. It brings together non-profit organizations that conserve and develop technical collections. This mission stems from the political will to reaffirm scientific, technical and industrial culture as an essential component of culture. It also responds to the long-standing lack of representativeness and visibility of heritage structures in technical fields. The latter, however, represent a large offer in the territory, most often strongly rooted in local economic and social history.

The constitution of RéMuT started with the identification of the structures concerned. It quickly appears that it will not be exhaustive: the shortcomings of the themes used in the lists of ministries, tourism offices to classify museums conserving technical collections, reflect the lack of knowledge of these structures by the public authorities, and our society as a whole; they reflect the difficulty of integrating science and technology into the public space.

Nevertheless, an initial list of 574 institutions was created, and the Musée des Arts et Métiers sent a letter to each of the listed institutions, where it proposed the creation of a network that would enable them to map these structures and identify expertise, create links between them, make them known, and share tools, experiences and expertise.
In a short period of time, nearly 60% of the institutions contacted responded positively: it was a massive and rapid response: the creation of this network meets a real need.

Breaking isolation

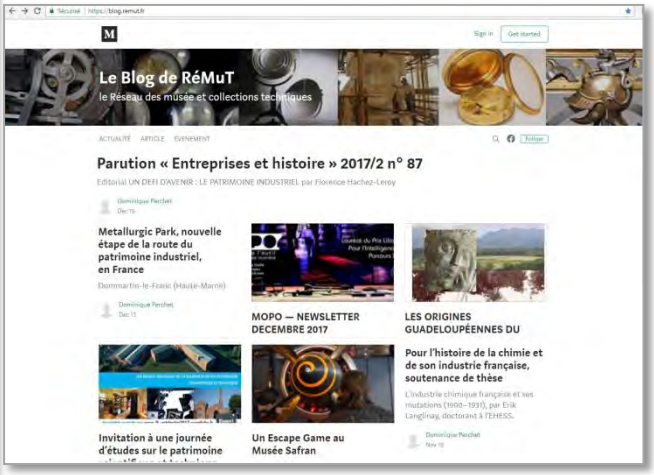
Quickly, a first national meeting day is proposed to see together the implementation of the strategy of animation and development of the network. The first stated expectations are for breaking the isolation.

Nearly two-thirds of museums operate with the participation of volunteer staff, and more than a third of them are totally dependent on it. Their existence is fragile, the durability of their collections uncertain. From then on, the first action of the network will be to set up tools for communication between members and to draw up a Charter, the basis of a common functioning.
The first tool, efficient, economical, and very simple to install is the mailing list remut@cnam.fr. It allows the same level of information for all members, and exchanges between staff from different structures. Questions concerning preventive conservation, proposals for the donation of material, alerts concerning the fate of certain collections, multiple subjects are discussed. But it is quickly apparent that this tool is not the place for substantive discussions.

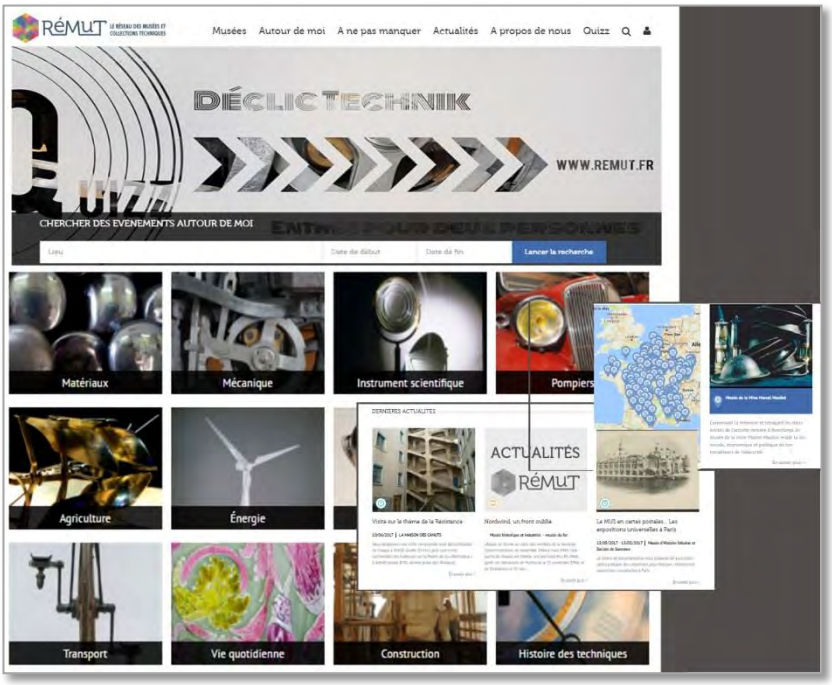
Improving the visibility of technical museums

A second very strong demand emerged during the first day of the meeting: the network must work to improve the visibility of museums among the public and professional bodies. It is becoming obvious that the development of the network requires more advanced tools: an internet and extranet site must make it possible, on the one hand, to make this part of the culture represented by technical museums known and valued by all audiences, and on the other hand, to respond to the desire to offer a space for mutualisation and exchanges. The CNAM and its museum, initiators of RéMuT, commit human and financial resources: a first internet and extranet site is set up by a computer apprentice, who will serve as the basis for the development of a professional version.

RéMuT page on Facebook



RéMuT's Blog



www.remut.fr

The collaborative site allows each institution to present its structure, its collections, its news: this exhibition on a common site must allow the respect of the individuality and autonomy of each one. Incidentally, this choice also meets an economic imperative: budgets for network coordination are limited. Everyone's participation is necessary.

On the extranet part, various tools and resources are proposed: a directory of institutions and their staff members, a discussion platform, document sharing and project mounting areas, offer the means to work in synergy, on a territorial scale. And in the age of the internet and social networks, a turnkey tool for creating websites for institutions that do not yet have one: they are numerous.

The first work of the network was to conduct a survey of its members to begin the development of a mapping of technical museums.

The results of this survey were used to establish the RéMuT database. Accessible online, it is directly fed by the members and partners of the network. The latter enrich it by documenting their institution and collections. The work on improving visibility to the public is reflected in the development of RéMuT's communication on social networks, by creating a Facebook page that relays member news (less than 20% of members have an institutional Facebook page), and the *RéMuT's Blog*, which offers news and feature articles. It also requires an update, about every two years, of its website: everything is evolving very quickly in this area, and the Internet part of the site is dedicated to the public, it is necessary to meet their expectations as best as possible.

A non-hierarchical governance structure

These tools put in place to manage the network are the technical part of its operation. Above all, RéMuT is animated and developed thanks to the participation of its members and the involvement of its steering committee. Initiated by the Musée des Arts et Métiers- CNAM, RéMuT relies on a coordination unit made up of CNAM staff and a steering committee composed of 12 member museums, two partner networks, and the network manager, CNAM staff. These two bodies work together to propose the main objectives of the network and its priority areas of work.

The members of the network are united by a charter, the basis of a common functioning. Similar structures often operate with a board of directors or its equivalent, and a scientific council. The RéMuT steering committee combines the two functions by bringing together heads of member institutions and those of partner networks. From its creation, RéMuT determines a mode of governance that is representative of its members, taking into account the proportions between public and private structures, those with or without the "Musée de France" designation, their geographical and thematic distribution, their size and those of their collections. This particular attention to respecting the representativeness of network members is essential. It emphasizes the cooperative nature of co-construction rather than an institutional framework, often distant and prescriptive. It also strengthens the effectiveness of responses to expressed needs. The steering committee and the coordination unit work to define the strategic axes of the network's development by collecting, in particular during the national days of meetings and through surveys, the needs and opinions expressed by the members.

Each institution retains its full autonomy: while the general missions of heritage conservation and the dissemination of scientific, technical and industrial culture are general elements common to all members, the diversity of approaches, the origins of the constitution of structures such as collections, bring sometimes different values or interests. The types of restoration, whether historical or functional, or the question of the inalienability of collections are typical examples of different or even contrary values in the examples cited, in heritage management. They do not prevent a dialogue between the institutions, and above all they offer a rich panorama to the public, in contrast to dusty images and drowsy uniformity that still float around the technical museums. These dialogues and exchanges can only be built on the basis of a collective recognition of each individual, and require a statutory equality of each institution vis-à-vis the network, a truly democratic participation of all its actors. This choice of horizontal governance does not preclude, however, the role of advising and recommending, a priori a more vertical process, on important themes: the fields of accessibility or the safeguarding and enhancement of the intangible heritage are themes that are rarely tackled by structures that are initially concerned with their "survival". They are dealt with in particular during the national days of meetings, and working groups composed of members of the network are set up to propose programs adapted to the various structures.

A national meeting day is organized every year: *In addition to the possibility of meeting and exchanging ideas, this national meeting day offers members the opportunity to participate in thematic round tables (object restoration, preventive conservation, fundraising and sponsorship, copyright, image rights, inventory, etc.), during which network members and outside professionals present their points of view and shed light on their practices. The themes are proposed and chosen by the members of the network.*]

Development of inter-network links

RéMuT is committed to action and support at the national level. Other networks, geographical and thematic networks provide a range of support and solutions on a local scale. RéMuT's role is to identify them, to relay this information to its members, and to create links that enable and facilitate the implementation of promising projects for all institutions, such as thematic information days, access to training, but also exchanges of good practices, from network to network.

These inter-network links contribute to the mapping of technical museums in France and help to build a solid framework around technical heritage.

This inter-network work also extends beyond the borders, especially with Morocco: RNSCT, the National Network for the Promotion and Dissemination of Scientific and Technical Culture in Morocco, contacted RéMuT in 2009 during a study trip to Europe. The intensive exchanges led to the desire to develop areas of partnership and cooperation between the two countries.

A first international colloquium was co-organized in May 2016 in Rabat on the museology of science and technology, to allow exchanges and direct meetings between the various French and Moroccan actors around the heritage dimension of science and technology, and to promote, through these meetings, the development of partnership, cooperation and co-production projects. Several Moroccan museums wished to join the RéMuT network. In the same way that RéMuT's richness and relevance are supported by the diversity of its members, this new dimension of working between the networks has become essential: an increased logic of partnership, exchange of experience and mutual support. Each network has its own specificity, thematic and geographical, but shares the major common objectives, and their actions are complementary.

The geographical dimension is an important factor, not as a risk of competition, but as a mutual contribution of skills: the national level opens up broad perspectives and a more global knowledge, when the regional or departmental levels bring a field understanding and local experience that often express innovative solutions and reveal a positive dynamism for other networks.

This development of synergy between networks will undoubtedly require the establishment of a super-structure, flexible and adaptable, and a general definition of the perimeters of action of each.

Exchange of expertise, pooling of resources and tools, co-construction of projects, concerted actions... These objectives that support our networks correspond to those of inter-network actions.

This logic of inter-network partnership therefore seems to be self-evident: it makes it possible to develop mutual learning, considering the multiple dimensions addressed for the development of CSTI, and culture in general. It avoids reinventing the wheel and makes it possible to better control all aspects of a problem, which often goes beyond the scope of one's own field of work, by opening up perspectives, multiplying the available resources and also offering a stronger voice, because more people, of course, but also more complete.

Travelling exhibition as a method of promotion of the University Heritage

Maciej Kluza, Jagiellonian University Museum, Poland

Educational interactive exhibitions are well-known in the world for almost 50 years. But this kind of activity in Poland started at the beginning of the 21st century, First such exhibition, entitled "Ancient and modern science" (Fig. 1) was opened in 2000. It consisted of about 45 experiments exploring wave physics, history of calculating tools and history of time measurement. Such choice of topics was made to point the branches of science which were important in the history of the Jagiellonian University. Several exhibits were models of historical scientific instruments from the permanent collection of the Jagiellonian University Museum. The exhibition was designed with the thought of easy transforming it into travelling exhibition, which was performed in 2005. For the next 12 years it was presented in many Polish cities, in universities, museums and other cultural institutions. The success of this voyage encouraged us to increase offer of the Museum. Also the following interactive exhibition were transformed into travelling exhibition. Exhibition "Senses", opened in the Collegium Maius, the seat of the Museum in 2005, dealet with the topic of human senses: sight, hearing, touch and smell (Fig. 2). It was replaced in 2012 by the mathematical exhibition "All… is the number" which was presented in the Museum till 2016 . On this exhibition original historical objects were presented together with the interactive exhibits (Fig. 3). All these exhibitions needed about 150 m^2 exhibition space and a big truck to transport. To enrich our opportunity of popularizing science by means of interactive experiments exhibition "Exploratory room" dedicated to small institutions was prepared. It consisted from only small-sized exhibits, with no tables furniture etc. This exhibition was easy to pack, transport and set up.

Interactive exhibition "Welcome to Nanoworld" was built in different way (Fig. 4). It was a final result of the international project Irresistible. All exhibits were designed and produced by groups of school students, who took part in the project. It engaged almost 900 students from 33 schools. The exhibits on this exhibition were connected not only with the topic of nanotechnology but also explored concepts of Responsible Research and Innovation. A typical interactive exhibit in the science center is focused on the direct interaction between a visitor and the exhibit. On this exhibition an idea of interactivity was treated broader. Several exhibits were designed to trigger interactions among visitors.

Also on the basis of temporary exhibitions on the history of science in our Museum the travelling exhibition were prepared. In 2009 on the International Year of Astronomy the exhibition "From Galileo's telescope to space observatories" was organized (Fig. 5).

A lot of the content of this exhibition: educational boards, interactive experiments, models of instruments as well as some original prints and instruments were used on the travelling version of the exhibition. An exhibition "Under guiding star od science" opened in our museum in September and October of 2017 was a biographical exhibition about great Polish physicist Marian Smoluchowski. Next year on the basis of this exhibition a travelling version will be prepared. It will be composed of posters, Smoluchowski's prints, scientific instruments, family memorabilia as well as interactive experiments. This year 20 posters prepared for this exhibition were shown as a temporary exhibition in Polish Parliament (Fig. 6), in Departments of Physics of Universities in Warszawa and Bialystok as well as during 44th Polish Physicist Congress in Wroclaw. Since 2005 our travelling exhibitions have been loaned more than 100 times and were seen by almost 400 thousand of visitors. The detailed data are shown in Tab. 1 and (Fig. 7). Travelling exhibitions the most frequently are borrowed by museums (68%). They were also visiting science centers (10%), universities (11%) and other cultural institutions (11%). Exhibitions were always mounted under supervision of the employees of our museum, who also trained a local staff, which take care about the exhibition during the loan.

How we can promote heritage of the university with the use of traveling exhibition? The exhibitions are focused mostly on young visitors. And it is important to reinforce recognition of the University name and "mark" among them. In all materials accompanying the exhibition: posters, leaflets, web page, Facebook profile must be mentioned, that exhibition was organized by the Jagiellonian University Museum. Moreover, visitors often ask staff about the authorship of the exhibition. Another way of promotion is use in the exhibition objects from the university or museum collection, either originals or models. The university heritage may be also promoted in the more direct way, by referring to the people or events from the history of the university.

On the exhibition "Ancient and modern science" several exhibits were models of original scientific instruments from the museum's collection. They were e.g. an astrolabe, a torquetum, a sundial, a nocturnal, a cross-staff, a Neper bones, a slide rule, a Crookes radiometer, a catoptric wheel. But, in fact, it was not directly described on the exhibition. Only few exhibits description it was mentioned about use of the instrument in Krakow's University. On the exhibition "From Galileo's telescope to space observatories" several original objects, instruments, books, photographs etc., from the collection of Museum and the Krakow's Astronomical Observatory were used. They were accompanied by interactive models. As it was mentioned, on the exhibition "All… is the number" original objects with a historical value were shown together with the interactive exhibits. The use of such object may focus students' attention on the scientific legacy of the University.

Another method of the popularization of the University heritage is to show achievements of the people connected to the University. In the exhibition "From Galileo's telescope to space observatories' was a part dedicated to pre-telescopic astronomy, where Copernicus, who was a student of our University was mentioned. Some models of his instruments were also presented. Also in the further narration there was information about first telescopic observations in Krakow in the middle of 17th century. The exhibition "Under guiding star od science" was entirely dedicated to Marian Smoluchowski, a great Polish physicist and professor of Jagiellonian University in 1913-17. One of the most interesting points of the exhibition was a vision of the Smoluchowski's office at the University arranged with the use of his own books, photographs and manuscripts and instruments which were on the inventory of the Physics faculty in that time (Fig. 8).

To check if the three above mentioned methods are really effective a special query was prepared. It was difficult to make this research directly on visitors because also historical loans should be taken into consideration. Therefore the query was sent to curators who were responsible for the exhibitions in the place it was shown. 80 queries were sent and we got almost 40 answers. It was possible to fill the query either in the attached word file or anonymously using a google form. At the beginning they were asked if (in their opinion) the visitors were aware that the exhibition was prepared by the Jagiellonian University. The results of that question are shown in the Tab. 1. About 85% of curators answered this positively. Some of them gave proofs of that claim. For example visitors appreciated high scientific value of the exhibition as prepared by the oldest Polish University, or they stated, that it was from the place where Copernicus studied. Many of the institutions loaned more than one of our travelling exhibitions, therefore visitors often asked when they would have another exhibition from the Jagiellonian University.

According to the opinion of curators the use of objects from the University collection was less noticeable by visitors. In fact, even curators had a problem to point them properly. In the last part of the query curators were asked to evaluate exhibition in the following aspects: 1. Was it attractive for visitors? 2. Does it contribute in increasing knowledge of visitors? 3. Does it help to break fear of science? 4. Do visitors learn something about Jagiellonian University? Do visitors learn something about history of science. ? The results of this evaluation are shown on (Fig. 9).

The final conclusion from the query was that travelling exhibitions, especially interactive ones, are good way to promote science in STEM area. Our expectations gave results in the promotion of the University. Visitors usually knew where these exhibitions were made and they found these exhibitions very attractive for them, they built a positive attitude to Jagiellonian University.

It is nowadays in Poland very important. Because number of students is decreasing Polish Universities compete to attract students, especially one's who want to study science. It happened in some Polish universities that there were years in which physics or chemistry were not started because of the lack of candidates.

Lastly, the travelling exhibitions in that form are not very effective as a method of promotion of the University Scientific Heritage. Original objects from the collection or their models are usually not associated as a heritage of the University. Maybe the biographical exhibition about Marian Smoluchowski will be an exception. This year it was only loaned as a poster exhibition and addressed mostly to the community of physicists. Next year it will be enriched in different kinds of objects be loaned to different cultural institutions and addressed to general public.

Illustrations:

Fig.1: Astronomical part of exhibition "Ancient and modern science"

Fig.2: Young visitors on the exhibition "Senses"

Fig. 3. Opening of the exhibition "All… is the number".

Fig. 4 Exhibition "Welcome to Nanoworld" on the tour.

Fig. 5. Exhibition "From Galileo's telescope to space observatories" on tour.

Fig 6. Poster exhibition about Marian Smoluchowski in the Polish Parliament.

Fig. 7. Map of the loans of travelling exhibitions from the Jagiellonian University Museum.

Fig. 8. Visualization of Smoluchowski's office on the exhibition "Under guiding star of science", made with the use of his books and instruments from the physical faculty.

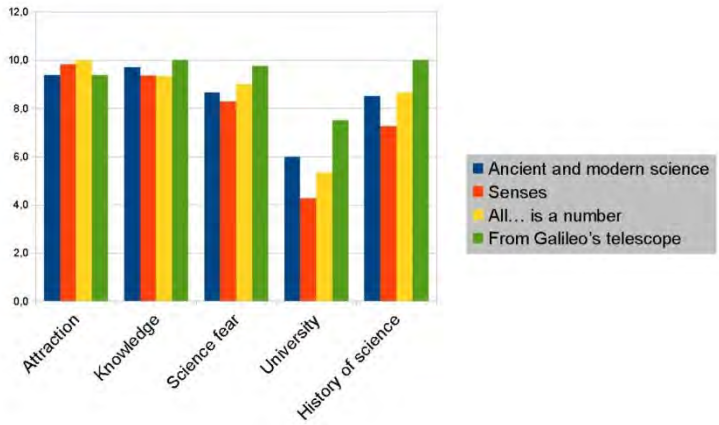


Fig. 9. Graph showing results of query among curators of the exhibitions.

Name	Number of loans	Number of visitors
Ancient and modern science	43	135 221
Senses	22	84 539
All… is a number	7	35 149
Exploratory room	5	~ 7 500
From Galileo's telescope to Space Observatories	28	113 552
Welcome to nanoworld	3	7 733
Smoluchowski exhibition	4	~ 1 500
Together:	112	385 194

Table 1. Summary of loans of the travelling exhibitions from the Jagiellonian University Museum (2005-2017).

In your opinion – were visitors aware that exhibition was organized by the University	Loans	Answers	Yes	No
Ancient and modern science	43	13	11	2
Senses	22	10	7	3
All… is a number	7	3	3	0
Exploratory room	5	1	1	0
From Galileo's telescope to Space Observatories	28	8	8	0

Table 2. A results of the question about visitor's awareness of the mark of the university from the query.

New Forms and New Themes in Popularization of Scientific Knowledge- Following Environment

Danka Šubová , Slovak Museum of Nature Protection & Speleology

Abstract
The Slovak Museum of Nature Protection and Speleology is the all-Slovak specialized Museum that has worked under the Ministry of Environment of the Slovak Republic since 1999. The Museum was established in 1930 as the Slovak Karst Museum focused on speleology. Later the Museum widespread its orientation of activities aimed at all protected parts of nature. Within a complete reconstruction of the Museum building, a historical building of the old Jesuit monastery, there were also revitalized Museum permanent exhibitions. They were completed by new parts – themes such as speleoarchaeology, biospeleology, origin of the Universe and the Earth, molecular basis of nature protection, history of nature protection in Slovakia, NATURA 2000, palaeontology, and sustainability in relation to economical and free time activities of the man in nature, and new forms such as an audio guide with stories of presented exhibits, a complete sound system in permanent exhibitions as well as numerous models and replicas. An aesthetic value of permanent exhibitions is also increased by original paintings in background of dioramas. Interesting connection of new themes and forms is presented by explanation of problems of photosynthesis and basis of genetics in relation to environment by a form of animated films. Popularization of science has an increasing importance in the present because a science language of individual branches is a specific one, and so it is not sufficiently understandable for broad public.
Key words: museum, speleoarchaeology, biospeleology, genetic basis of nature protection, NATURA 2000, palaeontology, sustainability, new forms, new themes

The Slovak Museum of Nature Protection and Speleology in Liptovský Mikuláš as the all-Slovak specialized Museum belongs to natural science museums of the Slovak Republic. With technical museums it has several common themes of activities. The Museum has two buildings – a historical one, a seat of the Museum, originally the old Jesuit Monastery from the 2nd half of the 18th century that is after the complete reconstruction now (Fig. 1), and the second one where specialized departments and depositories are placed.

The Museum is focused on protected parts of nature including caves. A value of protected nature parts of Slovakia is given by the high level of biodiversity that results from the high level of geodiversity, geomorphology of the territory, and the border between Pannonian and Alpine biogeographical regions, which pass through Slovak territory. In the Slovak territory we can see lowlands, alluvial forests, sandy habitats as well as volcanic ranges, gorges, canyons with waterfalls, rockfalls, mountains, and many caves.

We can also find here a lot of endemic species, glacial relicts, special cave fauna, or big beasts. Rosalia longicorn, old man's beard, sand iris, edelweiss, Slovak pasque flower, Tatra Alpine marmot, Tatra Alpine chamois, olm, greater mouse-eared bat, red deer, little egret, brown bear, wolf, or lynx belong to the most interesting or beautiful ones.
The Museum can be also perceived as a specialized historical museum focused on history of nature protection and speleology as the man's activities. It deals with development of legislation, eminent personalities, institutions, and associations that played an important role in forming the nature protection including speleology on the area of the present Slovakia. The Museum has a specialized all-Slovak Archive that is from 2005 oriented on nature protection and speleology in Slovakia. In these activities it cooperates with archives in the Czech Republic as well as Hungary.
Since 1999 the Museum has worked under the Ministry of Environment of the Slovak Republic, and the Archive has worked under the methodical management of the Ministry of Interior of the Slovak Republic.
With technical museums the Museum is linked by the field of speleology. The Museum collection fund also includes technical equipment that has been used in discovering the caves, measuring, lightning, photographing, or cave rescue service. Speleology is the oldest field of the Museum work. The Museum was established as the Slovak Karst Museum in 1930. Efforts to establish the Museum started earlier, and they were connected with origin of the Liptov Collection of Václav Vraný from 1905. These efforts were interrupted by the World War I, and by establishing the 1st Czech-Slovak Republic, and so the official date of Museum establishment is June 2, 1930. In the Museum history, an important role played a personality of Ján Volko-Starohorský, one of the Museum founder, a member of curatorium, and a long-years custodian. Because the Museum did not have own spaces at the beginning, the collections were firstly placed in the M. M. Hodža's Gymnasium, in which Ján Volko-Starohorský taught. The first real permanent exhibitions were created in 1950s, when the Museum gained its first building, the historical building of the Jesuit Monastery. They were focused on speleology only. Later the Museum activities started to be oriented on no-living nature on the surface, and also on living nature. In 1980s the Museum gained the second building, and created the new permanent exhibitions completed by parts of zoology, botany, and mineralogy.
From its origin, the Museum was oriented on speleological research what resulted into creating the collection of cave maps including top maps of Slovak speleology such as a map of the Dobšiná Ice Cave, the first show cave with electric lightning in Europe, a map of the Demänová Cave System, the longest one in Slovakia (41.463 km), and a map of the Old Castle Cave, the deepest cave in the Hipmann's Cave System (495 m).
The Museum administrates the National Cave Database, which includes data of about 7,000 caves located in Slovakia. It also publishes the oldest speleological journal Slovak Karst, and other journals Naturae Tutela and Sinter.

Since 1999 the Museum has administrated the State List of Particularly Protected Parts of Nature and Landscape, and it has provided inventory research focused on protected species and protected areas.
In environmental education, classical themes have been enriched by new ones such as the exhibition cycle of biodiversity of cultivated plants: Beauty from Plant Kingdom, Beans of Grandmothers, Wildlings. Exhibitions From the Cell Life, or Genetically Modified Organisms belonged to the next ones presenting unconventional themes.
In 2009 – 2011, there was issued a cycle of three atlases – Protected Trees of Slovakia, Protected Landscape Areas of Slovakia, and National Parks of Slovakia as well as Atlas of Species of European Interest for NATURA 2000 Sites in Slovakia, and Methodical Guide NATURA 2000 with financial support of the European Union.
In the Museum collection fund, there are natural-science collections completed by social-science ones, for example collections of stamps, post cards, coins, etc. with themes of protected areas and protected species.
In the field of environmental education, we work with all age categories from pre-school age to seniors in cooperation with kindergartens, primary schools, secondary schools, gymnasiums, universities, and the University of the 3rd Age in Liptovský Mikuláš.
We also work with marginalized groups mainly with sightless and weak-sighted people, and mentally handicapped people in cooperation with special schools and institution for sight handicapped people in the form of exhibition cycles named Fragments from Nature and Nature by our Eyes. In 2009 – 2015, there was realized a complete reconstruction of the historical building with its exterior, and revitalisation of the permanent exhibitions with financial support of the European Union.
Regarding new themes, a speleological part of the permanent exhibition Karst and Caves of Slovakia was completed by biospeleology and speleopalaeontology with modern forms of presentation – reconstruction of a human face part according to a cranium (Fig. 2), samples of cave troglobionts, and cave fillings including cave pearls.
In the part named Protected Nature – the Earth, a Place for Life we can mention origin of the Earth and the Universe, molecular basis of nature protection, history of nature protection, NATURA 200 and environment, and palaeontology with reconstruction of a cave lion skeleton (Fig. 3), or interesting paintings of palaeontological periods. In the attic, there is created a part Protected Nature – Humans, Mountains, NATURA 200 focused on sustainability in the relation to free time activities of the man in the nature such as tourism, mountaineering, skiing or ski-alpinism as well as in the relation to economic activities such as forestry, timbering, hunting, fishery, or beekeeping.
From new forms used in revitalised permanent exhibition, they can be mentioned an audio guide with stories of presented exhibits, a complex sound system in permanent exhibitions with real sounds as well as reconstructed sounds in palaeontology and speleoarchaeology, numerous models, replicas, and reconstructions.

An aesthetical value of permanent exhibitions is also increased by original paintings on backgrounds of dioramas (Fig. 4).

Interesting connection of new themes and forms is presented by explanation of the problems of photosynthesis, and basis of genetics in relation to environment by a form of animated films. Popularization of science has an increasing importance in the present because a science language of individual branches is a specific one, and so it is not sufficiently understandable for broad public. This is often about knowledge with close relation to problems of environment, and so it is needed to inform about these themes a broad public as well as students even before they will be specialized in other disciplines as they are biology, ecology and genetics, and knowledge related to environment could escape them from the horizon.

Figures:

Fig. 1

Fig. 2

Fig. 3

Fig. 4

Study on the Protection and Utilization of Technical Heritage in the construction and renovation of Dome Theater in Science Museum

Jia Shuo & Huangfu Jiangzi, China Science and Technology Museum

Abstract

Dome theater is the landmark infrastructure of science museum. A careful consideration and planning shall be made for how to build new cinema and transform old cinema by creatively using local technical heritage resources. The eliminated theater equipment carry the value of technical heritage and historical significance in the rapidly developed era. Studying and utilizing the old equipment properly can enhance the recognition of visitors to museum display, trigger the resonance of values and improve the exhibition effect. This paper analyzes the construction and renovation problems of museum theater from the perspective of protection and utilization of technical heritage combined with the world famous renovation cases such as Galileum Solingen, Germany and Houston Museum of Natural Science, USA etc.. In addition this paper will put forward the principles and recommendations for the protection and utilization of technical heritage in theater construction and renovation.

Key Words: Technical Heritage, Museum, Dome Theater, Construction, Renovation.

Introduction

Dome Theater and Planetarium in Science Museum, the complements to exhibition, realize the science communication and STEAM education infrastructure by means of science visualization, and display the content that is not available by exhibits, different from commercial theater in construction and operation. This paper will carry out study from the perspective of protection and utilization of technical heritage for dome theater by focusing on the six specific cases. The author thinks that the devices used in dome theater or planetarium have the same similarity that exhibit the content through the immersion sense created by spherical screen in spite of different devices. The dome theaters in some museums have both functions on dome video playback and planetarium, such as China Science and Technology Museum. In addition to the exhibition and education in science museum or planetarium, dome theater and film are also employed in many cultural heritages and museums to achieve unexpected display and dissemination effect, which are the advanced presentation means worthy of studying and utilizing by museums.

1- Dome Technology in World Cultural Heritage Exhibition

As a World Heritage Site, Mogao Grottoes of Dunhuang offers a wide range of heritage contents for research in many fields, involved in social sciences and natural science, including astronomy, geography, politics, philosophy, religion, literature, art, languages, character, architecture, archeology and others, forming a comprehensive multidisciplinary discipline -- Dunhuang Studies.

The Silk Road leaves rich preserves and record of technological heritage by ancient peoples of all countries and nationalities. We illustrate the cases of cultural heritage communication with dome technology of digital display center at the Mogao Grottoes, Dunhuang on the Silk Road.

1.1- *Predicament:*

In 1987 Mogao Grottoes near Dunhuang city in Gansu Province in western China was listed by UNESCO as "World Heritage List". Visitor numbers have increased inexorably since 1979 when the site opened. By the time of the golden week in National Day in 2014, every day there were about 20,000 visitors flocking in. And the most of caves of area less than 25㎡, even the famous "Rebound Lute" cave only 6㎡ where were too crowded to accommodate those audiences. In 2015 the audience volume was up to 1.05 million passengers.

The fragile cavern structure and ancient murals might be greatly damaged by the stresses and vibrations caused by spectators' movement and speech, temperature rise by breathing, carbon dioxide and water vapor etc. A national policy that identifies tourism as a pillar industry, along with pressure from local authorities and businesses to encourage more tourism, threatens to lead to an unsustainable situation for management, an unsafe and uncomfortable experience for visitors and irreparable damage to the fragile art of the cave temples for which the site is famous.

In the context of the comprehensive visitor management plan developed for the Mogao Grottoes, a multi-year study began in 2001 as a joint undertaking of the Dunhuang Academy and the Getty Conservation Institute to determine the impact of visitation on the painted caves and develop strategies for sustainable visitation such that, once implemented, these threats would be resolved. The methodological framework featured a major research (1) and assessment component that integrates visitor studies; laboratory investigations; environmental monitoring; field testing and condition assessment to address the issues affecting the grottoes and visitors. Results from this component led to defining limiting conditions, which were the basis for establishing a visitor capacity policy for the grottoes and developing long-term monitoring and management tools.

The result showed that the upper limit of number of visitors was only 3,000 person-time every day (2). If the original visiting mode is not changed, the visit quality would be difficult to be guaranteed. It's a top priority for researchers for how to scientifically and reasonably develop and utilize the heritage treasury.

2.1- *Solutions:*

To solve the outstanding contradiction between the visit demand of grand audience and protection of cultural heritage and achieve the goal of "Permanent preservation and sustainable utilization", the Chinese government has invested in the Mogao Grottoes Digital Exhibition Center in Dunhuang and its supporting project "Integrated Sand Control Engineering" that is an earth mound in the distance, very harmonious with the surrounding environment.

Due to the erosion of sandstorms and other factors, murals in Mogao Grottoes have been degraded in color and pattern. For many years, researchers at Mogao Grottoes have made digital archives for each cave and saved a large amount of valuable information. They have conducted post-production for a large number of caves, such as high-quality digital image acquisition, 3D scanning, CG rendering and digital repairing etc.

There are two giant screen theaters and two dome theaters besides the exhibition hall in the center. The researchers made two films using the high-quality digital archives collected in combination with the historical background of Mogao Grottoes, a giant screen film called "Millennium Mogao" introducing the historical background, and a dome film called "Fantasy Buddha Palace" which lasts 20 minutes each and projected on dome of diameter of 18 meters with 8K resolution through the 6 projectors of 4K resolution provided by Sky-Skan.

According to the survey statistics, the average visit length of each audience in Mogao Grottoes is two hours. Researchers have studied and launched a new mode of visit "Digital Dunhuang + Physical Caves" by the visitors' habits and conditions of digital display center. Audiences are guided to spend more than 40 minutes seeing the two films, so as to learn about the background before visiting caves by driving, and the average remaining time is enough to visit 8 caves. This new mode shortens the visit time and the cave amount they step in. Also reduces the damage to caves while ensuring the visit acquisitions on rise. Since some cave murals have been degraded and mottled, audience can see a clear digital image collected years ago through the movie.

They will having a far more direct touch than on-site visit without preparation. In addition, this arrangement makes the dome theaters almost packed every time, with optimized operation cost-effectiveness.

3.1- *Analyses and summary:*

According to estimates, the new pattern of "Digital Dunhuang + Physical Caves" has reduced the tourist flow peak from about 2,300 to 1,200 person-time in cave area, while the overall bearing capacity of single-day is enhanced from 3,000 to 6,000 person-time, showing a halved index and a doubled index.

The creative use of dome technology greatly reduces the pressure on the protection of cultural heritage, with doubled exhibition and communication effects. Mogao Grottoes of Dunhuang sets a world precedent in using dome theater technology as cultural heritage protection and utilization. The Mogao Grottoes Digital Exhibition Center has achieved a new balance between the surge of visits and stringent requirements of cultural heritage protection.

The relevant concepts and practices deserve to be learned and borrowed by other museums and heritage sites.

2. Case Study of Galileum Solingen, Germany

1.2- *Background:*

Solingen, Germany is located in the east of Dusseldorf, famous for the sword making in the Middle Ages, and later developed into a well-known international " City of Blades". Gudue, ZASSENHAUS, Böker, Wüsthof, TEMIOV, ZWILLING, Niegeloh Solingen and other international top fine swords, knives, scissors and razors brands were born here. The main products are cutting tools, surgical instruments and razors, and other industries include metallurgy, chemistry and so on. There is a cutting tool development museum in the city. Inevitably the coal fuels which they depended in early metallurgical and chemical industries heavily polluted the city, which has become a long-standing pain. Its lesson of treatment after pollution and a series of subsequent innovative measures are worth of being appreciated and absorbed by China and other developing countries. The Solingen Observatory in Germany is the oldest civil observatory in Germany. Since its founding in 1921, Walter-Horn-Gesellschaft e.V. has been running the Solingen Observatory for more than 90 years, obtaining a large number of donations and kind help. In recent years, they believe that it's time to build a new museum that contains both Planetarium and Observatory, and make a new word for it, Galileum by creatively combining the name of famous physicist and astronomer Galileo Galilei with planetarium. The new planetarium is not suitable for the original site because the site is not prosperous any more in the past few years, and the surrounding roads are disconnected from the public transport network and transportation, plus insufficient parking space, and the old equipment and technology lagging behind. Under this background, the plan of expanding at the original site will not be considered any more. The planners hold that it is necessary to build a new modern planetarium using the latest technology in the field of astronomy. To this end, it took a long time for Walter-Horn-Gesellschaft e.V. to find a new planetarium site.

The Solingen-Ohligs, where the new building Galileum is located has been heavily polluted during coal production process in about a hundred years ago. As early as the 1970s and the 1990s, the efforts were made to replace soil by excavating. But it is still in the list of contaminated areas to this day. These unfavorable conditions reduce score for the site selection. However, an unparalleled industrial heritage in the Ohligs area secures the embassy's firmness for the new site - a tank.

2.2- *Creative Solutions:*

To take full advantage of the municipality's industrial heritage resources the regional industrial heritage organization of Solingen, Germany has called for a competition to redevelop the local observation using an old spherical gas container in order to address the strong industrial character and historical context of the container and the local architecture. Generally, Science Museum will build a spherical structure with steel structure and concrete construction for dome theater or planetarium, so as to decorate theater equipment and facilities.

An old giant spherical tank and the original local building are required to highlight the strong industrial property and historical background of the region, which is harsh and innovative.
The new location (Ohligs area) is easily accessible by public transport (close to Solingen Central Station). For citizens, associations and local communities, the distinctive spherical tank planetarium will be very attractive in marketing. Galileum is expected to be completed by the end of 2018 and will include a 12-meter-wide dome theater and an observatory.
The following project is an entry from René van Zuuk Architekten:
The site is located on the edge of a residential area near a railroad, from which the steel spire of the old gas container is visible. With a diameter of 26 metres the container has a frame of eleven columns that rest on 3m high concrete foundations. The original design is pragmatic in its approach. A sphere was used as the most efficient model with the largest surface area available to function at the lowest cost. The staircase was built with the same functional consideration as the rest of the building and it follows that, to use the existing spherical structure, the new design would have to be approached with the same rigor.
The proposal will occupy the existing structure with an entrance to a back office, an entrance hall for 80 people, exhibition space with a planetarium and an observatory in the hemisphere. The base of the sphere is cut to provide an opening within the foundation that provides space for an entrance hall. Presentation rooms, offices and general amenities are located on the same level. These spaces open out on to a patio that provides light to an otherwise sheltered area of the project. The landscape is sculpted to the height of the foundation wall in order to compliment the spherical profile. The entrance begins with a series of steps rising up through the void on the first and second floors are two open exhibition floors. The third floor contains the planetarium and the observatory is located at the top of the sphere; here there is a second cut in the existing structure which allows the telescope to rotate without being obstructed. On top of the dome is an antenna with a laser to be used to give focus to the user. The existing structure has been calculated to support its functions, however, there is an additional exoskeleton structure which supports the structure from the outside. A steel tube in the center is to be used as an elevator shaft which will help support the buildings new uses.

3.2- *Experience: Review of urban history, skillful use of technical heritage resources*

The author believes that technical heritage is a neutral term that includes both advanced or laggard technologies and crafts, including positive and negative "Products" such as pollution caused by these technologies at that time. For planetarium renovation or reconstruction, the dome theater (or planetarium) is the core part. We know that planetarium means both the equipment called planetarium and the hall which we enjoy the show. Before the planners bought the site, the Walter-Horn-Gesellschaft e.V. and other experts took a full consideration on historical and technical heritage of Solingen.

They invited professionals who still found pollution problems in some places to conduct extensive evaluation through drill hole sampling. During the project construction process, the builders carried out a complete analysis on soil. The project was still affected by residual soil pollutants when foundation pits were excavated. After exhaustive and time-consuming treatment, the contaminated soil was finally cleaned up. Potentially contaminated areas, known as "black areas," were abandoned and the contaminated sites was "Basically" solved finally.

To attract citizens to concern the construction progress, the project leader set up a time-lapse camera at the construction site. Citizens can get a view on project progress in real time as watch a panda in daily life, from the foundation to whole process of completion, witnessing the "Growth" of new museum and really participating in the transformation of the city through the Galileum website (http://galileum-solingen.de/).

Along with the resource consumption and industrial upgrading, the traffic facilities of original location has been reduced. The new museum is established in a new bustling area with convenient transportation. With the improved development way of industrial city, the turbid sky is replaced by a clear and serene one. However, the Germans have never forgotten their history. By transforming the huge industrial heritage of spherical tank into a planetarium in a new era, it conveys an introspection in the past and regains their longing for the bright stars.

The spherical tank planetarium in Galileum presents the development of city and citizens' recognition on urban history and culture. Spherical tank carries the glory and honor of old industrial era, and reflects technical wisdom and development concept of new era for both inheritance and innovation.

3. “Houston reaches the stars”, Renovation Case of Houston Museum of Natural Science(HMNS)

1.3- *Background*

In fact, the word "Houston" is the first word spoken after humanity first arrived on the Moon, with distinguished symbolic meanings. On the afternoon July 20, 1969, US Eastern Time, Neil Armstrong, an USA astronaut, as the first human landing on the moon, reported from the Moon to the Earth: "Houston, Tranquility Base here. The Eagle has landed." The first word is "Houston," which represents the mother planet of our humanity, Earth.

Located in the western part of Texas, Houston is the fourth largest city in the United States. Houston is a world-famous Sky City and one of the largest research bases of NASA's with famous Johnson Space Center and enviable rich technical heritage where numerous firsts have been created and witnessed in human space history. Every year, thousands of tourists visit here. Houston Museum of Natural Science has the unshrinkable responsibility to exhibit the glorious history and bright future of space city.

2.3- *State of the art Planetarium to adapt world-class technical heritage:*

In 2015, the museum transformed the Burke Baker Planetarium into the world's first planetarium of True 8K (True8K) level through meticulous renovation plan and solid project management and implementation. In order to display the richest starry night and creating the sharpest and most dramatic immersive adventures they challenged the engineers to make a projection system that would approach the limits of the human eye. An arc minute is about what the human eye can resolve. For the dome, that means a meridian of a little more than 10800 pixels(60×180°). So 8K dome master has enough pixels to approach the resolution of the human eye. True 8K digital planetarium system can splice and fuse the pictures projected by 10 (or more) digital projectors of 4K resolution into a picture covering the whole dome screen, with total effective pixels of more than 50 million. Thanks to the world's most advanced digital astronomy technology, the playback goes beyond IMAX's traditional 1570 film screening system, making the Houston Museum of Natural Science top the world science museums.

To reproduce the most vivid and starry space in the planetarium, HMNS applies 10 Sony laser projectors, which make the dark area darker, shiny star shinier, and digital sky created more "Transparent" in the picture thanks to its feature of very high contrast. As it were, you seem to really touch the night sky in West Texas. The most advanced digital astronomy and dome theater system in the 21st century are hidden in a traditional museum building, leading the industry for brightness, resolution and contrast ratio.

3.3- *Inspiration:*

Actually it's not worth discussing the advanced equipment of high funding. The difficulty of this upgrading project is that the landmark dome theater building is not allowed to be demolished and reconstructed or changed a little in appearance due to long history of HMNS. The project builders confront a challenge. These restrictions have greatly increased the project difficulty and budget. The building and exterior including the dome are regarded as the museum's valuable technical heritage. In order to preserve its image and memory in the mind of public audience, renovation work can only be carried out within the dome, including the new spherical screen, new floor platforms, new interior walls, new seats, new lights, new sound system, and those 10 new projectors with 20 computers and fiber optic cables to support them.

The persistence in keeping the appearance of building can be used for reference by many cities with rapid economic development. In some places, urbanization has brought about a rapid population growth, and the venues that have been put into operation for a short period of time have become crowded after a few years of running, resulting in reckless expansion or rebuilding in different places. Such separation even chopping is short-sighted because the technological heritage value and meaning on recognition of local residents are neglected. The policymakers should be very cautious about it.

4. Warnings of Negative Example

Next, let's discuss a negative example to make further explanation. The world-renowned National Museum of Natural History(NMNH) once had a famous Samuel C. Johnson IMAX theater, where numerous spectators were infected, motivated and inspired. The films, entertaining, educational and singularly immersive, have the ability to engage even the most reluctant museum-goer. Teachers take their students to learn about the migratory patterns of monarch butterflies; parents say their children have left the Johnson Theater suddenly determined to become scientists. And many of them become zoologists, botanists, anthropologists, ecologists, geographers, and deep-sea explorers in the future.

In recent years, the museum received some complaints because many visitors had to wait for a long time for dining at the interval. Therefore, the museum demolished the 18-year-old theater not long ago (October 1st, 2017), and transformed the space into a restaurant. In fact, the movie hall sold 265,000 tickets in 2014 and 310,000 tickets in 2016, which is not so bad in recent years.

There is a new ordinary fast food restaurant in the area where the museum is located. However, Aerospace Museum is the only one offers IMAX theater experience in the entire Washington DC, which does not play traditional natural history films generally. What's worse, the theater will be closed next year (2018) for two years for renovation. Visitors from all over the world can hardly see the wonderful films that combine the beauty of nature and technology in the museum. No wonder there are lamenting comments: Do audiences really need hamburgers, french fries and cola instead of fascinating films about natural history? Such sadness is out of the regulators' ignorance over the museum theater as a technical heritage.

5. La La Land & Griffith's Samuel Oschin Planetarium

5.1- *"La La Land" and "City of Stars":*

The film La La Land, a great success, won a total of five awards such as Best Film Award from the British Academy of Motion Picture Arts and Television, and six awards including Best Director at the Oscars. The Los Angeles in the movie is both a City of Music and City of Stars. The hero and the heroine made a date to see an old film Rebel Without a Cause, and went to the scene for the film -- the Griffith Observatory.

The Griffith Observatory, located in Griffith Park, is one of the world's most famous planetariums and the seventh scenic spot in Los Angeles, overlooking the whole Los Angeles thanks to its high terrain. The Griffith Observatory became the landmark of Los Angeles because of the film Rebel Without a Cause starred by James Dean in 1955, which has appeared in more than hundred films and television so far. This technological heritage is endowed with strong cultural identity attribute.

The Observatory's Planetarium was officially completed and open in 1935. The Griffith Observatory, which was renovated and expanded early in this century, houses the Samuel Oschin Planetarium, the observatories on the east and west, the Leonardo Nimov Multimedia Theater, the Gunther Deep Space Gallery, the planetarium, Wilder Hall of the Eye and other exhibition halls. There are model of solar system on the lawn, astronomer monument, Einstein statue and other buildings outdoors. The Griffith Observatory has now become a pivotal astronomical science base.

The hero encountered Tesla Coil while walking through the Wilder Hall of the Eye. The Tesla Coil was displayed and preserved at Griffith Observatory in 1937, which was previously owned by Dr. Frederick Finch Strong who donated own Tesla coil to Los Angeles. The Foucault Pendulum seen by the hero in W.M. Keck Foundation Central Rotunda has never been changed since its opening in 1935. Both Tesla Coil and Foucault Pendulum are the important collections and technical heritages. We enjoy the science and beauty through these exhibits in the film.

To pay tribute to the movie Rebel Without a Cause, the film production team was intended to use the original planetarium for film Rebel Without a Cause. But the retro style cannot be restored due to renovations and upgraded equipment after the Rebel Without a Cause (1955). David Wasco, the film's art director completely reproduced an old planetarium for filming by imitating James Dean's old movies and photos. The core of sky hall -- planetarium, also fully guaranteed the retro style.

The production team purchased a 12-foot, old planetarium that was once fitted to the planetarium in the 1950s from eBay, which might be the most expensive prop used in the film. Judged by appearance, it is likely to be the Zeiss Mark II type optical planetarium, while the Griffith Observatory indeed applied Zeiss Mark II before 1964, which was replaced by Zeiss Mark IV and Zeiss Universarium Mark IX in 2006 when it's reopen.

5.2- ***Experience of China Science and Technology Museum (CSTM):***

Although the Griffith Observatory and its Samuel Oschin Planetarium have been upgraded for several times, the appearances and many classic exhibits remain the same. This inheritance makes it possible to film La La Land. The least of perfection, the old model Zeiss planetarium, an important prop, had to be purchased online. In this regard, China Science and Technology Museum where authors works has some experiences to be shared. Since the opening of new China Science and Technology Museum in 2009, some precious equipment have been retained, including the decommissioned projectors of multiple types serving the old China Science and Technology Museum since the 1990s, a variety of domestically produced and imported film projectors of 8mm, 16mm, 35mm and 70mm, dome film projectors and auxiliary equipment. To enable viewers to learn more about the principles of VFX and the development history of China Science and Technology Museum, the author's colleagues reconditioned these retired projection equipment and restored their working status in public space in the museum, as a permanent small exhibition for audience.

Through the presentation of these old screening devices, viewers can intuitively experience the rapid advances in film technology from film age to digital age. If Griffith Observatory retained the equipment used in various historical periods like China Science and Technology Museum, it would surely present a richer exhibition content and make feature film more historical.

Conclusions

These cases show that the memories of generations on technical legacy of a historic museum will greatly affect the visiting experience. The heritage describes the history of urban development and exerts more and more important influence. That's why the film La La Land is so successful. Such heavy heritage needs to be cherished by the museum.

We museum researchers shall take the initiative to contact and cooperate with all walks of life so that they may understand the value of this heritage and make good use of it. We believe that just like these cases, the gift of technical heritage from the museum will produce fantastic reaction with various film and television productions, attracting audiences to the museum to explore the stories in it.

References

1- *Strategies for Sustainable Tourism at the Mogao Grottoes of Dunhuang*, China. Martha Demas, Neville Agnew, Jinshi Fan. Springer Press.

2- *Advancing Sustainable Tourism at Cultural and Natural Heritage Sites Mogao Caves World Heritage Site*, China. SOM Steering Committee on Economic and Technical Cooperation(SCE), Tourism Working Group(TWG)

CIMUSET 2017 conference photos report

45th Conference, Rabat, Morocco 5-8 December 2017

The conference venue: Moroccan National Centre for Scientific & Technical Research (CNRST)

Registration, opening ceremony and presentations

Registration, opening ceremony and presentations


CNRST - 5th- 8th December 2017 Rabat, Mor
Mohamed KHALFAOUI
Director of CNRST
Ech cherki DAHMALI
Director of Maroc Telecom Museum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musée
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Technical Heritage & Cultural Identity
CNRST - 5th, 8th December 2017 Rabat, Morocco

Presentations


Permanent Exhibitions of Sci. and Tech. in KAHAKU.
M CIMUSET
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Day 2: Visit of the old poetry workshops, Oulja-Salé


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& Cultural Identity

Excursion day:
Visit of the old leather tanneries of Fes, Technical heritage still operational since the 12th Century

Excursion day: Visit of the Military Museum, Fes City

Gift to CIMUSET from the Military Museum,

Excursion day: Visit to Zellige & plaster old workshops, Fes City

Excursion day: Visit of other historical locations, Fes City

General assembly and meetings

Visit of Telecommunication Museum of Maroc Telecom Group

CIMUSET annual diner, offered by Maroc Telecom Group

CIMUSET ICOM international committee for museums and collections of science and technology

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- Contribute to the development and implementation of ICOM's program;
- Provide advice to ICOM on preservation of the cultural heritage within science and technology and dissemination of knowledge in this field;
- Represent the interest of the museums and centers of science and technology within ICOM;
- Co-operate with National Committees and Regional Organizations of ICOM and with other International Committees and Affiliated Organizations in matters related to the Committee's specific mandate and to the broader interests of ICOM.

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From Tuesday to Saturday: 09h - 17h/ Closed: Sunday, Monday & Holidays

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Our museum provides wheelchairs for disabled visitors, toilets with supporting bars, elevators, and proper spaces for wheelchair movements.

We also offer video guides for deaf-dumb persons and audio guide for visually impaired individuals in different languages with sensitive touch of collection pieces

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